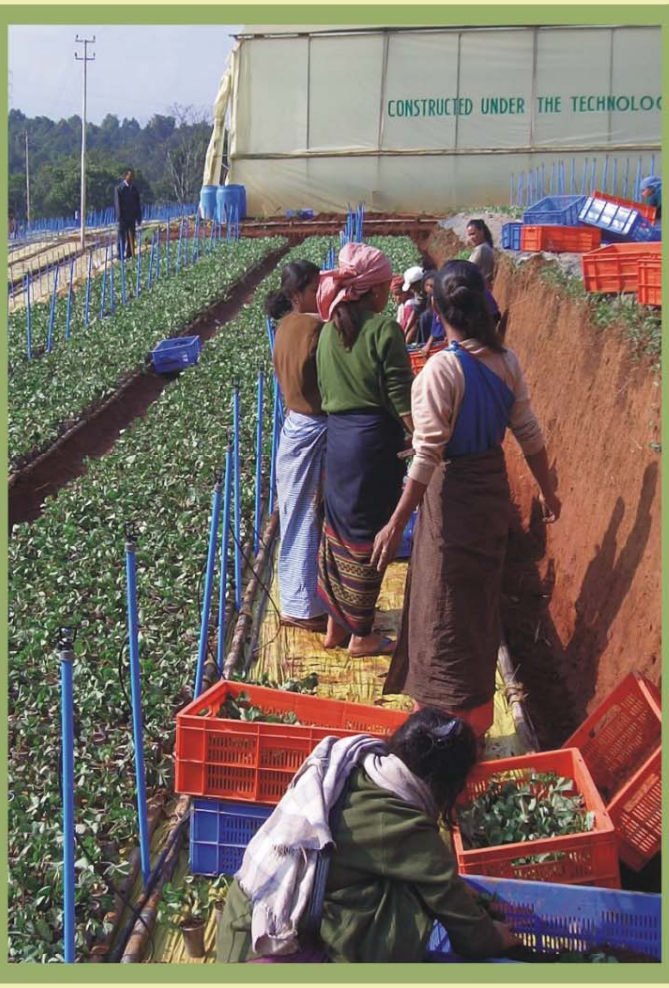
Report of the

Working Group on Horticulture, Plantation Crops and Organic Farming

for the XI Five Year Plan (2007-12)



Chairman — **Dr.K.L.Chadha**

Member Secretary — **Dr.M.L.Choudhary**

Government of India
Planning Commission
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PREFACE

The horticulture sector encompasses a wide range of crops namely fruit crops, vegetables crops, potato and tuber crops, ornamental crops, medicinal and aromatic crops, spices and plantation crops. New introductions like mushroom, bamboo and bee keeping (for improving the crop productivity) further expanded the scope of horticulture. While the first few Five Year Plans assigned priority to achieving self sufficiency in food grain production, over the years, horticulture has emerged as an indispensable part of agriculture, offering a wide range of choices to the farmers for crop diversification. It also provides ample opportunities for sustaining large number of agro-industries which generate substantial employment opportunities. The horticulture sector contributes around 28% of the GDP from about 13.08% of the area and 37 % of the total exports of agricultural commodities.

During the previous three Plan periods, focused attention was given to horticultural research and development which placed India as the second largest producer of fruits and vegetables, largest producer and consumer of cashew nut, tea spices, third largest producer of coconut, forth largest producer and consumer of rubber and sixth largest producer of coffee in the world. Today, as a result synergy between focused research, technological and policy initiatives, high efficiency inputs, horticulture in India, has become a sustainable and viable venture for the small and marginal farmers. Besides, the sector has also started attracting entrepreneurs for taking up horticulture as a commercial venture. Therefore, there is a great scope for the horticulture industry to grow and flourish.

The growth of any enterprise on a national scale pre-supposes sound and responsive infrastructure. During the past several years, the country has created infrastructural facilities to the requirements of horticultural research, education and development in the country in terms of setting up of Institutes, establishment of separate Departments of Fruits, Vegetables, Floriculture in several State Agricultural Universities and carving out State Departments of Horticulture from the erstwhile Agriculture Departments in many of the States. About 10 per cent of the total budget of Indian Council of Agricultural Research (ICAR) and 30 per cent of the total budget of the Department of Agriculture & Cooperation (DAC) has been earmarked for the horticulture sector during the X Plan. There is no doubt that the tempo generated during the X Plan will not only be maintained but accelerated during the next plan period to meet the aspirations of the farmers of the country besides providing the needed nutritional security to the Indian population.

The planning process in the country, through the Five Year Plans, has been instrumental in creating favourable policy environment, through earmarking resources for different sectors to ensure the overall development of in the country. There was a quantum leap during the VIII Plan in financial allocation for horticulture development programmes, which was sustained during the IX Plan and further strengthened during the X Plan. The Working Groups constituted by the Planning Commission during the IX and X Plans provided the necessary directions in setting priority for programmes in horticulture development in the country.

Now that the X Plan will be over by March 2007, the Planning Commission has initiated advance action for the formulation of the XI Five Year Plan by constituting a number of Working Groups to cover various national activities. Keeping in view the importance of horticulture, plantation crops and organic farming in the country, the Planning Commission, Government of India, entrusted me the responsibility of heading the prestigious Working Group on Horticulture, Plantation Crops and Organic Farming vide Order No. M – 12043/6/2006 – Agri. and dated 7.06.2006, for

the formulation of the XI Five Year Plan (2007-12). The composition of the Working Group which comprises of 23 members is as follows:

Dr. K.L. Chadha 10/7281, Vasant Kunj, New Delhi-110070	**Chairman**
Dr. R.B. Singh, National Commission on Farmers, NAS Complex, Todapur, Pusa, New Delhi- 110012.	Member
Dr. K.V. Peter, Vice Chancellor, Kerala Agricultural University, Vellanikara, Trichur – 680656, Kerala	Member
Dr. H.P. Singh Vice –Chancellor Rajendra Agricultural University, Pusa, Distt. Samastipur-848125 Bihar	Member
Shri K. S. Money, Chairman Agricultural and Processed Food Export Development Authority (APEDA), NCUI Building, 3, Siri Institutional Area, August Kranti Marg, New Delhi-110016	Member
Shri S.K. Pattanayak Jt. Secretary (N.H.M.) Deptt. Of Agriculture & Cooperation, Krishi Bhavan, New Delhi-110001	Member
Mr. G.V. Krishna Rao, Chairman Coffee Board, No. 1, /Dr. Ambedkar Veedhi, Bangalore – 560001 Karnataka	Member
Mr. Basudev Banerjee, Chairman, Tea Board, 14, Biplabi Trailokya Maharaj, Sarani (Brabourne Road), Calcutta – 700001 West Bengal	Member

Shri J.N. Chamber, Managing Director, National Horticulture Board, 85, Sector-18, Institutional Area, Gurgaon-122002 Haryana.	Member
Chairman, NABARD Bandra kurla Complex, Ploat NO. C-24, 5th Floor, “A” Wing, Bandra (East), Mumbai.	Member
Shri P.M. Sinha Chairman, Agriculture & Rural Development Committee, F.I.C.C.I., B – 787, Sushant Lok Phase-I, Gurgaon-122001 Haryana.	Member
Dr. S.P.S. Khanuja, Director, CIMAP, P.O. CIMAP Near Kukrail Picnic Spot, Lucknow – 226015	Member
Director Indian Institution of Horticulture Research, Hessarghata Lake Post, Bangalore-560089 Karnataka	Member
Shri T.A. More Director (Research) Konkan Krishi Vidyapeeth, Dapoli -415712, District Ratnagiri, Maharashtra.	Member
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Adviser (Agriculture), Planning Commission Yojana Bhavan, New Delhi-110001	Member
Ms. Rugmini Parmar, Director, Deptt. Of Expenditure, North Block, New Delhi-110001	Member

Dr. Tapan Dutta, Member
Adviser (Agril.) to Chief Minister of Assam,
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Shri Sopan Kanchan Member
President, Confederation of Indian Horticulture &
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Shri K. Natarajan, Member
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Shri E.B. Sethan, Member
President,
United plantations Association of
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Tamil Nadu

Shri D.D. Bharamagoudra, Member
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Organic Farming Association of India, G-8,
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Dr. M.L. Choudhary, **Member-Convenor**
Horticulture Commissioner,
Deptt. Of Agri. & Coopn.,
Ministry of Agriculture,
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New Delhi-110001

The Terms of References (TOR's) of the Working Group are;

i. To analyze the performance and evaluate the progress in Horticulture and Plantation crops in terms of objectives, thrusts, interventions, programs and milestones attained during X Five Year Plan and to suggest strategies / programmes for the XI Plan.

ii. To examine the significant research achievements in horticulture/plantations in the X Plan and to scrutinize the status of availability of quality planting material for the requirement of the National Horticulture Mission.

iii. To evaluate the impact of hi-tech horticultural practices and to review the present status of technology dissemination mechanism and suggest future strategies.

iv. To evaluate the present marketing networks and post harvest management systems operating in the country and suggest measures to reduce losses and improve the infrastructure for the post harvest handling, storage, marketing and exports.

v. To evaluate the performance of horticultural and plantation exports and suggest suitable measures to enhance the visibility of Indian produce in the global market and to analyze the impact of WTO and suggest suitable measures to protect the interests of Indian farmers.

vi. To review the existing status of small and marginal farmers of horticulture crops and small growers of plantation crops and to identify their needs for development of these sub-sectors including, backyard operations.

vii. To critically review the current database on horticulture and plantations and suggest improvements.

viii. To analyze the impact of HRD programmes implemented during the X Plan and suggest measures to adequately equip personnel to meet the challenges in the changing scenario.

ix. To analyze public and private investment in the Horticulture and plantations sectors and suggest ways of improving financial and other support to them.

x. To develop a strong market intelligence and forecasting mechanism to provide a competitive edge to the Indian farmers.

xi. To study the present mechanism of risk assessment in the horticulture and plantation sector and suggest appropriate measures to minimize the risk in horticulture sector.

xii. To study the nature, scope and progress of organic farming with respect to horticulture and plantation crops and to suggest measures to promote such products in the international markets.

xiii. To analyse the problems of the plantations sector with specific reference to tea, coffee, spices, and rubber, especially in the backdrop of volatile international prices, and to assess the effectiveness of government programmes/ assistance in ameliorating the situation.

The Working Group was given time to complete its report by 30 October, 2006. However, considering the vastness of the Terms of Reference and the delayed meetings by a few of the Sub-Groups led to subsequent delay in finalizing the report. The date of submission was, therefore, extended to 31st January 2007.

The Chairman of the Working Group was authorized to constitute various sub-groups keeping in view the terms of reference assigned to the Working Group. In the first meeting, held on July 12, 2006, it was decided to constitute 12 Sub-Groups dealing with different crops or issues pertaining to horticulture research and development. The sub groups included Horticultural Research and Development, Hi-tech Horticulture and Biotechnology, Planting Material, Organic Farming, Public- Private Investment, Risk Assessment; Post Harvest Management and Marketing (including Primary Processing and Market Intelligence) Export , WTO and Price Fluctuation, Technology dissemination and Small and Marginal Farmers, Human Resource Development and Data Base in Horticulture, Fruit and Plantation Crops, Vegetable Crops, Ornamental, Medicinal and Aromatic Plants and Plantations Sector

Besides, Chairman/ Co-Chair, Member Secretary and members of each sub group were identified. While some of the Sub-Groups were headed by the members from within the Working Group, for other sub-group eminent technocrats in their respective fields were identified to steer the sub group as Chairmen/ Co-Chairman of the sub-groups. A list of Chairmen, Co-Chairmen and Member Secretaries of each sub-group are given in **Annexure-0.1**. Based on the suggestions received from the members of the working group, Chairmen of respective Sub-Groups constituted their sub-groups drawing members within or

outside of working group and among the central and state governments, ICAR and its Institutes, SAUs, entrepreneurs, NGO's and farmers. The constitution of the various Sub-Groups and terms of reference are given in the Annexure- 0.2 to 0.13.

The Planning Process was initiated through a comprehensive dialogue with the various stakeholders who are the end users of the various initiatives that have been launched by the Government. Accordingly the second meeting was held on 26th July with the farmers and members of Confederation of Indian Horticulture. The third meeting was held on 28th July 2006 with the Chairmen, Co-Chair and Member Secretaries during which discussions were held regarding membership of sub-groups, schedules for holding meetings and dates for submission of reports. A brainstorming session was held on 6-7 October 2006 with State Horticulture Departments, Boards, ICAR and other stakeholders to identify issues and strategies for the formulation of XI Five year Plan.

A final meeting of the working group including all Chairmen, Co-Chairmen and Member Secretaries was organized on 23rd January, 2007 at New Delhi to review and finalize the draft report. The final report is being submitted after incorporating the suggestions received from the members during Working Group meeting held on 23rd January, 2007 in the reports submitted by various sub groups. Each sub group held 2-3 meetings depending on the requirement to finalize the sub sector reports.

Details of meetings held

Date	Participants	Remarks
12/07/2006	**1St Meeting** : Working Group Members	18 members attended the meeting
26/07/2006	**2nd Meeting** : Confederation of Indian Horticulture	27 representatives attended the meeting
28/07/2006	**3rd Meeting :** Sub-Groups, Chairmen/Co-Chair and Member Secretaries	35 persons attended the meeting
06/10/2006	**4th Meeting** : State Governments, Boards, Institutes, Universities, etc	65 persons including representatives of State Government, ICAR, ICAR Institutes, SAUs, National Boards, Working Group Members, Chairmen/ Co-Chair, Member Secretaries of Sub-Groups participated.
23/01/2007	**5th meeting :** Sub-Groups, Working Group Members, Chairmen/Co-Chair and Member Secretaries	34 persons including Chairmen, Co-Chairmen, Member Secretaries, Working Group Members participated

The report has been structured keeping in view the Terms of Reference identified by the Planning Commission and divided accordingly into 16 Chapters covering various commodities and sectors of horticulture. Efforts have been made to highlight the current status of horticulture and plantation sector in terms of area, production productivity & exports, future demand, research infrastructure available, constraints, progress during the Tenth Plan, opportunities and strategies to achieve the objectives. The programmes that were implemented during X Plan were reviewed and the gaps and constraints have been identified to suggest remedial measures. Signifying the importance of the issues related to Planting Material, Biotechnology, Hi-tech interventions, Organic Farming and Database, separate chapters on these issues are included. Similarly, exclusive chapters on Post

Harvest Management, Marketing, Export, Import and WTO issues, Technology Transfer, Human Resource Development, Risk management, credit and public Private investment have been included. In order to streamline the activities of various implementing agencies Organizational Reforms were dealt in a separate chapter to minimize the overlapping of the programmes and interests. An over view of the new programmes to be initiated and policy issues are also included as a separate chapter. An independent chapter entitled Summary and Recommendations has been included for a quick preview of the important points and recommendations, which could result into action programmes for accelerating the growth of the horticulture sector.

The working group while finalizing the report has taken due notice of the recommendations made by the National Commission on Farmers headed by Dr.M.S.Swaminathan. It has also taken into consideration the deliberations of the Round Table Meeting on National Horticulture Mission organized by the National Academy of Agricultural Sciences. Similarly the salient recommendations that emerged from the Conference organized by the FICCI were also taken in t consideration.

The task assigned has been a challenging one, the accomplishment of which would not have been possible without the cooperation and support of many. I take this opportunity to place on record my thanks to all the members of the Working Group for their active participation in the deliberations and for providing necessary guidance and inputs for drawing the recommendations.

I, personally, feel honoured and thankful to the Planning Commission particularly Dr.Abhijt Sen, Member (agriculture) Planning Commission for giving me the opportunity to head the Working Group on Horticulture, Plantation Crops and Organic Farming. I take it as a matter of pride that I the Planning Commission had also identified me earlier as Chairman of a similar working group constituted for the X plan and Member Secretary of the group during VIII Five year plan. Further the Terms of Reference drawn by the Planning Commission are comprehensive and are worthy of appreciation. These have been the guiding principle for the Working Group and the sub-groups.

I am thankful to Mrs. Radha Singh, former Secretary, Department of Agriculture & Cooperation (DAC) and Shri S. M. Desalphine, Additional Secretary, (DAC) for their advice, support and useful suggestions.

Sincere thanks are due to the Chairmen/ Co-Chair and Member Secretaries of all the Sub-Groups for their hard work and valuable inputs in finalizing the sub group reports. I also take this opportunity to thank the Members of various Sub-Groups particularly those actively participated in the meetings and contributed in the finalization of the detailed Sub-Group reports.

My special thanks are due to Dr. M.L. Choudhary, Horticulture Commissioner, Govt. of India, Member Secretary of the working group, for providing all the logistic support and involvement in organizing the meetings and finalizing the report.

Thanks are also due to Dr. V.V. Sadamate, Advisor (Agriculture), Planning Commission for participation in most of the meetings and sharing his views on the XI Plan formulation. I shall also like to record my thanks to Dr. (Mrs.) Renu S. Parmar, Director Agriculture, Planning Commission for her technical inputs and rendering logistic support and help for holding the meetings.

I shall like to make special mention of the contribution made by Shri Rakesh Kumar Shukla, who as a Coordinator of the Working Group performed an excellent job. He provided unstinted support during the meetings, compilation and finalization of the report. A core technical team comprising of Dr. K.V. Prasad, Dr. S.K. Singh, Dr. V.B. Patel and Dr. Pitam Kalia, provided me the support through their dedicated involvement, organizing the meetings, preparing the proceedings, compiling and finalization of the reports etc., I would like to recognize their contribution profusely.

The inputs received from, Dr. Tamil Selvan and Shri Venkatesh Hubbali, Dr.A.K.Singh, Dr.R.K.Pal, Dr.Ram Asrey, Dr.Shruti Sethi and Mr. Subhash Mehta are duly acknowledged. Thanks are also due to Dr.Nawab Ali, DDG (Hort) and Dr.S.N Pandey, ADG (Hort) for their inputs on Horticulture Research. Finally, I do whole-heartedly appreciate the special interest evinced by the farmers and the representatives of the Confederation of Indian Horticulture for their participation in the meetings and discussions. The inputs provided by them have been taken into consideration while drawing the recommendations.

I hope this report would prove to be a useful document for finalizing the strategies and programmes for holistic development of horticulture in the country during the Eleventh Five Year Plan and will usher in an era of abundance, nutritional security and prosperity among the populace of the country.

In case the efforts being put in at right level in exploiting the potential of horticulture in national economy is to be fully exploited a bold initiative on organizational reforms is called for. Our objective should be to develop suitable infrastructure for technology driven development rather than mechanical mode to ensure proper implementation and effective monitoring of the ambitious programmes likely to be implemented during XI Plan.

Date: 31st January, 2007

(Dr. K.L. Chadha)

Chairman
Working Group on Horticulture,
Plantation Crops and Organic Farming

EXECUTIVE SUMMARY

I. STATUS OF HORTICULTURE

1.1. **Horticulture Redefined:** Traditionally, horticulture involves four areas of study namely, Pomology (fruit culture), Olericulture (vegetable culture) Floriculture (culture of ornamental crops), and Post Harvest Technology (management of produce after harvest). However, over the years the scope of the above field has been expanded to include other crops like mushroom, bamboo, plantation crops like tea, coffee, and rubber. Bee keeping, one of the tools to improve the productivity of horticultural crops through enhanced pollination is also being taken care by the horticulture division at the center. In view of the above developments Horticulture can now be redefined as the **'Science of growing and management of fruits, vegetables including tubers, ornamental, medicinal and aromatic crops, spices, plantation crops their processing, value addition and marketing'.**

1.2. **Area, Production and Productivity:** During 2004-05 coverage of area under various horticultural crops in the country was 19.40 million ha which is about 13.08 per cent of the total cultivated area. The states/ UTs namely Chattishgarh, Gujarat, Haryana, Jharkhand, Madhya Pradesh, Nagaland, Punjab, Uttar Pradesh, Dadar & Nagar Haveli have less than 10 per cent coverage of area under horticultural crops and thus call for priority attention to horticulture development in the XI Plan. The states namely Andhra Pradesh, Assam, Bihar, Karnataka, Maharashtra, Orissa, Rajasthan, Tamil Nadu and Uttarankhand cover about 10-25 per cent area under horticultural crops. There is still tremendous scope for exploitation of horticulture production in these states. Other states cover more than 25 % area in horticultural crops.

1.3. Production base of horticultural crops has been expanding since independence. From eighth plan onwards this sector has witnessed tremendous growth in area, production and productivity. The area has increased from 13.43 million ha in 1991-92 to 21.74 Million ha in 2004-05 while production increased from 97.83 million MT (1991-92) to 171. 86 million MT during 2004-05.

1.4. **Fruits:** The global fruit production during 2004 was 511 million MT. During the past 15 years, production of fruits in China has gone up by 246 per cent, which helped China to become the largest producer of fruits (83.24 million MT) in the world from its third largest producer position and contributes 16 per cent share in total production. India is the second largest producer of fruits with a production of 49 million MT and contributes 10 per cent share in global fruit production. Brazil occupies the third position, with 36 million MT and contributes 7 per cent in global production.

1.5. India occupies first place in production of mango, banana, litchi, papaya, pomegranate, sapota and aonla; 2nd place in limes and lemons and 5th place in pineapple production of the world. The productivity of grape is highest in the world. India has higher national average productivity in banana and sapota compared to world average productivity, while in citrus, mango, apple, guava, pineapple, papaya, India has substantially low productivity in comparison to the world average.

1.6. India accounts for an area of 4.96 million ha under fruit crops with a production of 49.29 million MT. During the period 1991-92 to 2001-02 growth in area, production and productivity of fruits was observed at the rate of 3.39, 4.15 and 1.92 per cent while between 2001-02 and 2004-05 it was 7.37, 4.66 and -12.06 per cent for area, production and productivity respectively. Among various states, Maharashtra ranks first and contributes 27 per cent in area and 21.5 per cent production. Andhra Pradesh ranks second in area and production contributing 13 and 16 of fruits. The maximum productivity was observed in Madhya Pradesh (22.6 MT/ha), followed by Tamil Nadu

(19.9 MT/ha), Gujarat (15.9 MT/ ha) Karnataka (15.9 MT/ ha) and West Bengal (12.8 MT/ ha). The growth in productivity was maximum (5 per cent) in Kerala during 1991-92 to 2001-02 while it was 10.2 per cent in Uttar Pradesh during 2001-02 to 2004-05

1.7. **Vegetables:** India is the second largest vegetable producer after China with 11% production share in the world and Brazil is the third. It is also the largest producer of okra and second largest producer of most of the other important vegetable crops at global level, namely brinjal, cabbage, cauliflower, pea, onion and tomato and third largest producer of potato in the world. However, it falls behind in productivity in most of the crops except for tomato where India is ranked at number 1. In okra, it is at par with world productivity and in cauliflower it is quite close to the average world productivity.

1.8. Total vegetable production in India before independence was 15 million MT and since independence for decades the growth rate was stabilized around 0.5%. The impetus on vegetable research and policy intervention to promote vegetable crops witnessed a sudden spurt in growth rate of 2.5%, a hike of five times during the last decade. The potential technological interventions with improved gene pool and precise management can very well take growth rate to nearby 6% per annum. The area under vegetables increased from 5.59 million ha in 1991 - 92 to 6.76 million ha during 2004-05. The production in this period increased from 58.53 to 101.43 million MT. During the same period, productivity of vegetables increased from 10.5 MT/ ha to 15.0 MT/ ha.

1.9. While West Bengal continues to be the leading state in area and production, the productivity is higher in Tamil Nadu followed by Uttar Pradesh and Bihar. Potato has the highest share in total vegetable production of the country (28.8%) followed by brinjal (8.6%), tomato (8.5%), tapioca (7.8%), onion (7.4%) and cabbage (6.1%).

1.10. **Mushrooms**: Mushroom is a non-traditional horticultural crop having high quality of proteins, high fibre value, vitamins and minerals. World produces 61.16 lakh MT of cultivated mushrooms annually. The share in production of different types of mushrooms world-wide is button (31%), shiitake (24%), oyster (14%), black ear mushroom (9%), paddy straw mushroom (8%) and milky/others (the rest). China produces 63% of the world production of mushrooms and ranks first among world's mushroom producing countries.

1.11. India produces more than 70,000 MT of mushroom. In India button, oyster, milky and paddy straw mushrooms are grown but button mushroom contributes highest share of production. Even though button mushroom cultivation started in India in seventies at Chail and Kasauli (Himachal Pradesh) it is now grown all over the country, mostly in tropical areas, where raw materials and labour are available at competitive rates as compared to hilly regions. The mushrooms produced in the large commercial units in India are processed and packed in cans/jars for export. This is necessary as button mushroom has short shelf life of less than a day.

1.12. **Floriculture:** India is the second largest producer of flowers after China. About 1,15,921 ha of area is under floriculture producing 6,54,837 MT of loose flowers annually (2004-05). The loose flower sector grew over the Plan periods with the production of flowers almost doubling (1.84 times) between VIII Plan and end of X Plan. The area expansion during the same period was to a tune of 1.64 times.

1.13. The traditional flower sector registered an impressive growth during the VIII, IX and X plan periods and grew from 71, 000 ha at the end of VIII Plan period to 1,06,000 ha by the end of IX plan. During X plan an additional 10, 000 ha has been brought under the traditional flowers by the end of 2004-05 to register an overall area of 1,15,921 ha. The production during the corresponding periods was 3,66,000, 5,35,000 and 6,54,837 MT respectively. Tamil Nadu is the leading producer of loose flowers closely followed by Karnataka both in terms of area and production. The productivity per hectare was

highest in Bihar (17.05 MT) followed by Haryana (11.55 MT). On the other hand the productivity of flowers was the least in Rajasthan (0.59 MT). The overall productivity of the country during 2004-05 was recorded at (5.64 MT). Nearly 77% of area under floricultural crops is concentrated in seven states comprising of Tamil Nadu, Karnataka, Andhra Pradesh, West Bengal, Maharashtra, Haryana, Uttar Pradesh and Delhi.

1.14. The production of cut flowers increased over plan periods to attain a production of 1,952 million flowers during X plan period from 615 million cut flowers during the end of VIII Plan period. West Bengal leads with a production of 896 million cut flowers followed by Karnataka with 413 million cut flowers. Other major cut flower producing states include Uttar Pradesh, Maharashtra, Gujarat, Himachal, Uttarakhand etc.

1.15. **Medicinal and Aromatic Plants:** The medicinal plants based industry is growing at the rate of 7-15% annually. According to a conservative estimate, the value of medicinal plants related trade in India is to the tune of about Rs 5,000 crores per annum while the world trade is about 62 billion US dollars and is expected to grow to the tune of 5 trillion US dollars by the year 2050. The present international situation in the production and trade of essential oils and aroma chemicals is very complex and vibrant. No doubt, the developing countries have a dominant position in world production, but still the competition from developed countries remains very strong. The world production from the developing countries accounts for 55% followed by developed countries (10%).

1.16. The Indian Systems of Medicine have identified 1500 medicinal plants, of which 500 species are mostly used in the preparation of drugs. The medicinal plants contribute to cater 80% of the raw materials used in the preparation of drugs. The effectiveness of these drugs mainly depends upon the proper use and sustained availability of genuine raw materials. Majority of the medicinal plants (over 90%) required in the indigenous drug industries in India are still collected from wild sources. Since these are mostly cross pollinated, these cannot ensure consistent quality due to lot of genetic variability found in the natural populations. Moreover, the collection of plants from the wild has many disadvantages like unstable supply, unreliable botanical identification, poor post harvest handling and higher chances of adulteration and substitution.

1.17. Paradoxically, there is hardly any reliable data available on area, production and productivity of cultivated medicinal species since these are not recorded at the grass root level for want of adequate knowledge and interest by the record keeping authorities. All species are considered as one commodity and sometimes some data are taken by some states. The area of 2,72,150 ha under important medicinal plants are estimated on the basis of consolidation made from the fragmented information available in literature. National Medicinal Plant Board has identified 32 prioritized medicinal plants. The cumulative annual demand of all 32 plants was estimated to be 141398.6 MT during 2004-05.

1.18. **Spices:** India is the largest producer, consumer and exporter of spices and spice products in the world and produces more than 50 spices. The spices production in India is of the order of 3.72 million MT from an area of about 2.66 million ha. Area and production of spices in the country have registered substantial increase over the last fifteen years with average annual growth rate of 2.7% and 6.2% in area and production respectively. Chilli is the major spice crop occupying about 29 percent of area under cultivation and contributing about 34 percent of total spices production in the country. Turmeric accounts for 14% of production and 6 % of area, while garlic accounts for 19% of production and 5% of area. Seed spices contribute 17% of production and occupy 41% of area while pepper contributes 2 % of production and occupies 9 % of area of the total spices in the country.

1.19. Rajasthan occupies major area under spices owing to seed spices cultivation in the State followed by Andhra Pradesh, Kerala, Karnataka, Madhya Pradesh and Gujarat.

Andhra Pradesh, which is the foremost state producing chilli and turmeric in the country, ranks first in terms of production followed by Rajasthan, Madhya Pradesh, Tamil Nadu, Orissa, Karnataka and Kerala.

1.20. **Plantations Crops:** There are two groups of plantation crops namely coconut, arecanut , oil palm, cocoa, cashewnut dealt by Ministry of Agriculture and tea, coffee, rubber dealt by the Ministry of Commerce. The combined volume of output of tea coffee and rubber is about 2 million MT and constitutes about 3 per cent share of the total value of agricultural output in India.

1.21. **Coconut**: Coconut is grown globally over an area of 12.19 million ha producing 13.68 million MT (copra equivalent) in 93 countries of the world. India accounts for 22.34 per cent of the world coconut production and is one of the major players in the world's coconut trade. Currently the crop is grown in 1.93 million ha with an annual production of nearly 13,000 million nuts with average productivity of 6,632 nuts/ ha. Indonesia, Philippines and India are the major producers of coconut in the world. The area, production and productivity of coconut have increased at the global level (0.89, 4.36 and 3.79% per year) during the past 15 years (1990-2004).

1.22. The trend in coconut production is also on the increase. Coconut production, which was estimated at 5,940 million nuts in 1981-82 has shown an annual growth rate of 3.26 percent. Similar to the area, distribution of production has also undergone a change over the period. In 1981-82 Kerala accounted for 50.60 percent of coconut production whereas in 2004-2005 the share declined to 44.63%. Karnataka's share, which was 15.45%, eroded to 9.43%; Tamil Nadu, which accounted for 23.33% of the production during 1981-82 has improved its position to 25.27 in 2004-2005. The share of other states, which was 7.66%, increased to 11.32% during the period.

1.23. **Cashew nut:** India is the largest producer, processor, consumer and exporter of cashew in the world. The area under cashew in the world is 30.62 lakh ha while production is estimated to be around 20.82 lakh MT. India's share in the world raw nut production is about 25%. Raw nut production in South East Asian Countries has registered approximately 10 fold increase since 1980. Latin American countries have registered approximately 3 fold increase during the same period.

1.24. Maharashtra ranks first in area, production and productivity of cashew in the country. Cashew is grown mainly in Maharashtra, Goa, Karnataka and Kerala along the west coast and Tamil Nadu, Andhra Pradesh, Orissa and West Bengal along the east coast. To a limited extent it is grown in Assam, Meghalaya, Tripura, Andaman and Nicobar Islands and Chattisgarh besides plains of Karnataka.

1.25. **Cocoa:** World cocoa production has registered 131.7% increase in the past 30 years and was estimated at 3.52 million MT during 2004-05. The world's largest cocoa bean producer is Côte d'Ivoire, currently producing more than 1.45 million MT beans with a growth rate of 2.3 per cent/ year.

1.26. Cocoa is cultivated in India over an area of 27,811 ha with an annual production of 10,175 MT with a productivity of 530 kg/ha during 2005-06. Kerala is the leading producer of coco with 10,220 ha of area and 6,490 MT of production. However, Karnataka with 825 kg/ha leads in productivity. In India, a trend of increasing consumption of chocolates and other cocoa based products has emerged especially among the middle class. It is mainly grown in the states of Kerala, Karnataka, Tamil Nadu and Andhra Pradesh and cultivated mainly as an intercrop in arecanut and coconut gardens. It has great potential to be introduced in other states where coconut and arecanut are grown.

1.27. **Arecanut:** India is leading producer of arecanut and accounts for 56% and 58% of the total area and production in the world. Production of arecanut in the country which stood at 2,56,600 MT from an estimated area of 2,26,600 ha during the first year of

Eighth plan (1992-93), has reached 4,56,600 MT from an area of 3,74,300 ha during the third year (2004-05) of Tenth Plan. Karnataka, Kerala and Assam are the three major states producing arecanut. Arecanut industry forms economic backbone of nearly 10 million people of India and for many of them it is the sole means of livelihood. The country produces arecanut valued at Rs 3,000 crores annually.

1.28. **Coffee:** The major coffee producers in the world are Brazil (30%), Vietnam (11%), Columbia (10%) and Indonesia (6%). Global coffee production for 2005-06 was placed at 109 million bags, which showed a decline from last year, and was around 115 million bags as per ICO estimates. India's coffee production is in the region of just over 4% and ranks 6th in world's production. Arabica and Robusta coffee are the two species that are commercially cultivated in the world. Of these, nearly 70% is Arabica and the balance 30% Robusta .

1.29. In India, coffee is cultivated in about 3.80 lakh ha mainly confined to the southern states of Karnataka (59%), Kerala (22%), Tamil Nadu (8%) which form the traditional coffee tracts and the remaining area (11%) in the non-traditional areas such as Andhra Pradesh, Orissa and the north eastern states. In India, coffee is largely a micro enterprise and out of a total number of over 2.1 lakh coffee holdings in the country, around 2.08 lakh holdings (about 99%) belong to the small farmers having less than 10 ha. coffee area.

1.30. The Indian coffee production in 2005-06 was 2.74 lakh MT comprising 94,000 MT of Arabica and 1,80,000 MT highest level of 3.01 lakh MT during the end of IX plan i.e. 2001-02. The current productivity levels of Indian coffee are placed at around 620 Kg / ha for Arabica and 948 Kg/ ha for Robusta during 2005-06. While the combined productivity level of 803 kg/ ha compares well with the global coffee productivity across all the coffee producing countries (500 Kg/ ha), the major coffee producing country like Vietnam (Robusta) Brazil (Arabica) have much better productivity levels and stronger competitiveness compared to India.

1.31. **Rubber:** Among all rubber producing countries India position is 5th in area, 4th in production and 2nd in productivity. World natural rubber production is projected to reach 10.1 million MT in 2010. The annual growth rate would be 6 percent in the current decade.

1.32. Most of the rubber plantations are located in far-flung villages and they play a major role in rural development of the country. Women are employed in plenty in rubber plantations and this contributes to their empowerment. In employment generation, rubber-manufacturing industry also play an equally important role.

1.33. Though rubber is traditionally grown in the southern states of Kerala and parts of Tamil Nadu and Karnataka, the crop has now gained acceptance among the people of non traditional regions as well, especially the North-east. Rubber plantations are very helpful in protecting the environment.

1.34. **Tea:** India is the second largest producer and the largest consumer of tea in the world. It contributes 19 % share in area and 27 % share in production. During 2005-06, 521,403 hectares was under tea cultivation with production of 930 million kg. India consumes about 23.5% of total world consumption of tea, which is about 81% of the tea produced in the country.

II. HORTICULTURE RESEARCH

2.1 Horticultural R&D has received good attention since VIII Five Year Plan. The investment increased significantly. As a result considerable strengthening of horticultural programmes and infrastructure has taken place in the country.

2.2 **Research Infrastructure:** There are at present 10 Central Institutes with 27 regional stations, 12 National Research Centres, 9 Multi-disciplinary Institutes, 15 All India Coordinated Research Projects with 223 centres, One full fledged State Agricultural University on Horticulture & Forestry, 25 State Agricultural Universities with Horticulture discipline, 5 network projects, 330 Ad-hoc research projects and 29 Revolving fund schemes which are dealing with research on different horticultural crops. Besides the above a large number of CSIR laboratories and centres aided by Department of Biotechnology (DBT), Bhabha Atomic Research Centre (BARC) and Indian Space Research Organization (ISRO) are also undertaking basic and strategic research on horticultural crops. In addition, the Ministry of Commerce has established one Research Institute each for Coffee, Rubber and Spices and two for Tea which work on different aspects of these commodity crops.

2.3 **Improved varieties :** Over 50 varieties in different fruit crops comprising of aonla (2), acid lime (1), apple (4), banana (5), custard apple (1), grape (6), guava (3), litchi (3), mango (10), papaya (6), pomegranate (4) and sapota (2) have been released during the last two decades. Similarly, a large number of vegetable varieties have been identified and released for fresh consumption, culinary purpose, processing, nutritionally rich and those suited for export purposes. Several vegetable varieties are also available with resistance to diseases and pests. Varieties have also been developed in potato for short growing period, resistance to late blight, tolerance to viruses and immunity to wart disease and resistance to cyst nematode.

2.4 **Propagation:** Vegetative propagation techniques have been standardized in several fruit and plantation crops. Rapid methods of propagation through micro-propagation are available in banana, several flower crops, MAPs and foliage plants. Production of virus-free planting material through shoot tip grafting has been standardized in citrus.

2.5 **Plant Growth Regulators**: Use of plant growth regulators/ chemicals is now successfully exploited for flower production, improvement in fruit set and size, fruit quality and checking fruit drop and effective ripening.

2.6 **Canopy Management:** Efficient canopy management strategies have been developed. High Density Planting systems in crops like mango, cashew, citrus, banana, pineapple, papaya and apple have been standardised.

2.7 **Drip Irrigation/ Fertigation** technologies are available for banana, grape, papaya, pomegranate, mandarin, coconut, areca nut and cashew nut.

2.8 **Nutrient Management:** Fertilizer schedules have been standardized for a number of crops grown under different agro-climatic regions. Use of micro-nutrient sprays to minimize physiological disorders, improve fruit set and quality, enhanced shelf-life etc. are now practiced. Integrated Nutrient Management Strategies (INM) are available and need to be adopted on commercial scale in different perennial crops.

2.9 **Disease and Pest Management:** For disease and pest management, use of safe chemicals including bio-control agents has reduced the dependence on chemical pesticides, residues in fresh produce and death of pollinators and useful insects. Several technologies, using bio-control agents for control of insect pests like mealy bug in mango, grape, etc. have been developed and need to be adopted by the growers.

2.10 Plant protection schedules have been established for all commercially cultivated horticultural crops. Biological control methods have been standardized for control of mealy bug in grape, scale insects in citrus, rhinoceros beetle and leaf eating caterpillar in coconut. Integrated Pest Management (IPM) strategies in crops like cabbage (diamond back moth), tomato (fruit borer), potato (bacterial blight and tuber moth) standardized. Apple scab and potato late blight forecasting systems have been

developed. Twenty-four IPM packages including those for fruits, plantation and spice crops have also been developed for farmers.

2.11 **Protected Cultivation:** Protected cultivation / green-house/low poly tunnels production techniques are now available for growing cut-flowers and vegetables. Crops like tomato, cucurbits, cabbage, cauliflower, cucumber, lettuce, onion, spinach, brinjal, pepper, turnip, radish, can be successfully grown for high quality under protected cultivation. It has enabled farmers to produce vegetables in places like Leh and also off season production of vegetables in north India. Technology for protected cultivation of flowers like rose, chrysanthemum, gerbera and carnation in polyhouse, shadenet etc. has been perfected. Low cost greenhouse technology developed for high quality flower production in hilly states of J & K, Himachal Pradesh, Uttaranchal and North Eastern states. These structures are now used commercially for export of quality flower production in plains of Maharashtra & Karnataka.

2.12 **Post harvest Management:** At present, the post harvest losses are about 20-30 per cent in different horticultural crops. This is happening mainly due to mismatch between the production and infrastructure development for PHM. Technology development has been in vogue but its adoption is far below. Post-harvest management including pre-cooling, passive evaporative cooling for increasing the shelf-life of fresh fruits, vegetables, floriculture products, processed fruits and vegetables have been standardized. Packing materials like Corrugated Fiberboard boxes (CFBs), perforated punnettes, cling films, sachets, wraps etc. have been standardized for fresh horticultural produce. Tetra packs of different products are now house-hold items.

2.13 **Value Addition:** Development of new products like dried powder fruit based milk mix, juice punches, banana chips and fingers, mango nectar and fruit kernel derived cocoa substitute, essential oils from citrus, fruit wines, dehydrated products from grape, pomegranate, mango, apricot and coconut, grape wines, value-added coconut products like snowball tender coconut, milk powder and pouched tender coconut water (Cocojal) etc. are getting popular day by day. Improved blending/ packaging of tea and coffee have opened new markets. Consumer friendly products like frozen green peas, ready to use salad mixes, vegetable sprouts, ready-to-cook fresh cut vegetables are major retail items.

2.14 **Mechanization:** To keep pace with improved production and productivity, different machines have been developed for effective cultivation, intercultural operations, harvesting, grading, packaging and value-addition. Development of mango harvester, Kinnow clipper, potato digger, coconut peeler, etc. is being adopted by the growers. Machines have also been developed/ installed for different specialized uses like cool sterilization (irradiation) for sprouting in potato and onion, dehydration of different produce, vapour heat treatment (VHT) in major mango growing belts, packaging of coconut water, banana fig and chip making machine, etc.

2.15 **Research Gaps:** In spite of several research leads, there are still gaps, which require focused attention. Development of improved varieties/hybrids of fruits, vegetables, plantation crops, medicinal and aromatic crops, flowers and ornamental crops, spices, cashew, oil palm with high production potential, biotic and abiotic stress resistance and is the need of the hour. There is also need to evolve appropriate horticultural based cropping systems for different agro-climatic areas.

2.16 Gaps also exist in non-availability of desired varieties for specialized use like processing, export etc. in different fruits, vegetables and flower crops. There is need to standardize techniques for rapid propagation, evolve agro-techniques, efficient water management, integrated plant nutrient management systems and integrated disease and pest management for all commercial perennial crops .

2.17 There is a dearth of standardized rootstocks of perennial fruit trees, farming technology with tissue nutrient based fertilizer guides, existence of several physiological and pathological problems like malformation and alternate bearing in mango, granulation and decline in citrus, shot berries in grape, guava wilt, Fusarium wilt in banana etc.

2.18 In vegetables and flowers, there are no varieties suited for protected cultivation and cut flowers production, value addition, etc.

2.19 Organic production technologies need to be developed with scientific experimentation involving different disciplines to derive complete packages. Efficient post harvest technologies for different horticultural crops are still lacking. There is a need to make new products for internal and export markets. There is ample scope for standardization of Hitech production technologies and mechanization.

2.20 there is a need to development of post harvest handling, storage and processing system, product diversification and value addition. There is need to develop complete post harvest handling protocol, cold chain, export, market intelligence, etc.

2.21 By giving focused attention on the above mentioned problems it is envisaged that the desired production, productivity and quality levels can be efficiently achieved and India could emerge as a major player in global horticulture.

III. HORTICULTURE DEVELOPMENT

3.1 **Set up and programmes:** The Department of Agriculture & Co-operation of the Ministry of Agriculture is the nodal department for overviewing horticulture development in the country. The Division of Horticulture was carved out of the Crops Division in 1981 and a position of Horticulture Commissioner was created in 1985. The Division is vested with the responsibility of over-seeing the overall development of horticulture at national level and is supported by three Boards i.e., National Horticulture Board, Coconut Development Board and National Bee Board besides, two Directorates i.e. Directorate of Cashew and Cocoa and Directorate of Arecanut and Spices. The National Committee on Plasticulture Application in Horticulture which has 17 centres to work on plasticulture intervention is also attached to the Division. A Central Institute of Horticulture for effective dissemination of technologies and capacity building has been established at Mediziphema, Nagaland. The Department implements its programmes through the State Departments of Horticulture and provides leadership and coordinates activities for the promotion of horticulture.

3.2 Budgetary Allocation: The plan investment for horticulture development increased significantly from the VIII Five Year Plan onwards and resulted in considerable strengthening of the horticultural development programmes in the country. Starting with a meager financial allocation of Rs. 2.05 crores for horticulture development in IV Plan, the Plan allocation rose to Rs. 1453.06 crores in IX Plan. The allocation for horticulture increased many folds during the X Plan with the launching of Technology Mission for Integrated Development of Horticulture in North East Region, National Horticulture Mission, Microirrigation Programme and National Bamboo Mission. The allocation for the horticulture development during X Plan period (till 30 November, 2006) was stepped up to Rs. 4,472 crores, which was nearly three times the allocation of Rs. 1,453 crores during the IX Plan. In addition Rs. 1,178 crores was allocated to the commodity Boards of the Ministry of Commerce dealing with Tea, Coffee, Rubber and Spices. At present the horticulture crops programmes form around 30 per cent of the total outlay for agriculture development of the Department of Agriculture & Cooperation.

3.3 Technology Mission for Integrated Development of Horticulture in North East Region & Himalayan States: The Technology Mission was launched during the financial year 2001-02 to achieve overall development of horticulture in 8 states to harness the potential that exists in the North East region. The scheme was further extended to three other hilly States namely Jammu & Kashmir, Himachal Pradesh and Uttaranchal during 2003-04. To achieve the goals and mandate of mission, programmes have been formulated under four Mini Missions. An outlay of Rs. 845 crores was earmarked during X Plan period, of which an expenditure of Rs. 731 crores (86%) is incurred. Technology Mission for Integrated Development of Horticulture in North East and Himalayan States, has largely succeeded in its objective of sensitizing the farmers in harnessing the potential of horticulture in the region.

3.4 **National Horticulture Mission**: This was a major initiative taken up during the X Plan. The National Horticulture Mission was launched during the year 2005. The Mission envisages an end-to-end approach in covering production, post harvest management and marketing to assure appropriate returns to growers/producers; enhance acreage, production and productivity in potential belts/clusters; adopt a coordinated approach and promote partnership, convergence and synergy among R&D, processing and marketing agencies in public as well as private sectors; promote, where appropriate, National Dairy Development Board (NDDB) model of cooperatives to ensure support and adequate returns to farmers, facilitate capacity-building and Human Resource Development. Against an outlay of Rs. 1630.0 crores an expenditure of Rs. 790.51 crores (48.49%) has been incurred. NHM needs to be technically strengthened both at the Central and State level. The organizational structure of NHM therefore, needs to be reviewed. It is recommended that a technical person should lead a programme of such a dimension. Besides, yearly external technical monitoring should be ensured annually to find out gaps and also to make the process more effective and transparent at grass root level.

3.5 **National Bamboo Mission:** The National Bamboo Mission was approved on 27th October 2006 as a Centrally Sponsored Scheme. The Mission envisages to promote the growth of the bamboo sector through an area based regionally differentiated strategy. The mission addresses four major areas of bamboo development, namely (i) research & development; (ii) Plantation Development; (iii) Handicrafts Development and (iv) Marketing. Allocation for the National Bamboo Mission during X Plan is Rs. 91.37 crores.

3.6 Micro irrigation: A scheme on Micro irrigation was launched during March 2006 to promote judicious use of water resources with a target to bring 6.2 lakh ha area under micro irrigation. The Scheme, at present, is being implemented in 284 Districts of 13 States. The major components of the scheme are, coverage of area under drip and sprinkler irrigation HRD of farmers and developmental staff, awareness and quality control. Against an allocation of Rs. 800.49 crore for micro irrigation programme, an expenditure of Rs. 731.0 crores (86%) has been incurred. However, the programmes need to consider provision of assistance for closed spaced (high density planting) crops, creation of water sources, pumps, tanks, etc. and replacement of drippers, pipes, etc, introduction of micro sprinklers. The scheme should be extended to all horticultural crops including oil palm.

3.7 National Horticulture Board (NHB): The National Horticulture Board (NHB), established during 1984, is involved in the development of high quality horticulture farms in identified belts and make such areas vibrant with horticulture activity which in turn will act as hubs for developing commercial horticulture. The Board was launched with the sole objective of promoting post harvest infrastructure of horticultural crops in the country. However, in course of time the Board's programme some how got diluted resulting in deviation from its identified objectives. Against an outlay of Rs. 585.0 crores during X Plan period, the Board utilized funds to the tune Rs. 381.3 crores

(65.2%). The National Horticulture Board is not recommended to be continued in its present form. In view of launching of Technology Mission for Integrated Development of Horticulture in North East & Himalayan States and National Horticulture Mission its role needs to be critically reviewed. This requires total overview of the structure of the horticulture division and various its units.

3.8 Coconut Development Board: The Coconut Development Board was established in 1981, after Government of India abolished the erstwhile Directorate of Coconut Development formed during 1966. The Coconut Development Board (CDB) implements programmes for the Integrated Development of Coconut Industry. In addition to the regular programmes related to development of coconut in the country. Board also implements Technology Mission on Coconut launched during January 2002. Against an outlay of Rs. 175.0 crores to the Coconut Development Board for various Schemes including Technology Mission on Coconut, an expenditure of Rs. 127.7 crores (86%) has been incurred. On a review of the ongoing programmes of the Board it is recommended to restrict implementation of certain programmes in certain geographical areas and merge some of the schemes in order to remove overlap between regular schemes of the board and those of Technology Mission on Coconut as suggested in the mainsreport .

3.9 Coffee Board: The Coffee Board of India is an autonomous body, functioning under the Ministry of Commerce and Industry, Government of India. Set up under an Act of the Parliament of India in the year 1942, the Board focuses on research, development, extension, quality upgradation, market information, and the domestic and external promotion of Indian coffee. The sanctioned outlay during the X Plan period for the ongoing schemes is Rs.300 crores. Of this, the expenditure incurred during the plan period was Rs. 221.22 crores (74%). It is suggested to discontinue some of the Schemes of the coffee board, which have served the limited purpose by providing some comfort to growers & exporters during their time of coffee crisis. Besides some of the schemes need to continue during XI Plan after modification. New Schemes are also proposed to be launched during the XI Plan period.

3.10 Rubber Board: The Rubber Board is a statutory body constituted by the Government of India, under the Rubber Act 1947, for the overall development of the rubber industry in the country. The Rubber Board is mandated with integrated development of rubber in the country. The sanctioned outlay during the X Plan period for the ongoing schemes is Rs.415 crores. Of this, the expenditure incurred during the plan period was Rs. 447.70 crores (107.9 %). Objectives of X Plan could not be achieved in full and many programmes could not be implemented in time for which the board lays responsibility of late receipt of approval of the major scheme. Therefore all ongoing schemes except for Export Promotion are recommended to be continued.

3.11 Tea Board: The Tea Board Iis a statutory organisation established under the Tea Act, 1953 by the Government of India. It was established as an apex body concerned with integrated development of the tea industry in India by providing necessary assistance. The sanctioned outlay during the X Plan period (2002-07) for the ongoing schemes was Rs.463 crores. Of this, the expenditure incurred during the plan period was Rs. 462.98 crores (99.9%). While some of the existing programmes of the Tea Board need to continue as such, some other are recommended to continue after modifications. To cater to changing Global scenario and increasing consumer awareness, some new interventions have also been proposed.

3.12 Central Institute of Horticulture (CIH), Medziphema, Nagaland: Recognizing the importance for institutional support for development of horticulture in NE Region, the Government of India has sanctioned a Central Sector Scheme for setting up of Central Institute of Horticulture in Nagaland during January, 2006. CIH was allocated Rs. 5.60 crores during X Plan period of which an expenditure of Rs. 1.3

crores (23.21%) has been incurred. The thrust areas for the Institute in the XI Plan are (i) refinement /demonstration of identified technologies specific for the region; (ii) Production and supply of quality seed and planting material of improved/high yielding varieties and (iii) training of state department officials and field functionaries in selected aspects of horticulture development including post harvest management, processing and value addition. The Scheme was launched only during January 2006 and it should continue during the XI Plan period.

IV. PLANTING MATERIALS

4.1 **Importance:** Planting material plays an important role in the production of horticultural crops. Inadequate availability of quality planting material is one of the important deterring factors in development of a sound horticulture industry. At present 30-40% demand for planting material is being met by the existing infrastructure. Farmers do not have access to certified disease free material as a result of which production; productivity and quality of the produce suffers. Much of the dependence is on the unregulated and unmonitored private sector in most of the states. The existing nurseries lack modern infrastructure such as greenhouses, mist chambers, efficient nursery tools and gadgets, implements and machinery.

4.2 **Production Facilities**: In the existing infrastructure, there are just over 100 big nurseries. A number of Government Nurseries also exist in different States. Planting material is also being produced by the ICAR Institutes and SAUs. Private nurseries also play important role to meet the requirement of the growers and at present the number of small and medium scale nurseries is over 6,300. In recent years some Hi-tech nurseries like Indo-American Hybrid Seeds have also become popular. In addition to these there are 19 NSP centres under National Seed Project for the production of vegetable seed. In medicinal and aromatic plants, very few centers are engaged for the production of quality seeds. Seeds of 30 vegetable hybrids are also being produced under NSC which also deals with horticultural crops through contract growers.

4.3 **Micro-propagation** is also being commercially exploited and some 1.5 million plants are being produced every year in banana, sugarcane, ornamentals, spices and medicinal plants.

4.4 ICAR through its network of research institutes and national centers along with a net-work project on hybrid seed production has intensified work on quality plant material production of different horticultural crops.

4.5 Coconut seedlings and hybrid plants are being produced under schemes of the Coconut Development Board and under APEDA funded schemes for the production of planting material of spices.

4.6 Under the Technology Mission for integrated development of horticulture in NE states, 302 new nurseries have been established and under National Horticultural Mission 2830 new nurseries are proposed to be established by the end of XI plan.

4.7 Different nationalized banks like NABARD, SBI, PNB, etc. are also funding schemes for the establishment of nurseries.

4.8 Proposed Infrastructure: It is proposed to develop 1345 nurseries during 2006-07 under NHM and TMNE. Very few states such as Maharashtra, Andhra Pradesh and Punjab are self sufficient in production and distribution of planting material, while rest of the states out-source it from other states either from public or private sector nurseries.

4.9 Constraints: There are several constraints in the existing system of plant propagation. There are several private nurseries operating in the country playing important role in

multiplication of planting material of different horticultural crops several of them follow traditional methods and lack adequate infrastructure and sell plant material of unknown pedigree at exaggerated prices resulting in fleecing of the buyers. There are also several private nurseries propagating planting material of protected varieties. It is hoped that as a result of establishment of Protection of Plant Varieties and Farmers Right Authority of Govt. of India flouting of plant breeders rights would diminish.

4.10 Of the many other constraints, inferior quality seed being procured, un-availability of standardized root stocks and non-maintenance of healthy stocks of elite varieties are worth mentioning. In vegetables inclement weather, non-maintenance of isolation distance in cross pollinated crops, low indents for new varieties, non-availability of nucleus seed, inadequate supply of mother plant, unavailability of improved tools, non-adoption of plant protection measures, non-existence of virus indexing, use of diseased scion woods, procurement through open quotations are some of major constraints.

4.11 **Regulations**: At present there is no legislation to regulate production and sale of vegetatively propagated planting material and there is a necessity to ensure quality production through a mechanism by establishing an Apex Body.

4.12 The crop wise **requirement of planting material** in various horticultural crops has been estimated by a modest expansion of 4% per annum. Thus the total requirement of planting material of fruits, coconut, cashew, black pepper, tree spices, areca-nut, etc. which was around 1400 millions by 2002 which can be projected as 2,000 million by 2012.

4.14 In fruit crops projected demand of planting material during 2007-08 would be 7,145,841, which will increase to 83,59,632 during 2011-12. In vegetable seeds the annual seed requirement is expected to be more than 185 MT of breeders' seed. In floriculture the area would increase by 5,000 ha during XI Plan and the demand for planting material would be around 19,682 lakhs, which will require 2,232 ha of nursery area.

4.15 XI Plan Programmes: Rather than giving ad-hoc assistance for multiplying nurseries it is recommended that a scheme of establishment of national and regional nurseries may be taken up as detailed below. The envisaged major programmes during XI Plan to be taken in fruits up consist of establishment national and regional nurseries.

4.16 National Horticultural Nurseries: These will be responsible for large scale production and distribution of genuine quality seed and planting material to the entire country. In mango, such nurseries will be established at Dapoli/Vengurla, GBPUA&T, Pantnagar, IARI Regional Station, Karnal, GAU, Paria, IIHR, Bangalore, RAU, Samastipur, APAU, Sangareddy/Kodur and BCKVV, Malda. In grapes NRC Grapes, Pune, IIHR, Bangalore and APAU, Hyderabad have been identified. In banana, centres identified for national nurseries are NRC on Banana, Trichy, MPKVV, Rahuri, UAS, Bangalore and RPRC, Bhubaneswar. In pomegranate the identified centers are MPKVV, Rahuri and UAS, Bangalore. In litchi, the centers are RAU, Samastipur, GBPUA&T, Pantnagar and HARP, Ranchi. In guava, the centers are CSAU &T, Kanpur and MPKVV, Rahuri. In walnut, the centers are SKUAS&T, Srinagar and YSPUH&F, Solan. In apple, the centers are SKUA&ST, Srinagar, YSPUH&F, Solan and HETC, Chaubatia. In passion fruit, the centers are ICAR Complex for NE Region, Meghalaya; Kiwi fruit, YSPUHF, Solan and in ber, CAZRI, Jodhpur and HAU, Hisar and in papaya, IARI, Regional Station, Pusa, Samastipur CHES, Chettalli, TNAU Coimbatore and HAPS, Ranchi are identified centers for strengthening under the scheme.

4.17 Regional fruit nurseries: These nurseries are proposed to be set up on an area of 4 ha at SAU centers to act as model nurseries with an. The centers identified are FRS, Rewa, BHU, Varanasi, PAU, RSGurgaon, OUAT, Bhubaneswar, CAU, Imphal, AAU, Jorhat, BAU, Ranchi, CIPHET, Abohar, IGAU, Raipur, CIAH, Bikaner, HAU, Hisar, BAU, Ranchi, SKUAS&T, Srinagar, CIMAP, Lucknow, IHBT, Palampur, RRL, Jorhat,

CoA, Pune, CoH, Mandsaur (MP), BCKVV, Nadia, RAU, Udaipur, GAU, Anand, IARI Regional Station, Shimla, NDUA & T, Faizabad, CPCRI, Kasaragod, UAS, Dharwad, KAU, Vellanikkara, PDKV, Dapoli, APAU, Hyderabad, IARI-RS, Indore. In addition to these, Commodity Board Seed farms will be set up for coconut (5), spices (3), tea (5), coffee (2) and rubber (5).

4.18 Besides these nurseries it is proposed to establish **National Centres for production of virus-free plant material in Citrus.** These centres will be established at NRC on Citrus, Nagpur, PAU, Ludhiana/ Abohar, APAU, Tirupati, AAU, Jorhat, IIHR, Bangalore/ CHES, Chettali. These centers would under take identification of high yielding virus free plants of scion / stock varieties through meristem culture followed by Shoot Tip Grafting (STG) besides virus detection and maintaining seeds of the recommended rootstocks and budded plantlets for sale.

4.19. A **Scheme for Production of Vegetable seeds** for meeting the breeder seed requirements and research on important issues related to seed production is also proposed.

4.20 It is also proposed to establish a **Central Certification Agency** for quality planting material which will be responsible for certification of any plant material sold to growers. The agency will carry out frequent inspections to certify the planting material that is produced or traded in the country.

4.21 Interventions: The total requirement for breeder seed in **potato** is about 3,000 MT and there is a short fall of 900 MT. There is no seed production and multiplication chain in 50-55% of potato production areas. Areas where no seed supply channel exist, there is need to create an altogether new potato seed multiplication and supply chain involving private sector and State Govt. agencies. The seed village scheme proposed by the National Commission on Farmers is likely to give good dividend in this direction.

4.22 For **plantation crops** strict guidelines for the production and distribution of quality planting material require use of quality planting material for replenishing senile areas and the quotation/ tender systems of buying planting material in auction need to be banned for procuring the planting material.

4.23 For **Spices** programme a large scale multiplication of traditional spices needs to be initiated at the IISR, Calicut and Spice Board funded farms and SAUs. For seed spices, NRC for Seed Spices, Ajmer may be given necessary funds for making available commercial seed production of different spices like Dhania and Jeera; for black pepper, clove and cardamom multiplication may be done at IISR, Calicut and KAU, Thrissur.

4.24 In case of **Medicinal and Aromatic plants** there is dearth of planting material in many key species and limited improved varieties are available. Plants like Norii (*Morinda citrifolia* L) which are emerging as useful medicinal plants should be given desired importance. Hence different institutions under public sector like NRC on Medicinal and aromatic crops, Anand and CIMAP, Lucknow are required to multiply plants for supply to growers.

4.25 Paucity of genuine and quality planting material is said to be the major hindrance in area expansion and replanting fruit crops with private and un-registered nurseries spread all across the country often selling spurious materials. Hence, during the XI Plan period it is proposed that a **Planting Material Authority** under the aegis of Ministry of Agriculture is proposed to be established with the following objectives of

(i) To facilitate and monitor quality of planting material being produced and traded in the entire horticulture sector in the country,

(ii) To facilitate availability of genuine and quality planting material in different horticultural crops by accrediting nurseries and seed farms,

iii) To create guidelines for all plant propagation related activities in horticulture in the country,

(iv) To create awareness amongst people for adoption of improved varieties,

(v) To develop and facilitate linkages between planting material production systems in public and private sector and joint ventures and

(vi) To accredit, register and monitor all activity related to production of plants and seed of horticultural commodities. In nut shell the authority would be responsible for regulating norms, for quality in planting material, quarantine facilities, promotion of root stocks, trade norms, etc.

4.26 **Implementation of seed and nurseries act:** The seed act and nurseries registration act has been in operation since Dec, 1966. There are 21 seed certification agencies in the country at present. Currently National Seed Policy, 2001 provides frame work for ensuring growth of seed sector by providing farmers with superior planting material in a liberalized economic environment. However judicious control on production and distribution of plant material is lacking. These deficiencies are proposed to be cured in the Seed Bill 2004 introduced in Rajya Sabha by registering every horticultural nursery and adherence to certain rules and regulations by person holding registration of nursery. At present Nursery Registration Act is in force only in the states of Arunachal Pradesh, Chattisgarh, Goa, Jharkhand, Madhya Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Rajasthan, Sikkim, Tripura, West Bengal , while in some states some system of registering / monitoring exists.

V. BIOTECHNOLOGY

5.1 The last two decades have witnessed unprecedented technological advances in biological sciences especially in techniques of plant tissue culture, recombinant DNA technology and DNA based markers which have provided hitherto unthinkable approaches for harnessing genes of interest from across the biological systems even from those separated by sexual incompatibilities, for developing superior genotypes of different crops.Rapid multiplication of elite genotypes through micropropagation and refining as well as shortening the breeding process using marker-aided selection are the important technologies, which are already positively contributing to crop improvement programmes world over.

5.2 Micropropagation is the widely applied aspect of plant biotechnology and as a result over 100 tissue culture laboratories have been established in the country. Undeniably the most useful outcome of tissue culture has been in the micropropagation of ornamentals, fruits and plantation crops, MAP and forest trees. Laboratory research on micropropagation of plants of economic importance (Citrus, Eucalyptus, bamboo, teak, poplar, banana, turmeric and cardamom) has been scaled up to near commercial level. Tissue culture has been effectively used for multiplying and storing economically important, endangered (e.g. *Nepenthes khasiana*), threatened (Himalayan orchids) and biologically incompletely understood plants (Podostemaceae) and medicinal plants.

5.3 Micro-propagation is also being commercially exploited and some 1.5 million plants are being produced every year in banana, sugarcane, ornamentals, spices and medicinal plants. Commercial exploitation through micropropagation has become vital for improved crop production. The consumption of tissue culture plants for 2002-03 has been approximately 44 million plants with banana constituting about 41% share followed by sugarcane at 31 %, ornamentals at 14%, spices at 6% and medicinal plants at 4%. Micropropagation in banana is a success story. The demand for tissue culture banana is expected to increase by about 25 to 30 percent estimated to the extent of about 5.0

million every year by 2010. In 2011-2012, the anticipated demand for tissue cultured plant's would be 219.67 million plants against the installed capacity of 144 million plants

5.4 In the global scenario, ornamentals account for nearly 75%. At present most of the large commercial tissue culture laboratories are operative in states like Maharashtra, Karnataka, Kerala and Andhra Pradesh. Banana is the largest sold micropropagated fruit crop in India and abroad. Strawberry is also catching up in our country. Among plantation crops, cardamom has been successfully commercialized. The, major ornamentals produced through tissue culture are syngonium, chrysanthemums, dieffenbachia, gerberas, anthuriums, roses, orchids, lilies, gladiolus, etc.

5.5 There are several problems in commercial micropropagation like non-availability of proven and reproducible protocols in many desired crops, high production costs and sale price of tissue culture plants, Inadequate quality control of tissue culture plants, Inadequate availability and unorganized market of tissue culture plants, Proper demonstration and technology validation for exploitation on commercial scale and there is no control over genetic fidelity and freedom from viruses in tissue cultured plant.

5.6 Besides ICAR, DBT also has a strong programme on agricultural biotechnology with the focus on: Improving production and productivity; inducing drought and salinity tolerance; Inherent tolerance to pests and diseases and enhancement in nutritional qualities in crops like potato and banana. It has established Micropropagation units, Technology Parks (MPTs), High-Volume Hardening Units for tissue cultured plants, a National Facility for Virus Diagnosis and Quality Control of Tissue Culture Raised Plants at IARI, New Delhi and National Certification Centre for Tissue Culture Laboratories has also been established.

5.7 Most of the protocols developed are for herbaceous crop species and few for woody species. Hence, it is now felt that micropropagation protocols be refined for different crops like citrus, grape and apple rootstocks, pomegranate, guava, sapota besides walnut, litchi and some unexploited crops, where there is huge requirement of planting material. Commercial micro-prorogation of chip-making potato cultivars, all important ornamental crops and Medicinal and Aromatic Crops should continue with strengthening of the existing facilities both under public and private sectors.

5.8 **XI Plan programmes**: During XI plan it is recommended to

i. Establish National Centers for production of Virus-free Citrus Plants on the line of success achieved at the National Research Centre on Citrus, Nagpur and PAU Ludhiana/ Abohar in multiplication of disease-free citrus planting material. These centers should be replicated in different citrus growing belts at institution devoted to citrus R&D. a total of eight such centres are recommended. These centers provide with large net-houses for raising healthy rootstock seedlings and establishment of containment facilities for maintenance of virus-free scion variety stock plants. These centers are allocated a sum of Rs 1.1 crore each.

ii. The major cost involved in the production of tissue-cultured plant is the expenditure involved in hardening. To make the tissue-cultured plants available at affordable rate, the need is felt to establish large hardening facilities for tissue cultured plants in different horticultural crops located in different crop clusters. It is proposed that six new large scale hardening structures be installed in different regions having demand for nearly 15-20 million plantlets per annum of different horticultural crops. These centres be provided with Rs. 50 lakhs each for establishing semi-hardened tissue cultured plantlets and then supplying to the farmers.

iii. It is also proposed to establish a National Centre for Plant Disease Diagnosis in horticultural crops at IIHR, Bangalore with a grant of Rs. 200 crores to conduct research on disease management in different horticultural crops and

development of pathogen detection and their diagnostic kits. This centre will serve as a National Facility for the entire country to have provision for sharing facilities on hire for any study. There will a network of ten centres for production of Molecular Diagnostic kits for different diseases affecting horticultural crops. These centres should be given Rs. 1.0 crore each for creating these facilities.

iv. To strengthen the facilities for Horticultural Biotechnology and ancillary facilities at the different public sector undertaking, i.e. ICAR institutes and SAU's, 50 centres already involved in micro propagation should be strengthened with budget allocation of Rs. 200 crores to make available world class facility. .

v. A provision for Up-scaling of micropropagation activities in target horticultural crops at different centres in public and private sector is also recorded. The existing centres may be given financial support to create facility for large scale multiplication and hardening facilities.

VI. HI-TECH HORTICULTURE

6.1 High Density Planting: High density planting (HDP) is one of the methods to enhance productivity per unit area both in short duration and perennial horticultural crops. In perennial crops, it is more useful since it permits efficient use of land and resources, realising higher yields, net economic returns per unit area, easy canopy management suited for farm mechanization and cultural operations, efficient spray and weed control, improvement in fruit quality and easy and efficient harvest of high quality produce, etc.

6.2 There are five important methods to achieve HDP namely (a). Use of dwarf scion varieties; (b). Adopting dwarfing rootstocks and inter-stocks; (c). Efficient training and pruning, (d). Use of plant growth regulating chemicals; and (e). Suitable crop management practices.

6.3. There are several fruit crops where desired success has been achieved using HDP. These crops include apple, peach, plum, sweet cherry and pear among temperate fruits, and banana, pineapple and papaya among tropical fruits. In India, HDP technology has been successfully demonstrated in banana, pineapple, papaya and recently in mango, guava and citrus where two to three times increase in yields are realized. In plantation crops like cashew, coconut and arecanut, such dense plantings can best be adopted using multi-crop species cropping systems. These systems need popularization.

6.4 Some of the major concerns in adoption of HDP is that being an intensive system, requires high capital to establish though it is more productive and profitable, if followed scientifically. Non-availability of adequate planting material of dwarf varieties in different horticultural crops, except banana and non-availability of clonal rootstocks in some fruit and plantation crops are the major constraints in promotion of HDP. However, taking into consideration the need for doubling the production and productivity it is important that such intensive systems be adopted in India to replace the traditional planting densities and methods of fruit growing. The area expansion programmes under HDP need to be promoted among farmers.

6.5 Accordingly, the scheme for HDP promotion under NHM and TMNE should be continued with more budget allocation in targeted crops. This will also need to promote HDP systems along with micro-irrigation and fertigation methods standardized for different crops and agro-climatic conditions. The mono-species HDP is costly and technology-intensive, hence should be exploited for commercial sole fruit production. For small and marginal farmers, multi-species HDP approach should be standardized. In plantation crops, multiple cropping systems like coconut and arecanut with pepper; tree spices, tuber crops, banana and pineapple should be made popular in south India.

6.6 Use of Plastics: Plastics have several applications in commercial horticultural activities. These include drip irrigation; plastic film mulches; greenhouse structures; high and low tunnels; post harvest operations; etc. Use of plastics has proved beneficial to promote the judicious utilization of natural resources like soil, water, sunlight and temperature.

6.7 During the last decade, there has been a substantial increase in area under micro-irrigation and protected cultivation of different horticultural crops. The MI programme, which started as a subsidy scheme is now a demand driven enterprise in several states like Maharashtra, Karnataka, Andhra Pradesh and Tamil Nadu. As a result of these efforts, India is now one of the leading countries using micro-irrigation technology.

6.8 Drip irrigation has got maximum area under fruit crops followed by plantation crops. Among the crops, maximum adoption of drip system has been in fruit crops (35%) followed by plantation crops (18.5%). In fruits, the maximum area is under grape followed by mango, pomegranate and banana. This system saves irrigation water varying from 30 to 70% in different crops. At present, about 2,756.8 lakh ha have been covered under micro-irrigation, which can be further extended to 4,584.80 lakh ha with addition of 1,828 lakh ha during XI Plan. Continued support and subsidies grant to farmers for adoption on MI systems under different governmental agencies like NHB, NCDC, NABARD, nationalized banks, etc. should be given.

6.9 A small proportion of 1927.009 thousand ha under MI system is under sprinkler irrigation in plantation crops like tea and coffee. This system is more successful in undulating area and improves yield significantly and need to be popularized.

6.10 Precision farming: Precision farming can be defined as cultivation by adopting those technologies which give maximum precision in production of a superior crop with a desired yield levels and quality at competitive production. These include use of genetically modified crop varieties, micropropagation, integrated nutrient and water management, integrated pest management, protected cultivation, organic farming, use of modern immunodiagnostic techniques for quick detection of viral diseases and high-tech post-harvest technologies including cold chain.

6.11 To meet desired yield level in different horticultural crops, a network of 17 Precision Farming Development Centers (PFDCs) were established for conducting research and demonstration of different hitech technologies and also act as centers of excellence in research, training and demonstration. These centers develop technologies related to micro-irrigation, protected cultivation and mulching in different horticultural of the region.

6.12 During XI Plan, the PFDC centres were given additional fund for arranging human resource development activities through both short and long term demonstration and entrepreneurial trainings. The technologies adopted and developed are very popular with the growers and thus there is a vast scope in entrepreneurship development.

6.13 Protected cultivation: Protected cultivation of horticultural crops is production of high quality produce for internal and domestic markets. There are different types of protected structures being adopted by the growers based on the agro-climatic region and the availability of different inputs. Some of the most ideal regions in the country are the western and eastern India. In this region this technology is under maximum adoption for growing export quality gerberas, carnation, roses, etc. In vegetables, crops like pepper, tomato, cucumber, musk melon, baby corn etc. are successfully grown. In northern states, low polytunnel has been used to produce quality strawberries and high value vegetables.

6.14 During IX Plan, other plasticulture applications like greenhouse, shadenets, etc. also got momentum. Different pilot scale demonstrations were established by the State Governments/ Central Governments (SAUs /NGOs /Trusts (for their own land)/ ICAR

agencies and institutes. Several progressive farmers also adopted different schemes and started growing horticultural crops along with drip irrigation installation. Structure for low cost polyhouses, low tunnels, shade nets, etc. are been used local material to cut down the cost and make the technology affordable to marginal farmers.

6.15 Some of the polyhouses have cooling system to raise off season crops and therefore, require electricity for operation. Hence subsidy on power tariff for protected cultivation should be given by the state governments to make this promising technology commercially viable.

6.16. Mulching: Covering of soil around the root zone of plant with a plastic film is called plastic mulching. It is an effective means to restrict weed growth, conserve moisture and reduce the effect of soil borne diseases. Black plastic prevents the germination and growth of weed seeds. Mulching has been helpful not only in preventing moisture loss through evaporation from the soil and lowering the temperature but also reducing nutrient loss by leaching and weed control, reducing run-off, increasing penetration of rainwater, controlling erosion, correcting the chemical balance of the soil and reducing damage by pests and diseases.

6.17 Use of mulches has been demonstrated in both annual and perennial crops. At present, it is being adopted mainly in vegetable and few fruit crops. In India plastic mulching is yet to gain momentum. Inadequate awareness about the usefulness of mulching is one of the reasons. However, non availability of the mulch material in interior areas is another factor. Although assistance is being extended under NHM and TMNE programme for promoting plastic mulching, the coverage of area is meager in the country when compared to other countries like China. It would, therefore, be necessary to adopt an aggressive strategy during the XI Plan for promoting this technology through the ongoing schemes.

6.18 Integrated Nutrient Management: Integrated nutrient management (INM) refers to maintenance of soil fertility and plant nutrient supply to an optimum level for sustaining the desired crop productivity through optimization of the benefits from all possible sources of plant nutrients in an integrated manner. Nutrients are essential for productivity and quality of different fruit crops.

6.19 Addition of inorganic fertilizer constitutes one of the most expensive inputs in horticulture. However, their excessive and indiscriminate use has resulted in several environmental problems. Hence, to ensure high economic productivity and to sustain the available soil nutrient status at a desirable level, correct doses of manure, bio- and chemical fertilizers must be applied, based on use of reliable diagnostic tools. Considering energy, economy and environment, it is imperative that manures, bio- and chemical fertilizers should be used efficiently.

6.20 Integrated nutrient management system is the main focus of different of research programmes of ICAR through its AICRP projects on different horticultural crops. At present, the tissue nutrient based guides have been developed for crops like mango, banana, citrus, grape, guava, *ber*, pineapple, papaya, coconut, etc. It is important that these INM systems receive more focused attention in XI Plan to organize the entire horticulture under scientific nutrient management systems.

6.21 There is a need to strengthen the existing Tissue Nutrient Labs at different SAUs and ICAR institutes so that they can render services as referral laboratories for the entire production cluster/region. These centers will develop capability for analysis, diagnosis and recommendations on INM practices.

6.22 Among organic inputs, bio-fertilizers are commonly known as microbial inoculants that improve soil fertility and crop productivity. These are the beneficial micro-organisms which help in improved uptake and availability of different essential macro- and micro-nutrients, bio-control properties, enhanced growth, yield and quality, endurance to

abiotic stresses etc. It forms a key component in INM strategies. There is a demand for 76,500 thousand tonnes of bio-fertilizers in the next few years. However, there is a dearth in availability of bio-fertilizers and hence the programmes have to be initiated for multiplication and supply of bio-fertilizers.

6.23 Harnessing earthworms as versatile natural bioreactors is referred to as farmer's friend. The process of composting organic wastes through domesticated earthworms through domesticated earthworms under controlled conditions is vermin-composting. This sector needs to be promoted as a movement and accordingly programmes be initiated for establishing vermi-compost units during XI Plan.

6.24 Establishment of five National Bio-fertilizer Referral Laboratories is recommended to enhance production and quality certification for entire trade on bio-fertilizers in the country. Similarly, 12 National Network Centres on Bio-fertilizer Production may also be initiated. The National Bio-fertilizer Development Centre, Ghaziabad and its six centres should be strengthened for production of quality bio-fertilizers and organizing HRD trainings.

6.25 Integrated Pest Management: Integrated Pest Management (IPM) in agriculture aims at judicious use of cultural, biological, chemical, host plant resistance/tolerance, physical-mechanical control and regulatory control methods. Besides, it also employs bio-pesticides, antagonists etc. Different safe chemicals and bio-agents are employed in IPM and can effectively be used to minimize the risk of pesticide residues in fresh and processed produce.

6.26 IPM strategies include a number of components like use of safe pesticides, proper field sanitation practices, practicing deep tillage and optimum fertility management operations, adopting beneficial for agronomic manipulations like crop rotation, shifting of planting dates and crop duration, trap-cropping, conservation and utilization of natural enemies, destruction of alternate hosts, etc..

6.27 Due to the continued research by different institutions, there are different IPM and IDM packages available. Some of the technologies developed by different agencies on several horticultural crops have proven beneficial for the growers.

6.28 During the IX Five Year Plan, a central sector sponsored scheme entitled "Promotion of IPM in India" was implemented under which covers training programmes of 7 and 15-day on IPM were initiated as refresher courses for master trainers and Agricultural Extension Officers and farmers. The initiatives taken were strengthened during the X Plan through DBT sponsored training, demonstration and establishment of bio-control production plants in the country. These initiatives need further strengthening.

6.29 The Government has recognized the usefulness of biological control approach in the IPM programme. Presently, grants-in-aid @ Rs. 50 lakhs per laboratory in being allocated for creating mass production facilities.

6.30 For export oriented crops biological suppression alone may be used to produce pesticide residue free fruits, vegetables, spices and MAPs. Research should be strengthened on IPM for the development of cost effective and commercially viable mass production technologies of various candidate bio-control agents / bio-pesticides.

6.31 At present there is no proper monitoring of the quality of bio-control agents being produced and traded in the country. Hence, there is a need to establish two National Referral Laboratories for Bio-Control Agents be established during XI Plan. These centres will monitor the production, demand and give certification for the products being traded in the country. Besides they will develop new agents and technology for transport and storage of different products. Furthermore, there is a need to establish 14 Regional Centres for Demonstration and Promotion of IPM technologies in Horticulture.

6.32 Continue the financial assistance for strengthening accredited laboratories for mass production of bio-control agents and setting up of new units for the production of different agents so that these units continue to make available bio-control agents and bio-pesticides for use of farmers at controlled rates approved by the MoA.

6.33 There is also need to promote establishment of units for development of neem based pesticides in the rural sector to meet their growing demand in horticulture. During XI Plan period about 50 such units may be set up under the centrally sponsored scheme.

6.34 Mechanization: Non-availability of labour both skilled and unskilled is the main concern for the horticulture sector to make progress at the desired pace. This condition necessitates the role of mechanization and automation to bring about the required development. Need for mechanization starts with tools and machinery for filling of pots, digging of soil, application of fertilizers, weeding, spray of chemicals, training and pruning, protected cultivation, micro-irrigation, harvesting, washing, grading, sorting, packaging, processing, value addition, new product development, etc.

6.35 With stringent WTO and HACCP standards coming into force, it is imperative that production and post-harvest management systems in diverse horticultural crops gradually be made effective, safe and precision oriented.

6.36 Different machines have been developed for effective cultivation, intercultural operations, harvesting, grading, packaging and value-addition. These machines need to be popularized at farmers' level for providing subsidies. The different machinery ranging from sprayers and harvesters, potato digger, coconut peeler, etc. are gradually being popular.

6.37 There is a need for nursery automation for media preparation, budding and grafting, training and pruning, sprayers for different purposes, harvesting devices for perennial tree crops. Harvester for coconut, coconut tree climbing gadget, layout machines for tuber crops, pit diggers and harvesters, etc. for different horticultural crops to undertake different operations.

VII. ORGANIC FARMING

7.1 Organic Farming is mainstreaming in the country faster than expected. The factors attracting public and private attention include; increasing prospects of organic agribusiness trade because of increasing demand for safe food and an approach to sustainable development of farming based rural livelihoods in marginal areas and for small farmers. The first factor dominates the organic priorities of the developed world and the second factor dominates organic farming priorities of the developing world. Even though India is a late starter yet during the past five years organic farming and agribusiness option have spread across the country very fast. During the next five to ten years, India is likely to be able to convert about 10% of its agriculture into certified organic farming, it will have helped the farmers in the rain fed areas come out of the poverty trap and increase India's agribusiness share in the global trade, besides making it number one organic country in the world.

7.2 **Farming system:** The inherent characteristic of organic farming is that it encompasses the whole farming system, even if one was to focus on a sector like horticulture or a commodity, such as apple crop. Accordingly, either a farm is organic or it is not, even if the focus is on lead crops (horticulture cash crops). If the farmer is an organic fruit producer, the other food crops he produces will also be organic, and so will be his livestock husbandry system – the manure and milk he produces. Therefore, because of the strong inter linkages of this sector within the farming activities; the sector will be

better addressed in the five-year plan of the country if we target interventions to the organic farmers and organic area, rather than individual organic crops/ commodities.

7.3 During the X Five-Year Plan, organic farming was selected as one of the new areas for attention under National Programme on Organic Production, implemented by Ministry of Agriculture. A National Centre of Organic Farming was established by the Ministry to implement the scheme, which covers interventions like support to organic input industries, demonstration, training; support for service providers to help train farmers in organic farming techniques; support for Model organic farms and market development and promotion. A budget of Rs 57 crores was allocated to this scheme.

7.4 As a result of these interventions, organic agriculture has made unexpectedly high growth during the XI plan period. It is a combined effect of farmers efforts, Govt interventions, NGOs work and market forces that Indian organic movement has reached a stage where it can swiftly move to occupy the desired space in Indian agriculture, which was left as a vacuum by the green revolution. Today, India is among the few countries alongside EU, US, Japan, Brazil, Argentina, and Switzerland which have adopted organic standards and put in place an inspection and certification mechanism.

7.5 Nine states of India have promoted policies and programs on Organic Farming. While, Uttarakhand made organic a thrust area for improving mountain agriculture based farm economy and livelihood, Mizoram, and Sikkim declared the intentions to move towards total organic farming, even without necessary infrastructure, human resources and programmes. Karnataka formulated organic policy and Maharashtra, Tamil Nadu and Kerala supported public private partnership for promoting organic farming.

7.6 From the viewpoint of commodities, India today produces range of organic products from fruits and vegetables, spices to food grains, pulses, milk and organic cotton. In addition India produce also includes wild harvest of medicinal, aromatic and dye plants. Some of these are organically cultivated and exported. While data for export commodities is available the data on domestic availability of organic commodities still relies on best guesses of stakeholders. Organic foods are definitely emerging, with organic retail stores, super markets and packaged deliveries visible in big cities and small towns.

7.7 To create the domestic market for organic produce, the so called pull factor, is still missing because of low awareness among consumers about food safety and also because of lack of access to organic products, not because of production per se but because of weak supply chain systems, at present. Organic producer is looking for the market to get good price and quick sales but is partially successful. The organic retailers are looking for constant supplies, specially of fruits, vegetables, and food grains, which they do not know from where to get, and the prospective organic consumer does not have an easy access to organic products so far.

7.8 National Commission on Farmers has identified it as a tool for second green revolution in the rain-fed and hilly areas of the country. Keeping in mind the need for scaled up public interventions to promote organic farming , the commission estimated the need for investing over Rupees 2500 crores during the XIth five year plan. The Commission has made a recommendation that 25,000 Organic Villages with niche commodities should be developed in the hills during the next five years, and the local farm graduates and youth be involved in it. The Commission has observed the institutional infrastructure for promoting organic farming in the country is as yet far from satisfactory. Commission has recommended that a focused national movement on organic agriculture be launched, for mainstreaming organic farming in the national agriculture economy.

7.9 The Working Group, concurs with the recommendations of the National Commission on Farmers and has made it a basis for designing and proposing the 11th plan programme on organic farming. The objectives of the organic sector plan in XI Plan include ;

i. to make India number one organic country in the world in next ten years

ii. to convert five million hectares of farm land and 5 to 6 million organic farmers into organic, during the XI plan period

iii. by the end of the XI plan, produce Rs 15,000 crores worth of organic commodities; wherein 80% production is for domestic and 20% for export.

iv. to increase self employment opportunities through organic enterprises

7.10 Investment of Rs 2500 crores is proposed during XI plan in organic sector, in the following four areas;

i. farm conversion to organic and production processes

ii. developing organic supply chains for domestic market

iii. developing supply chains for export market

iv. human resource development and institutional capacity building

v. awareness promotion and developing policies, strategies, standards and regulations

7.11 **Institutional Setup:** However, this investment and other initiatives in this sector may not yield desired results because they face a key constraint in the absence of proper national institutional set up that can take care of all aspects—promotion, research, development and regulation of standards and trade. Today there are many players and as many stakeholders. Ministry of Agriculture, ICAR, Ministry of Commerce, National Steering Committee on organic farming, organic farmers associations, NGOs and above all new business houses coming up as investors for organic retail and exports. Further, International developments in organic regulations, trade and development promotion demands that India creates such a body so as to represent and take care of national interests in such fora and formulate comprehensive national strategy.

7.12 It is therefore, will be in the best interests of the country to create an umbrella organization " National Mission on Organic Farming". This national mission should have a wide mandate and be autonomous in functioning to serve all stakeholders from organic producer to consumer, international cooperation and trade regulations, setting and maintaining standards etc."

7.13 The focus of this organization may include,

i. to improve food and income security of small and marginal farming families through organic farming;

ii. to open up employment / self employment opportunities for educated youth through small and medium organic enterprises

iii. to enable India take its share of global organic market , and provide safe and nutritious food supplies to domestic consumers

iv. to ensure ecological and economic sustainability of Indian agriculture through organic farming

7.14 The Mission may also serve as

i. Watch dog and representative body for domestic and international developments in organic sector, specifically standards and trade regulations. It is recommended that this body facilitates creation of National Federation of Organic Stakeholders and support their operations so as to maintain organic relationship with it as feedback organ. Federation should be playing a strong advisory role to the national mission.

ii. Institutional Infrastructure development; formulating national policies, regulations and standards for organic farming promotion and regulating trade in organic and for monitor and implement all these aspects. Have the capacity to offer services to states in developing their respective organic policies, plans, policies, strategies and infrastructure; Resource planning and management; prepare investment plans, such as 5 year plan programme development and implementation of the country for organic farming and agribusiness development and monitoring and implementation of its schemes.

iii. The mission may also be made responsible to assess the needs, plan and implement such programmes which strengthen physical facilities for enhancing organic agribusiness in the and of the country.

iv. Organic Research, Technologies and Human Resources Development; it should create or be able to hire a pool of expertise in all sectors of organic so as to offer services on demand to government and private institutions/ agencies.

7.15 Organizational Structure of the Mission should be such that it should appear competent in all sectors of organic farming *viz.,* policy, planning, professional & technical aspects, trade and regulations areas. It should be able to maintain autonomy in functioning able to interact, coordinate and direct central ministries, departments as well as states on common interest programmes and issues. Led by a Chief Executive Officer of the rank of Secretary (official or non official) it may consist of a board of professionally competent members for each of the above-identified areas. This new body may facilitate merger of various institutional set ups initially created for organic farming and agribusiness promotion under different ministries, such as National Centre of Organic Farming, National Steering Committee on organic farming, APEDA programme in organic agribusiness promotion, Horticulture Board and NHM programme on organic commodities promotion etc.

VIII. POST HARVEST MANAGEMENT

8.1. **Post harvest losses** occur at each and every step of the value chain. The losses at the farm level occur due to improper harvesting methods, handling techniques and aggregation of the produce and then in transportation. At the wholesaler level the major losses occur due to rough handling and inappropriate storage. Losses at the retail, service and consumer levels are estimated at approximately 20 per cent in developed countries and about 10 per cent in developing countries.

8.2 Mechanical injury is a major cause of losses. Many of these injuries can not be seen at the time when the product is packed and shipped, Severe water stress results in increased sunburn of fruits, irregular ripening of pears, tough and leathery texture in peaches, and incomplete kernel development in nuts. Chilling injury is manifested in a variety of symptoms including surface and internal discoloration, pitting, water soaking, failure to ripen, uneven ripening, development of off flavors and heightened susceptibility to pathogen attack. Human and/or animal faeces are the source of microbial contamination of fresh produce; whenever water comes in contact with produce.

8.3. **Post harvest infrastructure:** It was from the Eighth Plan onwards that attention was

paid towards development of post-harvest infrastructure in the country. As a result the National Horticulture Board, was set up by Government of India to provide technical and financial support for creation of post-harvest infrastructure for horticultural crops. Other organization like Directorate of Marketing and Inspection, NCDC, APEDA, Ministry of Food Processing Industries, have also been implementing a number of schemes to strengthen post-harvest infrastructure for horticultural crops.

8.5 At present there are 11 grading and packing centres in Himachal Pradesh with an installed capacity of 37,500 tonnes. Similarly, Jammu and Kashmir has also developed apple grading/packing centres in Srinagar, Baramulla, Kupwara, Anantnag, Pulwama and Budgam. Walnut Hulling and Drying centers of 500 tonnes capacity each have also been set up in Anantnag, Pulwama and Budgam.

8.6 Maharashtra is not only the leading state in production of important fruits like mango, banana, grape, orange, pomegranate, onion etc but also leads in creating post-harvest infrastructure in the state. In Punjab, PAGREXCO has set up five mechanical sorting, grading, waxing centres with capacity of 2 MT/hour for kinnow at Hoshiarpur, Badal, Baluana, and Tahh Waterjalam. The APEDA, has also recognized 106 pack houses in different states which have facilities of international standards for grading and packing of fruits and vegetable particularly for exports. There are 4541 cold storage units in the country and 81.23% of the total capacity of cold storage in country is utilized by single product, i.e. potatoes.

8.7 In Uttar Pradesh, agri export zones for mango at Lucknow and Saharanpur and for potato at Agra have been developed.

8.8. Technology **Support:** Management of harvesting operations, whether manual or mechanical, can have a major impact on the quality of harvested fruits and vegetables. Some harvesting gadgets have been developed, e.g. mango harvester in Lucknow (CISH), Bangalore (IIHR) and Ratnagiri (KKV). These need to be popularized among the fruit growers. Curing which is conducted immediately after harvesting strengthens the skin. A simple post harvest treatment that involves hot water spray at temperatures of 50–60^{0}C while the fruits are brushed (hot water brush) in mango significantly reduces decay development caused by *Alternaria alternata*.

8.9. Gamma irradiation is an important emerging technology for extending post-harvest shelf life of various products, making them free from insect and pests, bacteria, fungus etc. Clearance has been given for radiation processing of spices, onion, potato and fresh fruits. This has opened up tremendous opportunities for commercialization of this technology in the near future. The Government of India is already promoting the post harvest sectors by various schemes. Assistance up to Rs. 5.00 crores is available for setting up irradiation units by Central/state Government organization. This programme needs to be continued in the XI Plan.

8.10 **Value addition** which in simple terms denotes – to make things valuable or important in terms of economic gain, time and money saving in preparation, quantity and quality improvement or modification of raw ingredients for specific desirable characteristics is also assuming lot of importance. In India, less than 2 per cent of fruits and vegetables produced are processed as against 65 per cent in the US, 70 per cent in Brazil, 78 per cent in the Phillipines, 80 per cent in South Africa and 83 per cent in Malaysia.

8.11 The value addition is only 7 per cent in India as against 23 per cent in China and 88 per cent in UK. There has been unprecedented increase in export of some fruits like mango, walnut and grape in the last few years. There are still many more fruits, which have potential for export. Some of these are bael, aonla, jamun, sapota,

jackfruit, custard apple, ber, kokum, pomegranate etc. The production of frozen peas, garlic and ginger paste, tomato puree, mango pulp etc. has been taken up in a big way only recently in India.

8.12. **Recent Reforms in PHM programmes:** In the scheme on backward linkage, assistance is available up to 10% (subject to a maximum of Rs.10 lakhs) of the cost of total raw materials purchased in a year from the existing limit of 5%. The minimum period of contract has been reduced to one year and the assistance is available for a maximum period of 5 years instead of 3 years.

8.13. The APEDA under the Ministry of Commerce is also implementing scheme of Agri Export Zone which attempts to take a comprehensive look at a particular produce/ product located in a contiguous area for the purpose of developing and sourcing the raw materials, their processing/ packaging, leading finally to exports.

8.14. At present a number of schemes are being operated separately by Government of India, Ministry of Agriculture, National Horticulture Mission, National Horticulture Board. APEDA under the Ministry of Commerce and Ministry of Food Processing. They cater to different components of post harvest infrastructure. It is necessary to bring in synergy between these programmes to prevent the overlapping of the programmes and benefits.

8.15. **Proposed infrastructure:** Common infrastructure facilities for sorting, grading and packing as well as post harvest treatment as required should be created at all the major seaports and airports for exports and major terminal markets for domestic marketing.

8.16. The present capacity of cold storage in the country is only 18.21 million tonnes as on 31 December 2003 which is only 12.49 % of the total horticultural production of 145.78 million tonnes. Thus, by adding 1,400 packing and cold houses in different states, additional capacity of 1.4 million tonnes would be added.

8.17. Shortage of quality packing material in specialized production zone is being realized since long. By setting up 800 additional such units, the demand for packing additional fruit and vegetables may be met out.

8.18. **R&D should be strengthened** in public / private institutes with focused funding and training of manpower at centers of excellence in India & abroad. R&D by private industry at government institutes may be funded up to 40% of the actual cost of project subject to a limit of Rs 10 lakh. Technology results should be shared with funding agency and be a national asset. Such centre will also impart training to the farmers, traders, semi-skilled workers, technician and supervisor pertaining to their marketing problems.

8.19. For **capacity building**, the central institute, like CISH, CFTRI, NIAM, CIPHET, IIHR, selected IIT'S and IIM's and State Agricultural University should offer specialized post harvest management and technology courses (diploma / degree) and short-term courses for operatives of the cool-chain.

8.21 An out lay of Rs. 35,000 crore will be needed to implement the proposed PHM programme during XI Five Year Plan.

IX. MARKETING

9.1 **The present marketing system** of horticultural produce in the country, particularly for fruits and vegetables, lacks system approach. Producers have often failed to realize expenses incurred for their transportation to markets, let alone the cost of production and capital investment, during the period of glut. Fruit and vegetable growers receive only a small part of price paid by the consumers as lion's share is

being taken by chain of middlemen. The high profit margin of intermediaries is quite disproportionate to their services.

9.2 There are 3 **types of markets**, which play a prominent role in organized marketing of fruits, vegetables and flowers these include Farmers' markets/village haats, Assembly markets, terminal markets and regulated markets.

9.3 Market orientation: There is a necessity to integrate farm production with national and international markets to enable farmers to undertake market driven production plan and adoption of modern marketing practices. If agricultural markets are to be developed in private and cooperative sectors, and to be provided a level competitive environment vis-à-vis regulated markets, the existing framework of State AMPC Acts will have to undergo a change although some of the states have already changed the act.

9.4 Alternative marketing mechanism: The state has to facilitate varying models of ownership of markets to accelerate investment in the area and enable private investment in owning, establishing and operating markets. Working of existing government regulated markets also need to be professionalized by promoting public private partnership in their management. Appropriate legal framework is also required to promote direct marketing and contract farming arrangements as alternative marketing mechanism.

9.5 Constraints: There are several constraints in marketing. Though agricultural production is largely free from controls, the same is not true of marketing and processing agricultural commodities. The State Governments alone are empowered to initiate the process of setting up of markets for agricultural commodities in notified areas. Processing industries cannot buy directly from farmers, except through notified markets.

9.6 Processed foods derived from agricultural commodities suffer from multiple taxes at various stages starting from harvesting till the sale of final processed products. There are stringent controls on the storage and movement of several agricultural commodities. In the present situation it is important to make the present marketing system more effective and efficient by removing unnecessary restrictions and by establishing a sound framework to reduce uncertainty of the markets. The State Agricultural Produce Marketing Regulations Act (APMC Act) and the Essential Commodities Act (EC Act) are important legislation that have to be amended in various states to remove restrictive provisions coming in the way of an efficient and competitive marketing system.

9.7 The scientific storage capacity is only 30 percent of the required capacity. Cold storage facility is available for only 10 percent of fruits and vegetables. Transportation and handling facilities for perishable commodities are inadequate and poor. The processing capacity is also inadequate and mostly inefficient. Physical infrastructure in market yards is inadequate. Most of the rural primary markets have no infrastructure. Due to lack of proper handling (cleaning, sorting, grading and packaging) facilities at the village level with about 30 percent of fruits and vegetables and 10 percent of spices are lost before reaching the market.

9.8 **Direct marketing** by farmers is being encouraged as an innovative channel. Some examples of these channels are Apni Mandi, Hadaspar Mandi, Rythu Bazars; and Uzhavar Sandies. These channels are mostly adopted in sales transactions of fruits, vegetables and flowers, which are highly perishable. In this channel, the produce moves quickly from farmers to consumer due to lack of middlemen. If farmers directly sell their produce to the consumers, it will not only save losses but may also increase farmers' share in the price paid by the consumer.

9.9 **Grading:** There is a huge infrastructural gap in the existing marketing system of the

country, which needs to be addressed through requisite measures during the XI plan period. Grading at primary market level is grossly inadequate. There are only 1968 grading units at the primary level, which include 587 units with cooperatives and 298 units with others. At the level of regulated markets, there are only 1093 grading units in a total of 7557 market yards/sub-yards. Only around seven percent of the total quantity sold by farmers is graded before sale. During 2004-05, 6.62 million tonnes of agricultural produce and 26.1 crore pieces valued at Rs 6224 crores were graded at primary market level.

9.10 **Forward and future marketing:** In the light of the perceived advantages from forward and future markets in terms of price discovery and risk management, as market based instruments, such markets have been identified as important tools of price stabilization. Extension of forward and future markets to all major agro commodities has, therefore, assumed great importance. Only if the markets are allowed to function under proper regulatory environment, the agricultural economy - one of the largest in the world - can fully exploit the benefits of markets in the state, country and abroad.

9.11 **Levies:** The present system of levy of fee at multiple points for the same commodity at different stages of transaction needs to be replaced by single point levy of market fee in the entire process of marketing in the State. Further, collection of market fee should be more in the nature of service charge based on the quality of services provided. The levy of fee can be at different slabs inconsonance with the type of scale of services/facilities provided to all market users.

9.12. **Marketing strategy:** To facilitate both the Government as well as the private sector in planning development of an appropriate marketing strategy in agriculture sector, it would be necessary to create at national level an 'Atlas of Agricultural Markets' which would provide information in respect of each commodity, major areas of production, movement and storage and of market and consuming centers.

9.13 Training and extension system in agriculture marketing will have to sensitize and orient the beneficiaries to respond to these challenges. Knowledge has to be imparted at the grassroot level in areas such as market driven production program, post harvest management of horticultural crops, availability of marketing finance, information on facilities for quality assurance and standards, grading, packaging, storage, transportation, contract farming, direct marketing, alternative markets including Forward and Futures markets, commodity exchanges, online market information system etc.

9.14 **Contract Farming** is becoming an increasingly important aspect of agribusiness, whether the products are purchased by multinationals, smaller companies, Government agencies, Farmer Cooperatives or individual entrepreneurs. Contract Farming concept, has, however, gained importance in recent times in the wake of the economic liberalization process. The main feature of Contract Farming is that grow select crops under a buy back agreement with an agency engaged in trading or processing. There are many success stories on Contract Farming such as potato, tomato and chilli in Punjab, Oil Palm in Andhra Pradesh, and seed production contracts for hybrids seed companies in Karnataka and Punjab, which have helped growers in realization of better returns for their produce.

9.15 The Government may work out a farmer centric 'Code of Conduct' for contract farming arrangements, which should form the basis of all contract farming agreements and also encourage development of farmer's groups/organizations to negotiate with the purchasers and take care of the interests of the small farmers. Till such time a cautious approach is needed towards contract farming in India.

9.16 The **amendment to the APMC Act** should be vigorously pursued and assistance under plan schemes for agriculture/ horticulture marketing should only be extended to States, which have carried out the amendments in the APMC Act in letter and spirit. All restrictions on storage and movement of all agricultural produce under the Essential Commodities Act should be removed.

9.17 **The warehouse receipt system** should be introduced, The Forward Contracts (Regulation Act) should be expeditiously amended. There should be rational riders on physical delivery in future markets. At present, futures are allowed for six months. These should be extended at least to 12 months so that full crop marketing year and its seasonality is covered.

9.18 Market fee needs to be converted into service charge and should be levied on produce which is brought to the market yard.

9.19 **Licensing system:** Private sector entrepreneurs are compelled to get multiple licenses in each marketing zones. Hence, single licensing system should be introduced for setting up of Private Markets and large number of Procurement Centers within one State. The companies should preferably have an end use for the produce under Contract Farming – either for processing, retailing or for export. Incentives should be given to the sponsoring companies for disseminating technical knowledge or introduction of new technology. Contract Farming tenures should be permitted for a relatively long period of 3-5 years or more.

9.20 **XI Plan Programmes** : It is estimated that the basic amenities can be provided in **village haats** markets at an average cost of Rs.9000 per haat. Government needs to take up this scheme urgently for providing basic amenities in these haat's with a 100% grant.

9.21 **Wholesale markets:** Although Rs.150 crores has been kept for setting up of wholesale markets under the NHM, it has not made any significant headway as yet. The scheme needs to be amended and privatization of wholesale markets and participatory management models need to be encouraged.

9.22 **Primary Processing Centers :** Considering the number of villages in the country in the form of clusters, 50,000 primary processing centers can be proposed to be created after actual assessment depending on the production potential of the area. Each center is estimated to cost Rs.15 lakhs. Cold storages with facility of built in pre-cooling, high humidity and controlled atmosphere for storage of produce for a longer period are essential for effective marketing of the perishable horticultural produce. Integrated pack houses catering to farms in respect of regions around 5,000-10,000 hectare for washing, sorting, grading, packing, cold storing etc should be established. For direct marketing through kiosks in the market yards need to be established across the country.

9.23 **Communication networks in markets**: Efficient communication is the key to marketing. Therefore there is an urgent need to establish a strong network of communication in the rural and urban markets for effective information flow. Similarly there is a need to improve rural connectivity with modern roads and links.

9.24 **Apni Mandis** in different states need to be established at least in every district. Flower markets need immediate improvements to protect the losses in handling and transportation. At least one modern state- of -art flower market is required to be developed near each major metropolitan cities.

9.25 Proper market infrastructure for medicinal and aromatic plants is required in the states of Kerala, Chattishgarh, MP, Uttarakhand and North Eastern States. About 500 such markets are required to be developed in these States.

9.26 It would be desirable to promote organized retail chains for fruits and vegetables in urban centers through promotion of entrepreneurship amongst the educated unemployed youth in urban areas to cater to the urban consumers' daily need necessities in better organized hygienic and efficient manner. Such organized retail chains should be equipped with cool chambers and other facilities to maintain the freshness of the products as well as to minimize deterioration.

9.27 There is need to create massive infrastructure in the form of specialized cold storages for different commodities, integrated pack houses and Electronic trading Priority needs to be given for rural periodic market, cold storages, reefer vans/ containers, cleaning, grading and packaging facilities, terminal markets centres for perishable cargo (CPC) and market information system.

X. EXPORTS, IMPORTS AND WTO

10.1 **Horticulture:** Horticultural crops occupy about 8% of gross cropped area and account for 30% of agricultural GDP. However, the presence of India as an exporter of horticulture products is insignificant. India's share in global horticulture trade was a mere 0.5% in 2004 as per a recent World Bank study ($ 575 million compared with a global trade of $ 108 billion).

10.2 India is exporting fresh fruits, vegetables, processed products of fruits and vegetables, cut & dried flowers, medicinal and aromatic plants, seeds, spices, cashew kernels and their products, tea and coffee. The total value of export of these commodities increased from Rs.29,723 million in 1991-92 to 64,450 in 2001-02 to 1,24,175 million in 2005-06. Horticulture produce and products account for about 35 per cent of the total value of exports of agricultural commodities from India during 2005-06. Of these, export of cashew leads all horticultural commodities followed by spices, tea and coffee. During the past one decade, the maximum increase in exports was observed in floriculture

10.3 Fresh fruits and vegetables comprise almost 35% of the world trade in horticulture, out of which, almost two-third is accounted for by four items, namely, citrus, banana, apple and grape. The other important items are mango, papaya and kiwi. Among the vegetables, which account for about 22% in the world trade in horticulture, the major items are tomato, onion, potato, bean, pea, mushroom, asparagus and capsicum. While the basket of India's fresh and processed horticultural export products is very diverse, only a few products account for a large share of total earning. Five commodities namely fresh onions, mango pulp, processed gherkins, fresh grapes and fresh mangoes together account for about half of the total horticultural exports.

10.4 **Fruits**: Among fruits only a handful of commodities or products account for the bulk of our export trade. While India is one of the largest producers of mango, banana, grape and litchi the vast majority of its output is consumed domestically, India's share of global exports is only 0.3% for fruits. However, fresh fruits make up around 11% of India's horticultural exports. Grapes and mangoes account for close to 60% of India's exports of fresh fruits.

10.5 **Vegetables:** Among vegetables, exports of fresh vegetables including onions during 2005-06 were of the order of Rs 919.8 crores out of which onions contributed to Rs 621 crores. Other major export products are mushrooms, green peas, brinjal and okra. Major markets for Indian vegetables include Bangladesh, Malaysia, UAE, Sri Lanka and Nepal.

10.6 **Processed Fruits and Vegetables:** Processed fruits and vegetables account for about 20% and 17% of the world horticultural trade, respectively. Among the processed fruits, 41% trade is of fruit juices and 12% of dried fruits. Similarly, among

processed vegetables, the major items are mushrooms, gherkins and frozen pre-cut vegetables. Major processed fruit exports include mango pulp, which accounts for close to 50% of the value of this category as well as pickles and chutneys from various fruits including mango. Gherkin, dehydrated onion, and mixed frozen vegetables account for 60% of processed vegetable exports. In 2004, exports of processed fruits and vegetables accounted for 19% and 31% of total horticultural exports respectively. The major markets are Bangladesh, Sri Lanka, USA, UK and UAE besides other countries of the Middle East.

10.7 **Floriculture**: Floriculture trade is approximately 6.3 billion US Dollars, of which cut flowers are about 86%. The value of exports of floriculture products from India has shown significant growth, from Rs.18.83 crores (1993-94) to Rs.210.00 crores (2004-05). The dried flowers and other plant parts contribute to about 70% of the exports in the floriculture segment. India is still a marginal player in the world floriculture trade indicating strong potential that can be exploited in this sector. Major markets for Indian floriculture products are USA, The Netherlands, UK, Germany and Japan

10.8 **Seeds and Planting Material:** India is also an exporter of seeds of fruits and vegetables. The export during the year 2004-05 has been of the order of Rs 63 crores. The major markets are USA, Pakistan, Japan, Bangladesh and The Netherlands.

10.9 **Medicinal and Aromatic Plants:** India at present exports herbal materials and medicines to the tune of Rs. 446 crores only while it has been estimated that this can be raised to Rs. 3,000 crores by 2005. The Chinese export based on plants including raw drugs, therapeutics and other is estimated to be around Rs.18,000 to 22,000 crores. In view of the innate Indian strengths which interalia include diverse eco-systems, technical and farming capacity and a strong manufacturing sector, the medicinal plants area can become a huge export opportunity after fulfilling domestic needs. Apart from requirement of medicinal plants for internal consumption, India exports crude drugs mainly to developed countries, viz. USA, Germany, France, Switzerland, UK and Japan, who share between them 75 to 80 percent of the total export of crude drugs from India. The principal herbal drugs that have been finding a good market in foreign countries are Aconite Aloe, Belladona, Acorus, Cinchona, Cassia tora, Dioscorea, Digitalis, Ephedra, Plantago (Isabgol), Cassia (Senna) etc.

10.10 **Spices:** Indian spices account for more than 5% of the total agricultural export earnings in the country. More than 0.30 million MT (10-12% of the total spices production) of spices are exported annually to more than 150 countries around the world. World trade in spices is of the order of 7.50 lakh MT valued at 1650 million US $. According to Spices Board, India commands a formidable position in the World Spice Trade with 43% share in volume and 31% in value (2005-06). It is estimated that, with a variety of spices in its production list almost one half of the world demand is being met by Indian exports. The share of value added products in spices is estimated at 66% of the total spices export. But most of this was low end value addition. There is both need and potential for increasing the relative share, more particularly in the case of value added spice exports.

10.11 In India, spices exports have been consistently moving up during the past years. Spices exports have registered substantial growth during the last fifteen years with an average annual growth rate of about 7%. It has increased from 109,636 MT valued at US $ 135 million in 1990-91 to 320,527 MT valued US $ 518 million in 2005-06

10.12 **Cashew:** India has been exporting the cashew kernels since early part of 20th century. Export earnings have been on the increase since 1985. India has earned an all time high export earnings of Rs. 2,709 crores during 2004-05.The country is at present exporting annually about 1.27 lakh MT of cashew kernels worth over Rs. 2,500/- crores. Cashew industry also provides employment to over 5.5 lakh

workers annually, mostly women. Between 1980 and 1985, although export earnings increased, quantity of cashew kernels exported decreased. Since 1985, there is a steady growth in the quantity of cashew kernels exported.

10.13 **Cocoa:** Though India has gained foreign exchange by way of export of cocoa products, cocoa of beans are also being imported. Cocoa Industry in India has expanded to a considerable extent in the current decade. At present there are more than 15 companies in the field. These have the capacity to process about 30,000 MT of cocoa which present availability is only 30%. In addition to utilizing the domestic products, import of dry beans to the level of 4,000-6,000 MT along with other cocoa products is also taking place to cater the needs of the industry. During 2005-06, India earned a foreign exchange of Rs.24.80 crores by exporting cocoa beans/cocoa products, whereas it imported cocoa beans, paste, butter, powder etc from other cocoa growing countries at a cost of Rs.112.865 crores to meet indigenous consumption and export.

10.14 **Coconut:** The global exports of coconut products during the last 15 years have shown decrease in exports of copra, copra meal; marginal increase in coconut oil, desiccated coconut and shell charcoal while significant increase in coco chemicals, activated carbon and coir and coir products. Coco cream and coco powder have been a major addition in export of coconut products during this period. India's export earnings from coconut and coconut products have been increasing at a compound growth rate of 12.40 per cent per annum. The rate of growth in the import of coconut products is nearly the same being 13.50 per cent per annum. Among the commodities in the export basket, coir and coir products account for the bulk of exports from this sector. Coconut oil and other coconut products make a very negligible contribution. This is mainly on account of the fact that the domestic prices of coconut products generally rule above the international price

10.15 **Coffee:** Coffee is the second largest traded commodity in the world next only to Petroleum. In India, coffee is predominantly an export-oriented commodity and over 70% of the coffee produced in the country is exported and the balance quantity is consumed within the country. There are 70 processing centers licensed by the Coffee Board and about 300 registered exporters. Consequent to liberalization, the marketing of coffee is carried out entirely by the private sector.

10.16 Export of coffee went up from the level of 1.80 lakh MT to over 2.4 lakh MT during the IX Plan period. The growth is mainly due to the highly favourable and remunerative prices prevailing in International terminals on account of demand supply mismatch owing to drastic reduction in production in Brazil because of frost damage. During the formulation of X plan, similar ambitious targets, both in terms of production (10% growth in Arabica & 5% growth in Robusta) and exports (7% in Arabica & 4% in Robusta) were envisaged. In effect, the original X plan production target was fixed at 4.2 lakh MT, of which, 3.30 lakh MT was to be exported and the balance 90,000 MT was for domestic consumption

10.17 **Rubber:** Rubber-based manufactured products sector is one of the few sectors for which India has positive trade balance. Exports of rubber products from the country during 2004-05 were Rs 31,990 million. In export of Natural Rubber, though India is a new entrant, the country holds 1.1 percent of the global share compared to the global share of only 0.8 percent in the total merchandise exports of India. Export of natural rubber from India rose from the low level of 6,995 MT in 2001-02 to 5,5311 MT during 2002-03 and 75,905 MT during 2003-04. Against a target of exporting 102,000 MT during the Tenth Plan, 1,77,385 MT was exported from the country during the first three years itself. During 2005-06, though the financial incentive for NR exports was withdrawn and the international prices remained unfavourable for about three

months, the quantity exported was 73,830 MT. Total export up to 2005-06 is 2,58,191 MT.

10.18 **Tea:** Until 1987-88, tea was the most significant item of agricultural export from India accounting for 20.7% of agricultural exports. Disintegration of the then USSR and loss of other hard currency markets adversely affected the Indian export over the last 20 years. India's world ranking as an exporter has come down from number one to number four, in the face of stiff competition from Sri Lanka, Kenya, and China Presently, tea export constitutes about 0.5% of total commodity exports and about 5% of total agro-export. The export of Tea during 2005-06 was Rs 1,632.09 crores

10.19 **Imports:** The import value of all horticulture products in 2003 was of the order of USD 1.06 billion. There has been about three-fold increase in the last one decade, which is attributed mainly to the phasing out of quantitative restrictions starting in the second half of the 1990s. Imports of fresh fruits, especially apples, have risen considerably by more than 245% per annum between 1997 and 2003, of course, on a small base. Growth has also been rapid for certain processed food products like apple juice and dried vegetables, though the single most dominant item in this category continues to be dried peas.

10.20 The imports, in case of some items has increased in the last few years for example the apples. The trade has reported that about 1000 containers of apple were imported for Diwali gifts in 2006. However, import penetration remains insignificant in terms of the share in total consumption. For fresh fruits, it is less than 0.1% of domestic production, and is also negligible for most fresh vegetables.

10.21 Import volumes for some products have risen at times when world prices are stable or rising. For example, in the case of dried peas, periods of high imports have been associated with higher prices. Similarly, for both apple and grape, the fastest growing items in the fresh fruits category, unit prices have been higher on the average in the post – 2000 period than in the preceding decade. From this, it seems clear that increasing import volumes are more reflective of demand conditions in India, than changes in international supply.

10.22 India though a major producer of spices can only export around 7% of its production due to the high domestic demand. In some traditional items like pepper, where India was once a major player, the situation is drastically changing to make India a major importer

10.23 India produces annually about 5.4 lakh tonnes of raw cashew nuts. However, India needs about 11 – 12 lakh tonnes of raw cashew nuts per annum for feeding over 1700 cashew processing units. In order to meet the requirement of the processing industry, India imports annually about 5-6 lakh tonne of raw cashew nuts from African and other countries. Since African countries have taken for cashew processing them selves, availability of raw cashewnuts for importing by India may gradually decline or may all together stop. Hence, there is urgent need to increase the domestic raw cashewnut production and become self sufficient in raw cashew nut production. To increase production cashew cultivation need to be promoted in Chattishgarh or waste lands available to certain extent in coastal regions and some non-traditional areas. Hence, it is essential to increase productivity per unit area.

10.24 India is also importing commodities like arecanut and cocoa, which are draining the foreign exchange. Since ample potential exists in the country for the production of these crops, efforts need to be made to improve their productivity.

10.25 Imports of NR into the country surged during the first quarter of 2005-06 because the domestic prices during the period were higher than the international prices. But, by the end of June, the domestic prices came below the international prices and the gap between the two progressively widened. However, imports continued against

contracts made during the first quarter when international prices were lower than the domestic prices. Import of NR up to 2005-06 was 238,305 MT. India had been a net importer of rubber and only negligible quantities of rubber used to be exported. In accordance with the policies of WTO mandated regime, rubber and rubber products could be imported without restrictions. To neutralize the impact of possible imports of rubber and rubber products, it is essential to promote export of rubber. It is proposed to support export promotion activities to establish the presence of India in the international rubber market

10.26 **Measures to Regulate Imports:** The imports of horticulture commodities into India do not face any reasonable SPS restrictions. We would need to strengthen our quarantine, health and safety standards monitoring systems and institutions.

10.27 Most developed countries deny access to Indian horticultural products, under the garb of SPS measures, or at least delay access to the extent possible. Quarantine procedures in India are not strictly implemented and there is a need for our authorities to be pro-active. For example, the apples and other fruits which are being imported in India need to be test checked to ensure that they are free from pests and diseases and do not pose any threat to the domestic systems of production.

10.28 A system for surveillance of the imported consignments and sample testing of the same needs to be brought into place and monitoring on a regular basis urgently so that imports do not continue to increase due to laxity of quarantine monitoring. A system for pest risk analysis needs to be put in place so that the risk of entry of new pests and diseases is dealt with appropriately.

10.29 **WTO Issues:** One of the most important issues currently being deliberated upon in the WTO relates to the provision of Special Products and Special Safeguard mechanisms. Negotiations are going on for provisions for declaring a few tariff lines important to them as Special Products (SPs). Some SPs will not attract any cuts in the bound tariffs while other SPs would attract bound tariff cuts, which are lower than the tiered-tariff reduction formula cuts. This is expected to be a safeguard mechanism for the developing countries.

10.30 The biggest challenge which Indian exporters of agro and food products face in the international markets pertains to low prices as an influence of the excessive export subsidies and domestic support extended by the developed countries to their farmers. We can hardly survive the price war unleashed by the subsidy rich farmers of the USA and the EU. Negotiations under WTO, so far, have not made much headway in persuading the rich nations to stop giving subsidy to their farmers in different forms

10.31 There has to be a balance between the three pillars of the negotiations. If tariffs were to go down it is essential that developed countries reduce export subsidies and domestic support implying reduction in production and increase in possibilities of import of foodstuffs by them from developing countries most of which are low cost producers.

10.32 The Agreement on Application of SPS Measures contains detailed provisions on transparency, harmonization and standardization. However, the very high level of standards set by some developed countries makes it amply clear that developing countries with their current level of industrial expertise would find it difficult to achieve these levels. Many of these standards, are set not on the basis of adequate scientific justification but are driven by commercial considerations. Hence, they tend to operate as non-tariff barriers affecting trade performance of developing countries. Standards set by private bodies have been started in many Western European countries which include parameters relating to social and environmental factors also

10.33 Maximum Residue Limits (MRLs) for pesticides in gherkin and grape are not harmonized by European Communities with Codex standards. In some of the products, the MRLs are not harmonized even within different member countries of EU. This lack of harmonization results into a technical barrier for Indian produce.

10.34 The approval by Japan of Vapour Heat Treatment protocols for control of pests in Indian mangoes has taken a very long time. Though, the protocols were developed by India quite sometime back, the Indian mangoes could reach Japanese market only in July 2006. Similarly the equivalence procedure for fruits and vegetables with China is in progress but at a very low pace. The matter regarding upgradation of India's status to GBR level-I (signifying no risk of BSE) by European Commission has been pending for several years. APEDA has taken these issues relating to specific products with respective member countries during bilateral discussions. However, the experience on pace of such deliberations leaves much to be desired.

10.35 It has been emphasized that SPS Agreement should be amended to bring in more discipline in this regard. In case a higher level of protection is considered necessary within an existing standard, Member(s) concerned should bring it before the respective international standards setting organization viz Codex/OIE/IPPC for revision in the original standard (or) a separate standard/measure be permitted for the concerned Member on clearance by Codex/OIE/IPPC as a special case.

10.36 The budget requirement for the promotion of exports through APEDA is projected at Rs 750 crores. However, budget for other commodities has been included in the budget allocation of the respective boards namely, Tea Board, Coffee Board, Rubber Board and Spice Board.

XI. TRANSFER OF TECHNOLOGY

11.1 Extension has played a key role in promoting scientific and commercial cultivation of all crops. Even though, several extension projects were launched in the country, the role specificity of extension system in promotion of horticulture has remained limited because of skewed primacy to food grain crops. Lowest production of most horticultural crops as a result of non-exploitation of technologies developed in horticulture is likely to continue unless horticulture extension system and strategy are drastically changed structurally, strengthened professionally and financed adequately.

11.2 Low horticultural information dissemination index as compared to field crops, poor extension contact, pro-large farmer extension approach, inappropriateness of technology keeping in view the production system, low capital base, low risk taking ability have been factors impeding full exploitation of benefits of developed technologies.

11.3 Women which play a vital role in seed selection, planting, nursery management, harvesting, grading and packing of horticulture produce need to be properly trained in modern technologies.

11.4 Several constraints have been identified in technology dissemination. Some of these are:

- Lack of robust extension system after the withdrawal of Training and Visit system in the country
- Horticulture extension is extremely weak due to lack of extension professionalism as well as lack of manpower adequately trained in extension science placed in horticultural technology transfer.
- highly trained manpower is needed for hi-tech horticulture

- Low information dissemination index of the major sources of information
- Lack of training centers for capacity building of farmers in advanced /modern practices, entrepreneurship development, marketing skills, financial management, quality standards and biosafety measures for export, IPR issues, etc.

11.5 The need of the hour is rejuvenation of policy interventions and their emphatic translation to boost up the production and trade of horticultural produce. Policy interventions for effecting a change need to focus upon the holistic issues related to technology development; its effective, efficient and speedy dissemination and optimum utilization for remunerative horti-business, Farmer participatory research for development of appropriate technology is recommended by emphasizing On-farm research to address the problems, needs and aspiration of growers as well as development of location-specific, appropriate and compatible technologies.

11.6 **Strategies:** As the farmers are to gear up to commercial cultivation and compete with global partners, they will be required to handle more complex information as well as technical know-how and do-how emanating from research system. These requires broadening the role and domain of extension, improving research-extension-clientele linkages, strengthening public extension services, promoting pluralistic extension system in public–private partnership mode, capacity building of extension functionaries and information management.

11.7 **Strengthening Contract farming institutions:** Dependency upon private sector, contracting firms and companies is becoming inevitable for small-scale farmers to facilitate accelerated capital inflow, technology and essential service delivery and assured market for quality crop production. However, appropriate structural arrangements should be initiated to develop an institutionalized mechanism for designing, organizing and operationalizing the contract system in the watchful eyes of the government and public institutions keeping in view the long–term implications. Structural arrangements should ensure fair deal in arbitration and dispute resolution, and for justice it should be the domain of the government. At the same time it is highly essential to educate the novice partner- the farmers about the dynamics of contract and corporate world.

11.8 **Distance learning programme on Horticulture:** Capacity building of farmers, entrepreneurs and other potential end users could be facilitated with education and training through distance learning system for practicing horticulture with latest technical know-how and do-how.

11.9 In order to strengthen the horticultural extension, a pragmatic paradigm shift is essential in the 11th Five Year Plan in terms of:

i) developing a cadre of horticultural extension professionals including extension scientists as well as horticultural scientists trained in extension education;

ii) capacity building programmes in hi-tech horticulture, would demand trained manpower in horticulturally advanced countries; ii

i) as a long-term strategy, creating a **National Institute on Hi-tech Horticulture** dealing with field research, technology transfer, training, extension management, and marketing promotion will be desirable.

11.10 The 120 Zonal Research Stations established and promoted under NARP need to be utilized by providing additional support for generating eco regional horticultural technologies. Likewise, the existing over 500 KVKs need to be strengthened horticulturally by providing a few additional horticultural scientists and field workers and added resources. The small and marginal farmers and agricultural labourers need special horticultural programmes for employment creation and income generation.

Empowerment of farm women through Self-Help Groups (SHGs) needs strengthening and support in agriculture in general and in horticulture in particular

XII. HUMAN RESOURCE DEVELOPMENT

12.1 The launch of National Horticulture Mission was one of the important and major steps towards a planned approach for development of horticulture sector with focus on cluster approach in all the states of the country except the North Eastern States, Himachal Pradesh, Jammu and Kashmir and Uttrakhand, where separate Technology Mission for Integrated Development of Horticulture exists. The mission document has included human resource development as one of the key activities for implementing other sub components under the changing global business environment in context of horticulture production, post harvest management, marketing and value addition Emphasis is given on capacity building of various stake holders in the sector viz., farmers, field level workers, officials and entrepreneurs.

12.2 During the X plan a number of training programmes were planned for implementation for human resource development for selected states as per the focus of horticulture crops. these programmes were merged in to National Horticulture Mission. These were Gardener Programme, Vocational Training course for Horticulture Supervisor, Specialized Entrepreneur in Horticulture, besides several other programmes initiated during the X plan namely, Protected Cultivation of Vegetables & Flowers (PVF), Hybrid Seed Production of Vegetables and Flower Crops (HVF), Mass Propagation of Horticultural Crops (MPH), Post harvest Management & Value addition in Horticultural Crops (PVA), Production & Processing Technologies of Medicinal & Aromatic Plants (TAP), Transfer of Technology through T&V System for Orchardists (TOT), Advance Training for Field Functionaries and Trainers (ATS) and Financial Assistance to the Trainees of Specialized Entrepreneurs (FAT)

12.3 The National Horticulture Mission has formulated a seven-point strategy, which includes " promoting capacity building and human resource development at all levels". Under the National Horticulture Mission, training and demonstrations are integral part of human resource development efforts for farmers' field level workers, officers and entrepreneurs.

12.4 **XI Plan Programme**: The training programmes for Farmers, Gardeners, Supervisors and Entrepreneurs proposed under 'Human resource development' by National Horticulture Mission for X Plan may be continued during the XI plan for capacity building of all stake holders. The details of above programmes are given in Chapter 12. It was felt that there is no need to create additional infrastructure for running these training programme except. Following suggestions are made in this regard

- Already a Central institute of Horticulture has been started during the X plan at Medezifema, Nagaland. It is recommended that instead of opening training institute in every states as envisaged, four additional National facility for Training in Horticulture should be setup one each in north, south, east and west par of India. These facilities should be fully equipped with hi-tech infrastructure e.g. glass houses, modern as well as low cost green houses for flower and vegetable production, mushroom production unit for different strains, micro-irrigation system, high density planting, vermiculture units, plant protection equipments, all other modern tools and equipments, grading units, packing materials and boxes both for fresh and processed horticultural produce and bee hives to give hands on training in various operations and principles of agri-business management. These should also have facility for training in the areas of organic farming, Good agricultural practices cool chain and value addition etc. Such training centers may be utilized for upgrading the knowledge of hi-tech technologies of the staff involved in

development and transfer of technology of horticultural programme in various states

- A large network of research institutes, NRCs and SAUs exists both under the central and state Governments. Many of them have attained excellence either in developing technologies in crops or aspects namely micro-propagation, post harvest management or value additions etc. Such centers should be accredited by the Ministry of Agriculture for training in respective crops or technologies. This will ensure high-class training in latest technologies with uniform recommendations to all development workers all over the country. The various courses to be offered by these centers may also be identified keeping in view the needs of the XI and subsequent Plan and their course curricula approved so that the required level of proficiency can be imparted in such trainings.
- Krishi Vigyan Kendra should be utilized for training of Farmers and Malis in a particular district for the crops grown in the area. Emphasis should be given for training farmers through visits in the area having achieved excellence in particulars crops or technologies.

12.5 In view of upward growth of horticulture sector during Xth plan period, besides training of various stakeholders in technical areas and subject matter, equal emphasis on capacity building should be given in management aspect of various operations, data base, post harvest management and value addition.

12.6 Due to lack of infrastructure and qualified trainers at grass root level the training and other capacity building efforts are found to be inadequate. Hence the private sector (Infrastructure & Consultants), N.G.O.s and Commodity based farmers' organizations, Agri-horti Societies should be involved for training and capacity building of farmers, malis and supervisory staff besides the public sector institutions like K.V.K.s etc.

XIII. DATA BASE

13.1 Horticulture is an important segment of agriculture sector, which, in turn, is one of the major components of national economy along with manufacturing, and services sectors. Therefore, the quality of relevant data inputs is extremely important in the context of realistic and effective policy planning process. It is rather ironical that despite unambiguous importance of horticulture data recognized and articulated repeatedly in different fora, there has been no systematic policy or conscious effort to address the underlying issues to improve either its reliability or quality. It is, thus, extremely important to seriously consider various issues and problems confronting horticulture data sector through appropriate policy intervention and support during the XI Plan so as to establish reliable horticulture database without further delay.

13.2 National Horticulture Board (NHB) is the main source of data on fruits, vegetables potato, spices, flowers and plantation crops as collected from State Horticulture departments. It compiles, checks, does necessary revision and publishes this data on area, production, productivity, prices etc. Similar data is also collected under a scheme called Crop Estimation Survey for Fruits and Vegetables, which is in operation in some States and financed by the Ministry of Agriculture, for selected crops. Directorate of Economics and Statistics (DES) in the Ministry of Agriculture also collects such data for some crops. Further, some data such as area covered under different crops (operational holdings) is also available through Agriculture Census at 5-year interval.

13.3 Reliability of data is one of the most crucial requirements. The problem is fairly acute owing to significant variations observed in the data provided by different agencies. Even temporal inconsistencies exist in the data obtained from the same source due to periodic revision of data, which though may not be completely unavoidable on account

of well-known factors but the problem actually arises in the event of abnormal fluctuations. In the absence of appropriate validation mechanism, it is often difficult to validate reconcile variation or the inconsistencies in data or determine its reliability as is the case in respect of similar data produced by other agencies.

13.4 **Constraints in Data Collection:** There are several constraints that restrict development of proper horticulture data system.

- The administrative constraints include lack of suitable authority in the absence of mandatory provision, to collect data that requires willingness and meaningful participation and coordination of others, systematic erosion of role, relevance and prestige of data collection personnel leading to their de-moralization and de-motivation.
- Financial constraints include absence of dedicated or exclusive funding, in most cases, for activities related to data development and management unlike specific allocations made for different activities or components such as rejuvenation, post harvest management, protected cultivation etc. under NHM.
- This means the present financial support or funding mechanism for development of horticulture data base is merely a kind of secondary support, at best, which is bound to cause the data development activities to suffer the most in situations involving scarcity of funds or whenever the economy measures have to be enforced.
- Technical constraints include lack of well-established methodology, improper or ineffective application of methods and procedures, inadequate training and HRD development and dwindling willingness to innovate.
- Infrastructural constraints include higher vacancies, resource difficulties involving constraints on acquisition of necessary equipment required for modernization of office.

13.5 The important remedial measures suggested are

i) Necessary capacity and capabilities for data system for which necessary policy intervention will be most crucial including providing sufficient financial support for acquisition of necessary equipment and creating basic infrastructure,

ii) Review the present policy and approach to ensure that the above objectives are fulfilled,

iii) Suitable directives may have to be issued to all concerned with the horticulture development as data partners having equal responsibility to cooperate and provide basic data,

iv) Adequate financial support is critical to allow effective functioning and accomplishing the task,

v) The most immediate priority is to reverse the process of neglect and degeneration of the data sector that has happened so far.

13.6 Data is the soul of any planning and is a most fundamental tool for making realistic assessment of the policy objectives and ascertaining how far the investment is justified. It is the backbone for providing correct understanding about the situation for taking necessary remedial steps. While correct data is crucial and is required to set right policy direction, wrong data can result in policy drift causing misplacement of priorities.

13.7 It should be understood that a little conscious investment in horticulture data development could protect the huge investment being made in other horticulture development activities, especially in the backdrop of several other competing priorities for resources to be invested in the economy for development purposes. Accordingly, it

is extremely important to address and tackle the issue of systematic development of comprehensive horticulture database during XI Plan. Appropriate policy thrust along with adequate administrative, financial and technical support should be considered vigorously being critical to pursue the expected inevitable task.

13.8 The setting up of extensive network of proper horticulture data establishments called **Horticulture Information Systems (HIS)** units in all the districts and at State level, preferably under the purview of State Horticulture Departments therefore gains importance. In addition, there should be an apex Unit (A joint secretary level post has already been provided in the Division of Horticulture of the Ministry of Agriculture) at the Centre in the Ministry of Agriculture to coordinate, organize, consolidate, analyze data obtained from the States and disseminate the same that could be treated as official data for the benefit of various users and for reference purposes.

13.9 The proposed network of horticulture data establishments should have collective role and responsibility to plan, collect, compile and coordinate horticulture data required for various policy planning purposes on area, production, productivity, import, export of different horticultural commodities. Besides, it should also incorporate other ancillary data such as commodity prices, storage capacities, stocks, market arrivals, employment generation-direct and indirect, cost of cultivation and economy of farming, marketing facilities, institutional support including training or technical support available for the farmers etc., to develop more robust horticulture data system.

13.10 Horticulture census To identify and designate Nodal agencies in all the States to coordinate data collection, compilation and scrutiny, at district level data, for further consolidation to derive State level data. It is imperative to initially conduct **Horticulture Census** with the objective of generating reliable base-line horticulture data, particularly at panchayat level, that is currently non-existent. There is also an urgent need to collect authentic district level data classified by different components.

13.11 The major objectives of HIS would be

i) To fill up serious gaps in horticulture data that continue to haunt the policy planners in making correct assessment about the current status of horticulture and its growth in the country.

ii) To generate reliable horticulture data to attempt effective forward production planning and determining prospective investment policies to exploit huge horticulture potential, besides regulating marketing, transportation and distribution of horticulture commodities and products in the emerging dynamic scenario.

iii) For developing more robust and responsive data system to meet the emerging data needs periodic workshops and conferences would be conducted to accomplish the task.

iv) To study international data collection methodologies and practices, especially in some developed countries and/or equally placed countries in the context of planning, development and management of our horticulture data system, which will help in building greater compatibility and comparability with the international data.

13.12 While adequate administrative support may be obtained under the Collection of Statistics Act 1953 envisaging suitable amendments, it will be necessary to simultaneously consider dedicated funding exclusively for the purpose of data development activities. It will be important to earmark, say a minimum of 5% of the total budget or funds, to prevent neglect or dilution that has been witnessed so far, especially whenever any economy measures have to be enforced. Availability of committed administrative and financial support will be crucial for time-bound development of much needed effective horticulture data in the country to facilitate

monitoring of the progress of achievement of objectives and justification of huge investment being made in the horticulture sector in the country.

13.13 For sponsoring comprehensive study on the data collection system by the expert agencies, adequate funds have to be earmarked. The tentative estimated financial requirements for setting up a network of Horticulture Information System (HIS) at districts, States and Centre is estimated Rs 300 crores during XI Plan. For horticulture census Rs. 250 crore is envisaged. For studying methodology by expert agencies Rs. 30 crores has been earmarked.

XIV. RISK MANAGEMENT, CREDIT AND PUBLIC PRIVATE INVESTMENT

14.1 In agriculture controllable risks like pests, diseases, weeds, and seed material can be managed with the use of technology, effective monitoring and appropriate usage of inputs. However, the challenge lies in providing risk management solutions for uncontrollable risks like rainfall - it's deficit, excess and distribution, extreme temperature conditions, hail incidences, extreme wind speeds, humidity variations etc. In order to minimize the loss several solutions have been inculcated in the financial system.

14.2 The National Agricultural Insurance Scheme (NAIS) was introduced in the country from the 1999-2000 Rabi season, replacing the Comprehensive Crop Insurance Scheme (CCIS) which was in operation in the country since 1985. The scheme is being implemented by the General Insurance Corporation (GIC) on behalf of the Ministry of Agriculture.

14.3 At present the scheme is being implemented by 21 States/Uts namely, Andhra Pradesh, Assam, Bihar, Chhattisgarh, Goa, Gujarat, Himachal Pradesh, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Meghalaya, Orissa, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal, Andaman & Nicobar Islands and Pondicherry.

14.4 In order to strengthen confidence in the existing seed breeders/growers and to provide financial security to seed breeders/growers in the event of failure of seed crops, the Government of India has introduced a Pilot Seed Crop Insurance Scheme from the Rabi 1999- 2000 season. The States of Andhra Pradesh, Gujarat, Haryana, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan and Uttar Pradesh are covered under the Scheme.

14.5 The weather-index based insurance covers the likelihood for diminished agricultural output/yield resulting from a shortfall of any of the pre-defined weather parameter for a specific geographical location and time period, subject to a maximum of the sum insured. The Metrological Department keeps detailed, daily records of the weather parameters such as rainfall, temperature, humidity and other weather conditions. The co-relation between the deviations in weather conditions and the effects of the same on crop yield can be effortlessly ascertained by statistical methods.

14.6 Weather insurance is a well-known tool for agriculture insurance in other developed economies and has been used successfully by various developmental organizations in various developing economies as well. With the launch of this product, farmers in India can protect themselves against extreme changes in weather patterns.

14.7 The success of the weather-based insurance in India would require substantial investment of resources to analyze the data and develop models across the various products and regions for the various weather parameters. Further, there is a need for awareness and education about the product across the range of stakeholders. The

weather-based insurance has the potential for providing a sustainable solution for Indian agricultural industry.

14.8 Improving production and productivity of fruits and plantation crops is a priority area and the cultivated area under these crops is steadily increasing. These perennial horticultural crops are presently not covered by NAIS and there is a demand for inclusion of these crops under the scheme.

14.9 Farmers are also exposed to the risk of price fluctuation in commodity prices. In order to safeguard the interest of the farmers' commodity exchanges were established. National Commodity & Derivatives Exchange Limited (NCDEX) and Multi Commodity Exchange Ltd are two of the major players in the market. NCDEX is a professionally managed online multi commodity exchange dealing in Cashew, Chilli, Coffee, Crude Palm Oil, Turmeric and other agricultural products. MCX is an independent and de-mutulised multi commodity exchange. The broad category of products traded in this exchange are Bullion, Oil and Oil seeds, spices, energy plantation and other products.

14.10 Warehouse Receipts are documents issued by Warehouses to depositors against the commodities deposited in the warehouses, for which the warehouse is the bailee. Warehouse Receipts may be either non-negotiable or negotiable. These documents are transferred by endorsement and delivery. Either the original depositor or the holder in due course (transferee) can claim the commodities from the warehouse. Warehouse Receipts in physical form suffer all the disadvantages of the paper form of title documents.

14.11 Policy Interventions envisaged during the XI Plan period include

- **i** Integrated micro-product to cover life, health, non-life assets of SF/MF at reasonable costs
- **ii** Group premia approach at village/ panchayat level to be considered
- **iii** More farmer friendly products and speedy settlements of claims
- **iv** Premium to be shared by Central and State Governments with farmers and banks concerned.
- **v** MFIs may be utilized to tie up with formal insurance companies for increasing outreach of micro insurance products
- **vi** NDRF to be created through annual contributions of nationalized banks, RBI, NABARD, SBI etc., from out of their profits, contributions from State/Central governments and small annual cess from loanee farmers.

14.12 **Credit** : Public or Private investment in agriculture and rural sector will have a multiplier effect in the rural economy and will play a significant role in development of the sector. If policy framework is enabled with minimal fiscal incentives, they can result in attracting the much-needed private investments in the rural and agriculture based economy. Besides this, the share of public investment in the sector also needs to be increased which has been observed to be reducing over the years.

14.13 **Status of Credit:** The major credit in the Horticulture and Plantation sector is flowing to more or less organised sectors, while the flow to minor fruit crops account for a small share in the sector, which call for future developments. The total ground level credit flow for plantation and horticulture and allied activities during the period 2000-01 to 2004-05 increased from Rs. 1,420 crore to Rs. 3,314 crore with a CAGR of 23.6%.

14.14 XI **Plan Requirements:** The credit requirement has been worked out at Rs. 61,334 crore for the XI Plan period assuming an annual growth rate of 25% for short term

credit requirements and 27% for long term credit requirements considering the incremental impact of thrust areas like Post Harvest Technology, Agri Export Zone, Organic Farming and Contract Farming, etc.

14.15 **Policy Interventions:** The major policy interventions recommended to achieve the projections and attract private investment in the sector are:

- Allowing FDI in agriculture produce retailing / post harvest activities and other specialized services like model nurseries, enhanced seed production and R&D
- Lowering of bank interest rates on loans for horticultural crops production and marketing activities to 7% by providing subvention on the bank loans for horticulture and plantation sector on the lines of crop loans where all crop loans for cultivation of agricultural crops up to Rs. 3.00 lakh are provided with a subvention of 2% by Government of India and the interest rate to borrower is 7%.
- RBI may consider earmarking a sub target within the Agriculture Sector say of 5% out of the 18% of Agriculture Sector exclusively for Horticulture and Plantation Sector which will give a further boost to investment in the sector.
- Fiscal incentives are suggested by way of granting 150 per cent deduction of expenditure for all investments by the Pvt. Sector in agriculture and the entire agri-value chain as in the case of R&D.

14.16 **Public Private Investment :** The Ministry of Finance, Department of Economic Affairs, GoI has developed a scheme for support to "Public- Private Partnership" (PPP) in infrastructure in July 2005 which specifically covers roads, power, urban transport, SEZ and tourism infrastructure projects and does not include infrastructure for the Agriculture sector.

14.17 The horticulture crops being perishable in nature, require special type of marketing infrastructure. Keeping in view the objectives of doubling the horticulture production from the existing level of 147 million tonnes to 300 million tonnes by 2011 - 12, market intervention, has been identified as one of the important aspect for the growth of horticulture sector. The National Horticulture Mission has already suggested an allocation of a sum of Rs.150 crores for the purpose of establishing terminal markets for horticulture produce during 2006-07.

14.18 This would offer an excellent opportunity for Public Private Partnership. The terminal market complexes are highly capital-intensive projects with investment ranging between 80-100 crores, even more for individual projects. Both the Central and State Governments may consider their involvement through equity participation. These terminal markets may also act as Export Hubs with necessary testing facilities for quality control which is a perquisite for any export from the country. Provision of land for development of these markets should be the responsibility of respective authorities in the state.

14.19 Developing efficient supply chain for perishable horticulture crop is a pre-condition for the growth of this sector. Fruit, vegetable and flowers require sorting, grading and then pre-cooling before these are transported to far away destinations. This requires huge investment for Post Harvest Management.

14.20 While the infrastructure at the field level may be created by the individual farmers or farmers' group pre-cooling centre, refrigerated vans, cold storage could be developed by corporate houses with equity participation from State/Central Government, Various Growers Association's could also be partners in this endeavor.

14.21 Creation of quick transport system for long destinations by road or rail is very important for efficient supply chain management. While refrigerated vans should be used for road transport, a dedicated refrigerated railway wagon should be put in

place for long distance transport of horticulture produce. Corporate houses involved in production and marketing of horticulture produce may be allowed to manufacture their own refrigerated wagons as is presently done by many companies, for other industrial commodities. Introduction of a dedicated super fast train for horticultural produce could be considered from the centre of production to the major metro markets in the country.

14.22 Creation of cold storage facilities in select airports situated in the important horticulture production centres of the country to facilitate quickest transport to cater to both the domestic and export market. Creation of infrastructure will offer an excellent opportunity for investment through Public Private Partnership.

14.23 The partnership of Private and Public Sectors may be extended to research and development. Many Corporate industries which are engaged in undertaking independent in-house research in the field of horticulture may be provided financial support to the extent of 50% of the cost of the research project. Government may avail royalty from the commercial benefits earned out of the research projects.

14.24 The infrastructure facilities of the existing Horticultural Research Departments/Centres (which include State Agricultural Universities) could be made available to the corporate houses for undertaking research projects and thereby share the commercial benefit of the research outcome.

14.25 There is a great opportunity to develop partnership with corporate houses to develop well equipped advanced laboratories across the country for testing the quality of the produce in conformity with International standards. The private industry may be encouraged to share their infrastructure for the R&D activities with the public sector research organizations for mutually beneficial association.

14.26 The private sector may be encouraged to establish state of the art R&D infrastructure for taking up on cutting edge research projects in collaboration with the scientists of the public sector organizations in areas like nanotechnology, protected cultivation, biotechnology and information technology applications in horticulture. The private sector may be encouraged to establish state of the art breeding stations with latest exotic varieties to evolve varieties that suit the international markets.

14.27 Vast area under horticulture farms are owned by State Government/Agriculture University. These horticulture farms remain under utilised for various reasons. State Government may consider to lease out these farms to the small/medium private entrepreneurs for a period of 10-15 years and design good business models which can even act as a training ground for the prospective agri entrepreneurs. Special preference needs to be given to the Agri-clinic and Agri-business entrepreneurs with a focus on horticultural crops.

14.28 Government (State/Centre) may consider developing Horticulture Parks jointly with Corporate Houses. These Horticulture Parks, like Industrial Parks/Food Parks may provide entire requisite infrastructure, for production, processing and marketing in one compact area. This may be on the same pattern as that of AEZ.

14.29 There are many options for designing the PPP model, the most commonly used options are Joint Ventures, Build-Operate-Transfer (BOT), Build-Own-Operate-Transfer (BOOT). However, the most preferred model for marketing would perhaps be the ‘Financially Free Standing’ projects. In this case the Public sector undertakes some of the initial planning, providing ancillary works or fulfillment of statutory procedures; whereas the private sector undertakes the project on the basis that costs will be entirely recovered through user charges. The Marketing Board may also participate in the equity to the extent of the cost of land to be allotted to the market.

XV. ELEVENTH PLAN PROGRAMMES, BUDGET AND POLICY ISSUES

15.1 The strategy during the XI Plan will be to provide dynamism to the sector by consolidating the gains made during the Tenth Plan, and implement programmes which would ensure holistic development of horticulture sector.

15.2 The developmental programmes are running in the country under the aegis of Ministry of Agriculture, Ministry of Commerce and Ministry of Food Processing Industries. The programmes under these ministries can be categorized into (i) programmes to be continued as such, (ii) programmes to continue with minor modifications and (iii) programmes to be restructured

15.3 Programmes like National Bamboo Mission and Central Institute of Horticulture were launched recently and are recommended to continue as such during XI Plan.

15.4 Most of the programmes in operation in the last Plan are still relevant and therefore need to continue with minor modifications, these programmes are (i) TMNE, (ii) NHM (iii) Miroirrigation and (iv) Rubber Board.

15.5 Some programmes like (i) NHB, (ii) CDB, (iii) Coffee Board and (iv) Tea Board need major modification as some of components under the programmes are no more relevant. To make these programmes more effective and achieve these objectives modification and restructuring of the programmes of NHB CDB, Coffee Board and Tea Board is recommended.

15.6 The financial requirement for various Missions/ boards/ Programmes, which require to be continued during XI Plan under Ministry of Agriculture, is estimated at Rs. 26,550. Whereas the boards/APEDA under the Ministry of Commerce would need Rs 5150 crores to continue the current programmes and expand activities during the XI Plan.

15.7 The Working Group recommends launching of the following new initiatives during XI Plan period.

Missions:

a. National Mission on Organic Farming

Boards

b. Establishment of Cashew Board;

c. National Bee Board.

Authority

d. Establishment of Planting Material Authority for Horticulture

Commodity Development Programmes

e. National Vegetable Development Programme;

f. National programme on development of commercial floriculture, medicinal & aromatic plants

Other Programmes

National Horticulture Information System;

g. National Training Facility for Horticulture;

h. Horticulture Insurance;

i. Small Farmers' Horticulture Estates and

The tentative budgetary requirement to implement these new programmes during XI Plan is estimated at Rs. 9,800 crores.

15.8 The overall requirement of funds for the development of horticulture during the XI Plan would be to the tune of Rs. 41,500crores.

15.9 To implement these programmes some of policy issues related to administrative, infrastructure, financial, administrative and policy needs to be looked into during XI Plan period.

15.9. Administrative Aspects

i. Budgetary allocation for horticulture development has increased many folds. However, there is acute shortage of manpower to look after the programmes. This calls for urgent review and suitable strengthening by redeployment from the Agricultural Division.

ii. Programme on horticulture should be led by suitable technical persons well versed in technicalities of horticulture.

iii. There are several components, which are being under taken both National Horticulture Mission, Technology Mission for North East Region and National Horticulture Board. There need to reorient such programmes so as to avoid overlapping.

Projected outlay for Horticulture development during the XI Plan period

S. No	Existing scheme	Requirement (Rs. In crores)
	Ministry of Agriculture	
i	National Horticulture Mission (NHM)	15,000.0
ii	Technology Mission for Integrated Development of Horticulture in North East & Himalayan States	3,000.0
iii	National Horticulture Board (NHB)	1,000.0
iv	Micro irrigation	4,500.0
v	Coconut Development Board (CDB)	500.0
vi	Central Institute of Horticulture (CIH)	50.0
vii	National Bamboo Mission (NBM)	2,500.0
	Sub-Total	**26,550.0**
	Ministry of Commerce	
i	Tea Board	1,000.0
ii	Coffee Board	900.0
iii	Rubber Board	1,000.0
iv	APEDA	750.0
v	Spice Board	1500
	Sub-Total	**5150.0**
	Proposed Schemes for XI Plan Scheme	
i	National Vegetable Development Programme*	1,400.0
ii	National Programme on Development of Commercial Floriculture and M&A Plants	2,400.0
iii	Organic Farming Development& Regulation Authority	2,500.0
iv	Cashew Board	500.0
v	National Training Facility for Horticulture	200.0
vi	Planting Material Authority	1,000.0
vii	National Horticulture Information System	500.0

viii	Horticulture Insurance	500.0
ix	National Bee Board	300.0
x	Small Farmers Horti. Estates	500.0
	Sub-Total	**9,800.0**
	Grand Total	**41,500.0**

15.10 Technical Aspects

Regional Priorities: Due emphasis needs to be given to expand area under horticultural crops in the following categories of States:

i. All the States where current area under horticultural crops is below 10% of the total cultivable area.

ii. States which has immense potential for horticulture but not fully exploited for e.g. M.P., Orissa and Bihar

iii. Newly formed States like Chhattisgarh, Jharkhand and Uttaranchal

Crop Priorities

I. Fruit Crops

- Priorities need to be given for those and crops varieties, which are identified for a specific cluster and agri-export zones
- There is need to develop production technologies based on agri-ecological regions.
- Indigenous and unexploited fruits possessing nutritional, processing value for e.g. jamun, bael, custard apple, fig, phalsa, date palm etc. need to be given focused attention.
- Emphasis needs to be given to promote cultivation of suitable crops in dry-land, arid regions and wasteland.
- Most of the fruit orchards specially Mango and citrus have become very old and rejuvenation may not be the solution for such orchards. Therefore, replanting such orchards has to be taken on priority basis without further delay.
- The present developmental programmes of NHM cover only 291 districts out 462. It is felt that a district cannot represent a cluster, therefore, crop specific clusters have to be identified in all the Districts depending on the suitability of crop.
- Introduction of high yielding strains/varieties of temperate fruit crops on a large scale for increasing fruit production and productivity through new orchards as well as replacement of old and uneconomical orchards.
- Introduction of advance technologies in orchard management and economic use of inputs like fertilizers, growth regulator and pesticides.
- Promoting farming system approach and diversification by intercropping with medicinal and aromatic crops.
- Introduction of advance technologies for the on farm storage, grading and packing of fruits at gram panchayat level.
- Construction of fruit collection and forwarding centres in the fruit growing areas.

II. Vegetable Crops

i. Vegetable contribute a major share in ensuring food and nutritional security of population however, no meaningful programme have been launched on vegetables in

recent times. Vegetables are even excluded from the recently launched NHM. The following aspects of vegetable crops needs to taken on priority:

- Saturation of area with F1 hybrids
- Promoting leafy vegetables for nutrition particularly in villages and tribal areas
- Protected cultivation for high quality vegetable for export
- Promoting kitchen gardening
- Focus on crop having short supply
- Promotion of technologies for round the year production of crops like onion

ii. Spices

- Need to develop high yielding disease free varieties.
- Urgent need to encourage multistory cropping and inter cropping to maximize the yields

III. Floriculture

i. Suitable programme needs to be launched for development of elite new varieties suitable for export on PP mode so as to slowly replace the patented varieties.

ii. There is need to develop an interface with R&D organization, farmers and the industry to promote larges scale production of pharmaceutical and nutraceutical flowers on contract farming movement.

iii. India need to reorient its exports based on pot plants and cut foliage. Incentives for identification, domestication and commercialization of indigenously available foliage and pot plants need to be given.

iv. Introduce funding for time bound market driven projects by the private organizations to supplement and strengthen the public sector R&D

v. Besides loose flowers, cut flowers and dry flowers there is a need to promote other sectors like florist and floral decorations, pot plant production and rentals, bedding plant production, corporate landscaping, turf industry, essential oil extraction, aroma therapy, pot pourri, natural pigments and dyes and flower seed production.

IV. Medicinal & Aromatic Plants

i. Several agencies are working on MAP crops

ii. Herbal gardens are being promoted to lay emphasis on sensitization of MAP cultivation. Any meaningful programme would call for commercializing those plants that are required in large quantities in domestic and international markets. Some species like Noni (*Morinda citrifolia*) which is gaining popularity needs to be given priority to exploit its potential.

iii. There is a need to establish a regulatory and controlling authority on the lines of drug and cosmetics Act and Seed & Nursery Act to prevent unscrupulous activity and boost he image of Indian MAP sector.

iv. Establishment of referral labs for crude drug analysis to ensure authenticity of herbal raw material.

v. Priority needs to be given in areas of new drug development from plants, development of pharmacopeia standards for quality, safety, efficacy and scientific validation of therapeutic claims

vi. A strong and viable national strategy is warranted for complete inventorisation, economic mapping, conservation, cultivation, post harvest technology and storage facilities of MAP crops.

vii. To allow suitable concessions for products which contain natural aromatic compounds (like vanilline) as flavouring agent to discourage large scale importation of synthetic vanilline.

V. Coconut

i. Coconut plantations in large area have become old and senile. Focus priority therefore should be accorded to large-scale replantation programmes.

ii. Very few farmers are practicing scientific farming in coconut. Development and transfer of technologies is the key for reviving coconut industry.

iii. There is need for focused attention on farm level processing, product diversification, byproduct utilization and value addition.

iv. Tree life insurance and welfare schemes for coconut climbers.

v. Due to shifting towards more lucrative white collar jobs there is an acute shortage of professional climbers to harvest the produce. Although machines are available to harvest but they are not safe and often cause fatalities. Concerted efforts need to be mad for the development of the sector.

vi. Still conventional varieties are being planted that have lot of disadvantages. There is a need to take up large scale plantation of Dwarf hybrids under high density planting to improve productivity and farm income.

15.11 Infrastructural issues

i. Government should create common infrastructure for post harvest management, vapour heat treatment (VHT), irradiation centers with equal participation from Central and State Government for promotion of horticulture exports. The operational part and maintenance may be entrusted preferable to some private agencies to ensure their uninterrupted functioning and proper maintenance.

ii. Create special seed production zones on the lines of SEZ's for hybrid seed production of vegetable/ flower seeds for domestic and export markets.

iii. Provide physical infrastructure and financial support for the newly established commodity associations for strengthening of their activities.

15.12 Financial issues

i. Assistance under most of the Schemes are based on cost norms of IX Plan, which has became quite irrelevant in the current situation where cost of all the inputs have increased by many folds. To make the assistance more realistic and fruitful, review of cost norms for all the crops, green houses and shade nets, microirrigation, post harvest management and market infrastructure is recommended.

ii. The current Inadequate financial assistance currently for area expansion is not adequate to enable high density plantations and for cultivation of high capital crops like grape, banana, strawberry, medicinal & aromatic plants. Besides, assistance for non-perennial crops are released in two instalments instead of one, which does not serve the purpose for which it is intended.

iii. Special financial support for selected specialty crops of different states like Litchi in Bihar, Banganpally Mango of A.P, Dasheri of UP, Alphanso of Maharashtra, Pineapple of NER, Kinnow in Punjab, Passion fruit in North East and Grapes in Southern States to develop core competence to promote exports.

15.13 Policy initiatives

i. In order to reduce cost of cultivation VAT, Octroi etc and import duties on plastic raw material need to be abolished. Excise duty on micro irrigation system needs to be reduced considerably.

ii. There is urgent need to amend forest laws regarding cutting of trees as these are hampering the task of rejuvenation of horticultural plantation.

iii. Economy of North East region is largely based on salaried population and therefore very few entrepreneurs have come up to take horticulture activity. Besides, cost of transportation is extremely high both within and outside the region. Government should therefore provide incentives to promote entrepreneurship besides, transport subsidy should also be provided to the farmers in the region for moving goods within and outside the state. For goods originating from NER and underdeveloped states like Bihar, Chattisgarh and Jharkhand to provide level playing field to the farmers to market their produce.

iv. The Technology Mission on North Eastern States (TMNE) has made significant contribution in the overall development of horticulture in the NER with innumerable number of success stories. In order to replicate such success in the less developed states it is proposed to expand the TMNE to the states of Bihar, Jharkhand and Chattisgarh.

v. There is need to create a separate corpus fund for horticulture to meet any emergency requirements on project base so as to protect the farmers in distress.

vi. Geographical Identity of a particular crop which is dependent upon the soil and climatic conditions generally characterizes the superior quality of the produce and this zone should not be restricted to physical map and boundaries of the district/state etc. The name of such zones should have a particular place and its surrounding area irrespective of district/state boundary. The registration/patent should be given/named to that place for a particular fruit.

vii. Efforts need to be made to screen out the places linked with a particular fruit/vegetable and thereafter attempt for registration for Geographical identity.

XVI. ORGANIZATIONAL REFORMS

16.1 The programmes related to horticulture are at present handled by multiple Ministries including Ministry of Agriculture, Ministry of Commerce, Ministry of Food Processing Industries and Ministry of Rural Development which often overlap with each other. In order to bring synergy among the various programmes and meaning to the enormous expenditure being made by these ministries on similar programmes, there is an urgent need to bring all the programmes under an umbrella ie., Ministry of Agriculture.

16.2 While a large number of programmes having been launched during IX and X Plan, development of infrastructure in the Division of Horticulture has not kept pace. The technical input for the planning and implementation of the various programmes is not commensurate with the quantum of programmes and the financial allocation. This calls for rethinking and reorganisation in the best interest of the utilization of large allocation likely to be made during the XI Plan and the achievement of the objective set for these programmes.

16.3.It is therefore recommended that considering the above emphasis a position of Member (Horticulture) be created in the Planning Commission to provide technical guidance and linkages to various programmes being implemented by various Ministries.

16.4 The position of Horticulture Commissioner (Ex Officio Joint. Secretary) needs to be upgraded and brought at par with that of the Agriculture Commissioner and Animal Husbandry Commissioner (ex officio Additional Secretary) in the Ministry of Agriculture.

16.5 Three modules on reorganization are proposed to overcome constraints in current organisational structure of Horticulture Division.

- As a first alternative towards reorganising, it is proposed to consolidate all units engaged in horticultural activity in various Ministries e.g. Ministry of Agriculture (NHM, TMNE, Microirrigation, NBM, NHB, CDB & NBB), Ministry of Commerce (APEDA, Coffee Board, Rubber Board, Spices Board & Tea Board), Ministry of Food Processing Industries and Ministry of Rural Development by forming a Department of Horticulture under the Ministry of Agriculture with Secretary or a post of Special Secretary (Technical) exclusively for horticulture.
- Alternatively, an Indian Council for Horticultural Research and Development needs to be created, as suggested earlier in 1993 by the than Agriculture Minister, to take care of both the R&D in horticulture including marketing and exports.
- As a third alternative, creation of National Authority for Horticulture Development under Ministry of Agriculture, on the pattern of National Rainfed Development Authority in Ministry of Agriculture.

16.6 It has also been felt that it is necessary to strengthen horticulture division by creating a Technical Advisory Group, which will be responsible for providing technical inputs for systematic development of horticulture, creation and development of suitable literature. Though this group would be advisory in nature, all technical decisions requiring various interventions would be their responsibility. The group may consist of well known horticulturist with specialisation in (i) fruits & plantation crops (ii) vegetables & spices, (iii) floriculture & medicinal and aromatic plants, (iv) plant protection, (v) post harvest management and value addition (vi) marketing & export.

16.7 There is need to create separate horticulture Departments in States where these do not exist. Besides, Director (Horticulture) should be vested with the responsibility of implementing NHM. Similarly, all officers down the line should have the technical background to implement the programmes of horticulture or be suitable trained for that purpose.

16.8 To make implementation and monitoring more effective at grass root level, District level Horticulture Officer should be made Mission in-charge instead of District Magistrate. It is felt that cluster approach under the NHM/TMNE won't be fruitful unless the posting of State officials is made as per technical requirements of the Cluster.

CHAPTER I
STATUS OF HORTICULTURE

1.1 HORTICULTURE REDEFINED

Horticulture a derivative of latin words *hortus*: garden plant; *cultura*: culture denotes culture of garden plants. It involves four areas of study: Pomology (production of fruits), Olericulture (production of vegetables) Floriculture (production of ornamental crops), and Post Harvest Technology (involving maintaining quality and preventing spoilage of horticultural crops). However over the years the scope of the above filed has been expanded to include other crops namely mushroom, bamboo, plantation crops like tea, coffee, rubber, cocoa, coconut, cashew nut, arecanut, oilpalm, palmyra palm. Bee keeping, one of the tools to improve the productivity of horticultural crops through enhanced pollination is also taken care by the horticulture division at the center.

Botanically fruit is a ripened ovary and adnate parts thereof. The science of cultivation of fruits is called **Pomology**. It deals with the growing and harvesting of fruits. However some crops like watermelon, musk melon which are consumed in raw form are not covered in this group at present.

Plantation Crops are defined as a group of commercial crops of (i) perennial nature, (ii) cultivated extensively in tropical and subtropical situations which (iii) need employment of labour throughout the year and the produce of which is usually consumed after processing. Plantation crops may be defined as 'tropical crops grown on a large scale by a uniform system of cultivation under central management. In general 'Plantation crops are those cultivated on an extensive scale in large contiguous area owned and managed by an individual or a company. Again in the ICAR, the nodal research organization in the country the Central Plantation Crops Research Institute has been dealing with coconut, arecanut, oil palm, palmyrah palm and cashew. Even Oil Palm, a plantation crop with similar growth habit, upkeep like coconut (which also yield oil) is often erroneously clubbed with oil seed crops.

As far as **Vegetables** are concerned they are edible material of herbaceous origin of a plant or part there of generally grouped into leaf, fruiting, flowering, pod, stem, bulb, and root types used for food as raw or cooked with cholesterol free no calorific value, providing micronutrients, vitamins, antioxidants, fiber and alkaline reaction. Several crops which produce tubers namely potato, cassava, sweet potato are all covered under vegetables. Similarly **Spices** which are aromatic or pungent vegetable substances of herbaceous plant origin used for colour, fragrance, preservation and taste of food are now broadly covered under vegetable crops. This will avoid grouping of crops like onion, ginger, turmeric and chilli both under vegetable and spice crops. .

Traditionally **Floriculture** has been defined as the art and knowledge of growing flowers to perfection. Globally floriculture denotes a discipline of horticulture concerned with the cultivation of flowering and ornamental plants for gardens and for floristry, comprising the floral industry. However due to enormous diversity of crops and product range the floriculture sector handles today, the floriculture sector in the modern context may be defined as the art and science of growing traditional flowers, cut flowers, bedding plants, flowering and foliage potted plants, arboriculture trees, cut greens, fillers, turf grass and dry flowers for beautification, value addition and isolation of essential oils, pharmaceutical and nutraceutical compounds.

Medicinal plants are those plants that possess secondary metabolites that have pharmaceutical and nutraceutical properties, which prevent or cure ailments. A majority of

the present day drugs are basically plant derived. While **Aromatic plants** are those plants that possess volatile fatty acids (essential oils) that are characterized by sweet aroma used for making perfumes, flavours, cosmetics, aromatherapy products, confectionery, food and beverages. However both the groups comprise mainly ornamental or forest species not covered in any other groups. However overlapping of crops among the groups is quite evident owing their use and application. For instance a number of ornamental crops (jasmine, rose, tuberose, geranium etc) also fall under the aromatic crops and many ornamental crops also fall under the category of medicinal plants (*Aloe vera, Chlorophytum etc,)*

In view of the above developments Horticulture can be now redefined as the science of growing and management of fruits, vegetables including tubers, ornamental, medicinal and aromatic crops, spices, plantation crops, mushroom, bamboo their processing, value addition and marketing.

1.2 STATUS OF HORTICULTURE INDUSTRY IN INDIA

India grows wide group of horticultural crops namely fruits; vegetables, potato, tropical tuber crops and mushroom; ornamental crops; medicinal and aromatic plants, spices and plantation crops like coconut, cashew, cocoa, tea, coffee and rubber. Recently bamboo and honey bees are also included in the list of horticulture. Government of India laid major emphasis on horticulture from mid eighties onwards as a mean of diversification for making agriculture more profitable through efficient land use, optimum utilization of natural resources (soil, water and environment) and creating skilled employment for rural masses especially women folk. The past efforts have been rewarding and India has now emerged as the largest producer of coconut, arecanut, cashew, ginger, turmeric, black pepper and the second largest producer of fruits, vegetables and tea. Among the new crops, kiwi, olive, gherkins, Kinnow and oil palm have been successfully introduced for commercial cultivation in the country.

Production base of horticultural crops has been expanding since independence. From eighth plan onwards this sector has been witnessed tremendous growth in area and production and productivity. The area and production under horticultural crops were 13.43 million ha and 97.83 million tonnes respectively during 1991-92 which increased to 21.74 Million ha and 171. 86 million tonnes during 2004-05 (Table 1.1)

The area under horticultural crops has been increasing in various states. During 2004-05 coverage of area under various horticultural crops was 19.40 million ha (Table 1.2) which is about 13.0 % area of the total cultivated area. The states/ UTs namely Chhatishgarh, Gujarat, Haryana, Jharkhand, Madhya Pradesh, Nagaland, Punjab, Uttar Pradesh, Dadar & Nagar Haveli have less than 10 per cent coverage of area under horticultural crops which need programme for area expansion under horticultural crops. The states namely Andhra Pradesh, Assam, Bihar, Karnataka, Maharashtra, Orissa, Rajasthan, Tamil Nadu and Uttaranchal covers about 10-25 per cent area under horticultural crops. The 6 states namely Arunachal Pradesh, Himachal Pradesh, Jammu & Kashmir, Meghalaya, Sikkim, Pondicherry covers about 25-50% of their area under horticulture while the states Goa, Kerala ,Manipur, Andman & Nicobar, Delhi, Lakshdweep have more than 50 per cent of their area and are saturated for further area expansion in horticulture.

Table 1.1 Area production and productivity of horticultural crops in India during 2004-05

Crops	1991-92		1996-97		2001-02		2004-05	
	Area (000'ha)	Production (000'MT)	Area (000'ha)	Production (000'MT)	Area (000'ha)	Production (000'MT)	Area (000'ha)	Production (000'MT)
Fruit	2,870	28,630	3,580	40,458	4,010	43,001	4,954	49,294
Vegetable	5,140	58,530	5,515	75,074	6,156	88,622	6,755	101,433
Mushroom	NA	NA	NA	40	NA	40	NA	50
Flowers	NA	NA	71	366	106	535	116	655
Medicinal & Aromatic Plants	NA	NA	NA	NA	NA	NA	192	226
Spices	2,005	1,900	2,372	2,805	3,220	3,765	5,155	5,113
Coconut	1,530	6,930	1,890	8,990	1,893	8,821	1,934	12,178
Arecanut	212	240	261	307	335	409	365	439
Cashew	530	300	659	430	750	470	820	554
Tea	420	754	434	810	515	838	521	893
Coffee	223	180	251	205	321	301	328	275
Rubber	488	367	553	550	567	631	578	750
Cocoa & Others	14	7	12	7	16	6.54	28	9.3
Total	**13432**	**97838**	**15578**	**130.042**	**17889**	**147439.5**	**21,746**	**1,71,859.3**

Table1.2 State wise area under horticulture crops during 2003-04

State/UTs	% Area under Horticulture	State/UTs	% Area under Horticulture
Andhra Pradesh	11.41	Nagaland	7.20
Arunachal Pradesh,	40.15	Orissa	20.91
Assam	14.34	Punjab	4.85
Bihar	19.63	Rajasthan	14.80
Chattishgarh	2.75	Sikkim	58.80
Goa	70.85	Tamil Nadu	16.86
Gujarat	8.57	Tripura	28.47
Haryana	6.50	Uttaranchal	15.20
Himachal Pradesh	44.85	Uttar Pradesh	6.41
Jammu & Kashmir	34.13	West Bengal	25.89
Jharkhand	4.73	Andman & Nicobar	100.00
Karnataka	12.73	Chandigarh	10.00
Kerala	73.33	Dadar & Nagar Haveli	9.17
Madhya Pradesh	4.61	Daman & Diu	12.50
Maharashtra	10.23	Delhi	83.32
Manipur	57.21	Lakshdweep	100.00
Meghalaya	31.25	Pondicherry	31.24
Mizoram	18.00	National	13.08

1. 3 STATUS OF FRUIT CROPS

1.3.1 Global Scenario

The global fruit production during 2004 was 511 million tonnes. During the past 15 years, production of fruits in China has gone up by 246 per cent, which helped China to become the largest producer of fruits (83.24 million tonnes) in the world from its third largest producer position. It contributes 16 per cent share in production. India is the second largest producer of fruits by producing 49 million tonnes and contributes 10 per cent share in global fruit production. Brazil occupies the third position, with 36 million tonnes and contributes 7 per cent in global production. The other countries among top ten producers are USA (5 per cent), Italy (4 per cent), Spain (3 per cent), Mexico (3 per cent), Indonesia (3 per cent), Iran (2 per cent) and Philippines (2 per cent) (Table 1.3).

Table1.3 Fruit production in major countries of the world

Country	Production (million tonnes)			
	1991	2001	2004	% Change over 1991 to 2004
World	353.32	472.24	511.04	44.6
China	24.08	68.92	83.24	245.7
India	28.04	43.00	49.29	75.8
Brazil	31.59	33.31	36.01	14.0
USA	24.70	30.06	30.19	22.2
Italy	17.52	18.29	17.92	2.3
Spain	12.79	15.14	16.69	30.5
Mexico	9.63	14.30	14.76	53.3
Indonesia	6.61	11.66	14.75	123.1
Iran	7.58	12.67	13.14	73.4
Philippines	8.21	11.12	12.37	50.7

India occupies first place in production of mango, banana, litchi, papaya, pomegranate, sapota and aonla, 2nd place in limes and lemons and 5th place in pineapple production of the world. The productivity of grape is highest in the world. India has higher national average

productivity in banana and sapota compared to world average productivity, while in citrus, mango, apple, guava, pineapple, papaya, India has substantial by low productivity in comparision to the world average.

1.3.2 Indian Scenario

India with its wide diversity in climate and soil has given rise to the formation of a variety of ecosystems. It produces a large range of fruits commercially in various agroclimatic zones. , Among these, mango, banana, citrus, pineapple, papaya, guava, sapota, jackfruit, litchi and grape, among the tropical and sub-tropical fruits; apple, pear, peach, plum, apricot, almond and walnut among the temperate fruits and aonla, ber, pomegranate, annona, fig, phalsa among the arid zone fruits are important. India accounts for 10 percent of Global total production of fruit crops. Increase in the production and productivity is largely due to the adoption of improved technologies, which include quality planting material, balanced nutrients and timely protection against major insect-pests and diseases.

Analysis of area, production and productivity under fruits in various states reveals over all growth in area, production and productivity during the VIII, IX and Xth plan periods (Table 1.4 to 1.6). Maximum growth in area and production under fruits observed in Maharashtra state. The productivity rate was higher in Kerala during 1991-92 to 2001-02 and Uttar Pradesh during 2001-02 to 2004-05. Among states, Maharashtra ranks first in area and production and contributes 27 per cent and 21.5 per cent respectively. Andhra Pradesh ranks second in area and production contributing 13 and 16 per cent.

Among the various fruit growing states, the maximum productivity was observed in Madhya Pradesh (22.6MT/ha), followed by Tamil Nadu (19.9 MT/ha), Gujarat (15.9 MT/ ha) Karnataka (15.9 MT/ ha) and West Bengal (12.8 MT/ ha). The growth in productivity was maximum in Kerala (5 per cent) during 1991-92 to 2001-02 while in Uttar Pradesh (10.2 per cent) during 2001-02 to 2004-05.

Table 1.4 Area under fruits in major fruit growing states

State/ UT's	Area (000 ha)			Growth rate (%)	
	1991-92	2001-02	2004-05	1991-92 to 2001-02	2001-02 to 2004-05
Andhra Pradesh	313.1	575.8	652.0	6.28	4.23
Bihar	266.9	272.3	276.1	0.20	0.46
Gujrat	84.6	149.0	251.9	5.82	19.13
Karnataka	209.2	257.1	255.1	2.08	-0.26
Kerala	236.3	234.5	170.4	-0.08	-10.10
Madhya Pradesh	64.7	46.6	48.7	-3.23	1.48
Maharashtra	256.1	582.8	1,346.5	8.57	32.20
Orissa	136.3	225.0	233.4	5.14	1.23
Tamil Nadu	136.2	227.5	224.6	5.26	-0.43
Uttar Pradesh	453.7	288.3	274.9	-4.43	-1.57
West Bengal	111.2	147.6	166.3	2.87	4.06
Others	606.1	1,003.6	1,063.9	5.17	1.96
Total	**2,874.2**	**4,010.1**	**4,963.8**	**3.39**	**7.37**

Table 1.5 Fruit production of major fruit growing states

State/UT's	Production (000 MT)			Growth rate (%)	
	1991-92	2001-02	2004-05	1991-92 to 2001-02	2001-02 to 2004-05
Andhra Pradesh	4,008.2	6,157.4	7,735.4	4.39	7.90
Bihar	2,799.3	2,877.0	2,769.5	0.27	-1.26
Gujarat	1,828.9	2,346.9	4,014.4	2.53	19.59
Karnataka	3,191.8	4,028.9	4,046.9	2.36	0.15
Kerala	1,101.3	1,772.6	985.1	4.87	-17.78
Madhya Pradesh	1245	1,143.8	1,102.6	-0.84	-1.22
Maharashtra	3,518.4	8,840.6	10,586.3	9.65	6.19
Orissa	978.0	1,362.9	1,404.0	3.37	1.00
Tamil Nadu	2,316.1	4,342.4	4,467.6	6.49	0.95
Uttar Pradesh	2,878.5	2,282.8	2,912.8	-2.29	8.46
West Bengal	1,131.7	1,985.5	2,128.3	5.78	2.34
Others	3,634.8	5,860.1	7,141.9	4.89	6.82
Total	**28,632.6**	**43,000.9**	**49,294.8**	**4.15**	**4.66**

Table 1.6 Productivity of fruits in major fruit growing states

State/ UT's	Productivity (MT/ha)			Growth (per cent)	
	1991-92	2001-02	2004-05	1991-92 to 2001-02	2001-02 to 2004-05
Andhra Pradesh	12.8	10.7	11.9	-1.78	3.52
Bihar	10.5	10.6	10.0	0.07	-1.72
Gujarat	21.6	15.8	15.9	-3.12	0.39
Karnataka	15.3	15.7	15.9	0.27	0.41
Kerala	4.7	7.6	5.8	4.95	-8.55
Madhya Pradesh	19.2	24.5	22.6	2.46	-2.66
Maharashtra	13.7	15.2	7.9	1.00	-19.67
Orissa	7.2	6.1	6.0	-1.68	-0.23
Tamil Nadu	17.0	19.1	19.9	1.16	1.38
Uttar Pradesh	6.3	7.9	10.6	2.24	10.20
West Bengal	10.2	13.5	12.8	2.83	-1.65
Others	6.0	5.8	6.7	-0.27	4.76
Total	**10.0**	**10.7**	**9.9**	**0.74**	**-2.53**

India accounts for an area of 4.96 million ha under fruit crops with a production of 49.29 million tonnes. During the period 1991-92 to 2001-02 growth in area, production and productivity of fruits observed at the rate of 3.39, 4.15 and 1.92 per cent while between 2001-02 and 2004-05 it was 7.37, 4.66 and -12.06 per cent respectively. The trend in area, production and productivity of different fruits during 1991-92 and 2001-02 and 2004-05 is given in Table 1.7 and 1.8.

Table 1.7 Area, production and productivity of major fruit crops in India

(Area '000 ha, Production '000 tonnes, Productivity MT/ha)

Crop	1991-92			2001-02			2004-05		
	Area	Prod	Pty	Area	Prod	Pty	Area	Prod	Pty
Apple	195	1,148	5.88	241.6	1,158	4.8	230.7	1,739	7.54
Banana	384	7,790	20.27	466.2	14,210	30.5	529.7	16,225	30.63
Citrus	387	2,822	7.21	618.5	4,789	7.5	712.4	5,997	8.42
Grape	32	668	20.87	49.4	1,210	24.4	60.2	1,546	25.69
Guava	94	1,095	11.64	154.6	1,716	11.1	162.0	1,686	10.40
Litchi	49	244	4.97	58.1	356	6.1	60.0	369	6.14
Mango	1,078	8,752	8.11	1,575.8	10,020	6.4	1,961.9	11,605	5.92
Papaya	45	805	17.88	73.7	2,590	35.1	73.0	2,568	35.18
Pineapple	57	769	13.49	77.2	1,182	15.3	81.2	1,229	15.14
Sapota	27	396	14.66	52.0	594	11.4	133.1	1,060	7.97
Others	526	4,144	7.87	643.1	5,176	8.0	847.0	4,477	5.29
Total	**2,874**	**28,632**	**12.07**	**4,010.3**	**4,3001**	**14.6**	**4,963.8**	**49,295**	**9.93**

Table 1.8 Growth in area, production and productivity of major fruit crops in India

(Per cent)

Crop	1991-92 to 2001-02			2001-02 to 2004-05		
	Area	Production	Productivity	Area	Production	Productivity
Apple	2.17	0.09	-2.01	-1.53	14.52	16.25
Banana	1.96	6.20	4.17	4.35	4.52	0.14
Citrus	4.80	5.43	0.40	4.82	7.79	3.93
Grape	4.44	6.12	1.57	6.81	8.51	1.73
Guava	5.10	4.59	-0.47	1.57	-0.59	-2.15
Litchi	1.72	3.85	2.07	1.08	1.20	0.22
Mango	3.87	1.36	-2.34	7.58	5.02	-2.57
Papaya	5.06	12.40	6.99	-0.32	-0.28	0.03
Pineapple	3.08	4.39	1.27	1.70	1.31	-0.35
Sapota	6.77	4.14	-2.48	36.79	21.29	-11.27
Others	2.03	2.25	0.16	9.61	-4.72	-12.88
Total	**3.39**	**4.15**	**1.92**	**7.37**	**4.66**	**-12.06**

1.3.3 Crop-wise Status

1.3.3.1 Apple

India has large area under apple cultivation next to China and Russian Federation, it ranks ninth in production among apple-growing countries of the world because of low productivity. Apple is the fourth major fruit crop of India and occupies a total area of 0.230 million ha with production of 1.74 million tonnes. Leading apple producing states are Jammu and Kashmir, Himachal Pradesh, Uttaranchal and Arunachal Pradesh. Maximum area, production and productivity under apple are reported from Jammu and Kashmir. Himachal Pradesh has the second largest area under apple but production and productivity are very low compared to Jammu and Kashmir. In Uttaranchal and Arunachal Pradesh, productivity is still lower than Himachal Pradesh. During the last 4 years apple area in Himachal Pradesh and Uttaranchal showed decline while productivity has gone up in both the states. In Nagaland the apple area showed increasing trend while the production and productivity had a negative growth because of the new plantations, which are yet to come into bearing (Table 1.9 to 1.10).

Table 1.9 Area, production and productivity of apple in India

States	Area (ha)		Production (MT/ha)		Productivity (MT/ha)	
	2001-02	2004-05	2001-02	2004-05	2001-02	2004-05
Jammu & Kashmir	90,100	1,07,900	9,09,600	10,93,300	10.10	10.1
Himachal Pradesh	92,800	86,200	1,80,600	5,27,600	1.90	6.1
Uttaranchal	51,800	27,800	59,300	1,08,500	1.10	3.9
Arunachal Pradesh	6,700	8,400	8,500	9,500	1.30	1.1
Nagaland	100	300	300	100	3.30	.4
Total	**2,41,600**	**230700**	**11,58,300**	**17,39,000**	**4.80**	**7.5**

Table 1.10 Growth in area, production and productivity of apple in India

(2001-02 to 2004-05) **(Per cent)**

States	Area	Production	Productivity
Jammu & Kashmir	6.19	6.32	0.00
Himachal Pradesh	-2.43	42.95	47.52
Uttaranchal	-18.73	22.31	52.48
Arunachal Pradesh	7.83	3.78	-5.42
Nagaland	44.22	-30.66	-50.51
Total	**-1.53**	**14.51**	**16.04**

1.3.3.2 Banana

India is the largest producer of banana in the world. Other major banana producing countries are Brazil, China, Equador, Philippines, Indonesia, Costa Rica, Mexico, Thailand, Burundi, Columbia, and Vietnam. Ecuador, Philippines, Costa Rica and Colombia, produce much less banana than India, but they are specialized in producing first grade table bananas and maximum export of banana is done by these countries. Among fruits, banana ranks third in area with 0.53 million ha and first in production with 16.22 million tonnes contributing 11 per cent of area and 32.9 per cent of fruit production. The state of Tamil Nadu ranks first in area while production and productivity is highest in Maharashtra (Table1.11). Lower yields in Assam (24.5 MT/ ha), Kerala (7.63 MT/ ha), Andhra Pradesh (22.99 MT/ha) and Karnataka (23.8 MT/ha) are mainly due to varying cultivation practices adopted and extent of inputs applied for cultivation. Lower yields in Kerala are mainly due to cultivation of low yielding cultivars like Nendran. The phenomenal increase in production and productivity in certain pockets has been due to adoption of high density planting, use of tissue-cultured seedlings and drip irrigation. During past four years productivity of banana in Bihar has gone up by 18 per cent. The overall increase is productivity during 2001-02 to 2004-05 in Maharashtra in inexplicable (Table1.12).

Table1. 11. Area, production and productivity of banana in India

State	Area (ha)		Production (MT)		Productivity (MT/ha)	
	2001-02	2004-05	2001-02	2004-05	2001-02	2004-05
Andhra Pradesh	50,500	53,500	11,11,200	12,29,700	22.00	22.99
Assam	43,600	42,100	6,05,900	5,81,000	13.90	13.80
Bihar	2,7200	28,000	5,44,900	9,20,000	20.00	32.86
Gujarat	33,100	46,300	11,54,300	19,79,300	34.80	42.75
Karnataka	53,800	52,613	12,77,600	12,92,444	23.80	24.57
Kerala	28,100	55,700	3,95,400	4,25,200	14.10	7.63
Madhya Pradesh	18,200	16,500	7,36,500	6,60,300	40.50	40.02
Maharashtra	59,700	72,200	39,24,100	45,34,600	65.70	62.81
Tamil Nadu	84,600	81,500	35,43,800	34,61,800	41.90	42.48
Others	67,200	81,287	9,16,200	11,40,956	13.63	14.04
Total	**4,66,200**	**5,29,700**	**1,42,09,900**	**1,62,25,300**	**30.50**	**30.63**

Table 1.12 Growth in area, production and productivity of banana in India (2001-02 to2004-05) **(Per cent)**

States	Area	Production	Productivity
Andhra Pradesh	1.94	122.84	1.48
Assam	-1.16	-1.39	-0.24
Bihar	0.97	19.08	18.00
Gujarat	11.84	19.69	7.10
Karnataka	-0.74	0.39	1.07
Kerala	25.62	2.45	-18.51
Madhya Pradesh	-3.22	-3.58	-0.40
Maharashtra	6.54	4.94	-1.49
Tamil Nadu	-1.24	-0.78	0.46
Others	6.55	7.59	0.99
Total	**4.35**	**4.52**	**0.14**

1.3.3.3 Citrus

India occupies sixth position among citrus growing countries in the World. Maximum productivity is obtained in USA (35.11 MT/ha) followed by Brazil (21.66 MT/ha), Spain (19.80 MT/ha) and Italy (17.76 MT/ha). In India citrus ranks second in area with 0.71 million ha and third in production with 6.0 million tonnes (Table 1.13). Limes, lemons, sweet orange and mandarin cover bulk of the area under citrus fruits. Citrus fruits are grown mainly in the states of Andhra Pradesh, Maharashtra, Karnataka, Punjab, Gujarat and N.E. region. Kinnow is cultivated commercially in some states of northern India particularly Punjab, Rajasthan, Haryana and Uttaranchal. Cultivation of grapefruit and pummelo introduced decades back did not catch up commercially.

Table 1.13. Area production and productivity of citrus in India

States	Area (ha)		Production (MT)		Productivity (MT/ha)	
	2001-02	2004-05	2001-02	2004-05	2001-02	2004-05
Andhra Pradesh	1,44,700	1,60,100	1135,600	2122,000	7.9	13.3
Assam	14,800	16,600	125,000	142,500	8.5	8.6
Bihar	16,400	16,800	130,000	122,900	8.0	7.3
Gujarat	20,200	27,900	1,97,800	285,300	9.8	10.2
Karnataka	16,800	15,000	3,60,200	338,000	21.5	22.5
Madhya Pradesh	13,000	16,600	2,08,700	265,200	16.0	16.0
Maharashtra	1,68,700	2,37,800	1730,400	1438,000	10.3	6.0
Orissa	24,000	26,400	134200	204,700	5.6	7.7
Punjab	17,100	22,500	2,27,200	312,300	13.3	13.9
Others	1,82,900	1,72,700	539,200	766,000	-	-
Total	**6,18,500**	**712,400**	**4789,100**	**5996,900**	**7.7**	**8.4**

Mandarins are cultivated over an area of 0.18 million ha with a production of 1.24 million tonnes. Total production of mandarins at global level during 2000 was 18,841,078 MT (2001-02). In mandarin production, India stands next to China (76,11,059 MT) and Spain (17,98,400 MT). However, productivity in India is quite low, i.e. 6.7 MT/ha, compared to Spain, Morocco, Korea Republic, Italy, Egypt, Brazil, Turkey and USA (17.4 to 24.8 MT/ha). Mandarins are produced in Maharashtra, Madhya Pradesh, Assam, West Bengal, Mizoram, Nagaland, Tripura, Arunachal Pradesh, Tamil Nadu, Rajasthan, Sikkim, Meghalaya and Manipur Kinnow is cultivated exclusively in Punjab, Haryana, Rajasthan, over an area of 15,903 ha with a total production of 2, 35,331 MT (2001-02). It is also produced to some extent (4,85,000 tonnes) in Pakistan. Maximum acreage and production under Kinnow is in Punjab, followed by Haryana and Rajasthan.

Sweet oranges are cultivated in several states of India covering 0.19 million ha with a total production of 2.08 million tonnes (2004-2005). Maximum area and production of sweet

orange is reported from Andhra Pradesh followed by Maharashtra, while maximum productivity is recorded from Madhya Pradesh. Rajasthan and Himachal Pradesh have the lowest productivity.

Lime (*C. aurantifolia*) and lemons (*C. limon*) are grown in sizable area of 0.17 million ha with a total production of 1.54 million tonnes. Limes are mostly grown in Andhra Pradesh, Karnataka, Gujarat, Maharashtra, Rajasthan, Madhya Pradesh and Tamil Nadu, whereas lemon is mostly grown in hilly areas of Assam, Nagaland, Tripura, Manipur, Mizoram , Uttaranchal and Punjab. Maximum production of lime takes place in Andhra Pradesh, followed by Karnataka, Gujarat, Bihar and Maharashtra. Highest lemon production is in Assam (54,000 MT) followed by Tripura (40,312 MT). India is only next to Mexico in production of limes and lemons. Highest productivity of limes is in Karnataka and medium in Andhra Pradesh, Gujarat and Maharashtra. The lowest productivity of lime is in Tamil Nadu as the plantations are in declining condition (Table 1.14 and 1.15).

Table 1.14 Lime / lemon producing states in India

State	Area (ha)		Production (MT)		Productivity (MT/ha)	
	2001-02	2004-05	2001-02	2004-05	2001-02	2004-05
Andhra Pradesh	40,704	50,200	4,88,448	6,93,200	12.00	13.8
Assam	8,770	8,800	54,000	59,200	6.16	6.7
Bihar	16,400	16,800	1,30,900	1,34,200	7.98	8.0
Gujarat	20,200	22,300	1,97,800	2,24,700	9.79	10.1
Karnataka	12,700	9,076	2,82,700	1,75,411	22.26	19.3
Madhya Pradesh	1,128	1,100	18,048	17,300	16.00	16.0
Maharashtra	10,000	34,000	94,800	1,76,600	9.48	5.2
Manipur	1,130	NA	5,141	NA	4.55	NA
Mizoram	992	NA	2,780	NA	2.80	NA
Nagaland	645	NA	6,075	NA	9.42	NA
Punjab	668	NA	4,676	NA	7.00	NA
Rajasthan	2,900	2,800	18,200	19,400	6.28	6.9
Tamil Nadu	7,800	NA	12,300	NA	1.58	NA
Tripura	3,227	NA	40,312	NA	12.49	NA
Others	39,564	22,800	1,03,081	41,700	2.61	1.8
Total	**1,61,300**	**1,67,900**	**14,13,700**	**15,41,800**	**8.76**	**9.2**

Table 1.15 Growth in area, production, productivity of lime / lemon

(2001-02 to 2004-05) **(per cent)**

States	Area	Production	Productivity
Andhra Pradesh	7.24	12.38	4.77
Karnataka	-10.59	-14.71	-4.64
Gujarat	3.35	4.34	1.04
Bihar	0.81	0.83	0.08
Maharashtra	50.37	23.04	-18.14
Assam	0.11	3.11	2.84
Rajasthan	-1.16	2.15	3.19
Madhya Pradesh	-0.83	-1.40	0.00
Others	-16.78	-26.04	-11.65
Total	**1.35**	**2.93**	**1.65**

1.3.3.4 Grape

The major grape growing countries are Italy, France, USA, Spain, China, Turkey, Iran, Argentina, Australia, Chile, Germany, South Africa and India. India's high productivity in grape has made it to reach 12th position in the World as far as production is concerned, but from acreage point of view, India's position is 33rd among grape-growing countries in the

World. Grapes are cultivated in 0.06 million ha with a total production of 1.55 million tonnes and productivity of 25.7 MT/ha. It registered 6.81 and 8.53 per cent increase in area and production between, 2001-02 to 2004-05 while productivity improved by 1.3 per cent. Maximum area and production of grapes has increased in Maharashtra, followed by Karnataka and Tamil Nadu. In Andhra Pradesh, Punjab and Haryana, grapes are cultivated only to a limited extent. However, there is again a recent surge in grape production in Andhra Pradesh (Table 1.16 and 1.17).

Table 1.16 Area, production and productivity of grape in India

State	Area (ha)		Production (MT)		Productivity (MT/ha)	
	2001-02	2004-05	2001-02	2004-05	2001-02	2004-05
Andhra Pradesh	1,500	1,900	29,400	37,800	20.0	20.0
Haryana	1,100	100	6,400	1,400	5.7	10.5
Jammu &Kashmir	200	200	300	300	1.6	1.5
Karnataka	10,000	9,700	1,69,700	1,67,400	16.9	17.2
Madhya Pradesh	100	100	2,600	2,400	25.0	25.0
Maharashtra	32,500	43,800	9,11,600	12,33,900	28.1	28.2
Mizoram	200	500	600	600	3.2	1.2
Punjab	1,400	1,200	36,700	32,300	27.2	27.0
Tamil Nadu	2,400	2,500	51,700	69700	22.0	28.2
Others	100	200	600	500	6.0	3.2
Total	**49,400**	**60,200**	**12,09,700**	**15,46,300**	**24.5**	**25.7**

Table 1.17 Growth in area, production and productivity of grape

(2001-02 to 2004-05) **(per cent)**

States	Area	Production	Productivity
Maharashtra	10.46	10.62	0.12
Karnataka	-1.01	-0.45	0.59
Tamil Nadu	1.37	10.47	8.63
Punjab	-5.01	-4.17	-0.25
Andhra Pradesh	8.20	8.74	0.00
Haryana	-55.04	-39.75	22.59
Madhya Pradesh	0.00	-2.63	0.00
Mizoram	35.72	0.00	-27.89
Jammu and Kashmir	-	-	-2.13
Others	25.99	-5.90	-18.90
Total	**6.81**	**8.53**	**1.61**

1.3.3.5 Guava

Guava is cultivated in sizeable area in Brazil, Mexico, Thailand, USA (Hawaii), New Zealand, Philippines, China, Indonesia, Venezuela and Australia, etc. The best quality guavas are cultivated and produced in Uttar Pradesh particularly in the Allahabad region. In India it is cultivated in an area of 0.16 million ha with a total production of 1.29 million tonnes (Table 1.18). The maximum area under guava is found in Bihar, followed by Maharashtra, Uttar Pradesh, Andhra Pradesh, Karnataka, West Bengal and Gujarat. More than 50% of the total production of guava is produced in Bihar, Maharashtra, Karnataka and Uttar Pradesh. The highest productivity of guava is observed in Karnataka (18.70 MT/ha), Lowest productivity being in Maharashtra (6.9 MT/ha) and Orissa (6.5 MT/ ha). The total production between 2001 and 2005 had negative growth rate (-9.17%). Significant increase in productivity i.e. 8.17 percent was seen in Uttar Pradesh during the period from 2001-02 to 2004-05 (Table 1.19).

Table 1.18 Area, production and productivity of guava in different states of India

State	Area (ha)		Production (MT)		Productivity (MT/ha)	
	2001-02	2004-05	2001-02	2004-05	2001-02	2004-05
Andhra Pradesh	11,800	7300	1,18,600	120800	10.0	12.0
Bihar	27,100	27700	3,24,600	256100	12.0	9.3
Chhatisgarh	4,800	NA	96,300	NA	20.0	NA
Gujarat	7,200	6100	9,500	86100	13.1	14.1
Karnataka	8,600	8100	1,52,800	151000	17.7	18.7
Maharashtra	15,800	30800	1,90,100	212300	12.0	6.9
Punjab	5,200	7300	91,000	127900	17.5	17.5
Uttar Pradesh	17,300	14800	1,36,100	147900	7.9	10.0
West Bengal	7,400	9400	1,21,300	140900	16.5	15.0
Others	49,300	25900	3,89,600	288300	7.9	11.1
Total	**1,54,600**	**162000**	**17,15,500**	**1285600**	**11.1**	**10.4**

Table 1.19 Growth in area, production and productivity of guava in India, (2001-02 to 2004-05) **(Per cent)**

States	Area	Production	Productivity
Andhra Pradesh	-14.79	0.61	6.27
Bihar	0.73	-7.60	-8.15
Gujarat	-5.38	108.49	2.48
Karnataka	-1.98	-0.39	1.85
Maharashtra	24.92	3.75	-16.84
Punjab	11.97	12.02	0.00
Uttar Pradesh	-5.07	2.81	8.17
West Bengal	8.30	5.12	-3.13
Others	-19.31	-9.55	12.00
Total	**1.57**	**-9.17**	**-2.15**

1.3.3.6 Litchi

India is the largest producer of litchi in the world. Other major Litchi producing countries are China, Taiwan, Thailand, South Africa, Madagascar and Australia. Although authentic data on litchi-production is not available, total world litchi production is estimated to be 6-6.5 lakh tonnes. In India, the total area under litchi is 0.060 million ha with production of 0.368 million tonnes (Table 1.20).

Litchi is largely grown in Bihar, West Bengal and Assam. It is also grown in small pockets in Uttaranchal, Punjab, Haryana, U.P., West Bengal and N.E region. The productivity of litchi in Bihar and Uttaranchal has gone down by 3.45 and 49.3 per cent respectively (Table 1.21). The present situation clearly suggests the potential for increasing productivity particularly in Assam, Tripura, Jharkhand, Uttaranchal, Orissa and Himachal Pradesh. So far, adequate attention to litchi in Assam, Tripura, Orissa, Himachal and Uttaranchal has not been given. Furthermore, no efforts have been made to exploit early availability of litchi during the season from Assam, Tripura, and West Bengal to meet the domestic and export demand.

Table 1.20. Area, production and productivity of litchi in India

State	Area (ha)		Production (MT)		Productivity (MT/ha)	
	2001-02	2004-05	2001-02	2004-05	2001-02	2004-05
Assam	4,100	4,500	18,700	22,500	4.6	5.0
Bihar	27,700	28,400	2,21,700	2,04,900	8.0	7.2
Jharkhand	1,500	1,400	7,500	16,500	5.0	12.0
Nagaland	800	NA	4000	NA	5.1	NA
Orissa	3,500	3,900	10,200	11,900	2.9	3.0
Punjab	1,200	1,300	11,600	12,600	10.0	10.0
Tripura	1,700	2,200	9,000	12,400	5.1	5.6
Uttaranchal	7,800	6,700	7,500	8,900	10.0	1.3
West Bengal	5,900	7,200	61,400	69,900	10.5	9.8
Others	4,000	4,400	4,500	9,000	-	-
Total	**58,200**	**60,000**	**3,56,200**	**3,68,600**	**6.1**	**6.1**

Table 1.21. Growth in area, production and productivity of litchi in India (2001-02 TO 2004-05) (Per cent)

States	Area	Production	Productivity
Assam	3.15	6.36	2.82
Bihar	0.84	-2.59	-3.45
Jharkhand	-2.27	30.06	33.89
Orissa	3.67	5.27	1.14
Punjab	2.70	2.79	0.00
Tripura	8.97	11.27	3.17
Uttaranchal	-4.94	5.87	-49.34
West Bengal	6.86	4.42	-2.27
Others	3.23	1.53	-1.65
Total	**1.02**	**1.15**	**0.00**

1.3.3.7. Mango

India produces approximately 40.0% of the world's mango and occupies top position among mango-growing countries. China and Thailand stand second and third among mango-producing countries in the world. Brazil, China, Thailand and Mexico have higher average national productivity than India. India has an average productivity of 5.90 tonnes/ha which is about half of the productivity compared to Brazil (11.64 tonnes/ha). The area under mango in India is 1.96 million ha with a total production of 11.61 million tonnes and productivity of 5.9 tonnes/ha (Table 1.22).

Table 1.22. Area, production and productivity of mango in India

State	Area (ha)		Production (MT)		Productivity (MT/ha)	
	2001-02	2004-05	2001-02	2004-05	2001-02	2004-05
Andhra Pradesh	3,41,200	3,91,900	24,45,800	3135200	7.20	8.0
Bihar	1,39,300	1,40,100	12,53,500	8,65,600	9.00	6.2
Gujarat	65,300	89,700	4,57,600	7,29,100	7.00	8.1
Karnataka	1,15,400	1,17,500	11,30,600	11,05,900	9.80	9.4
Maharashtra	1,64,400	4,32,700	5,59,000	6,34,300	3.40	1.5
Orissa	1,07,300	1,20,300	4,02,400	4,16,300	3.80	3.5
Tamil Nadu	1,10,800	1,18,400	4,38,700	5,39,400	4.00	4.6
Uttar Pradesh	2,53,000	2,47,000	19,50,000	25,85,600	7.70	10.5
West Bengal	65,400	69,100	5,85,000	4,60,800	8.94	6.7
Others	2,13,700		7,97,600		3.73	
Total	**15,75,800**	**19,61,900**	**1,00,20,200**	**1,16,05,200**	**6.40**	**5.9**

Mango is grown in about 40 per cent area and contributes 23.5 per cent in total fruit production. It is grown in almost all the states of India. Andhra Pradesh tops the list of mango producing states, with highest acreage as well as production. Other major mango producing states are Uttar Pradesh, Bihar, Karnataka, West Bengal, Maharashtra, Tamil Nadu, Orissa and Gujarat. Uttaranchal, Madhya Pradesh and Punjab have very low production. There has been an increase of 31.55 and 14.44 per cent in area and production respectively in mango between 1991-92 and 2001-02 (Table 1.23). While this increase between 2001-02 and 2004-05 was 7.58 and 5.02 respectively for area and production. Comparatively lesser increase in production seems to be due to larger areas under new plantations, which are yet to come to full bearing stage.

Table 1.23. Growth in area, production and productivity mango in India

	(2001-02 to 2004-05)		(Per cent)
States	**Area**	**Production**	**Productivity**
Andhra Pradesh	4.73	8.63	3.57
Bihar	0.19	-11.61	-11.68
Gujarat	11.16	16.80	4.99
Karnataka	0.60	-0.73	-1.38
Maharashtra	38.07	4.30	-23.87
Orissa	3.89	1.14	-2.70
Tamil Nadu	2.24	7.13	4.77
Uttar Pradesh	-0.80	9.86	10.89
West Bengal	1.85	-7.65	-9.17
Others	3.25	12.41	8.90
Total	**7.58**	**5.02**	**-2.68**

The biggest concern in mango production is low productivity in the country. The main reasons for low productivity are old senile orchards, low-yielding cultivars, wider spaced plantations, non-adoption of improved cultivation practices and cultivation of seedlings besides recently planted orchards, which are still in non-bearing phase.

1.3.3.8. Papaya

The major papaya producing countries are Brazil, Nigeria, Mexico, India, Indonesia, Ethiopia, Congo Democratic Republic, Peru, China, Columbia, Thailand and Venezuela. India is the fourth important producer of papaya in the world.

Table 1.24. Area, production and productivity of papaya in India

State	**Area (ha)**		**Production (MT)**		**Productivity (MT/ha)**	
	2001-02	**2004-05**	**2001-02**	**2004-05**	**2001-02**	**2004-05**
Andhra Pradesh	11,700	11,400	11,73,600	8,75,000	100.0	76.5
Assam	7,500	6,800	1,11,800	99,200	14.8	14.7
Gujarat	4,400	6,800	1,75,100	2,68,900	39.4	39.7
Karnataka	3,600	3,600	2,38,100	2,21,700	65.5	70.5
Kerala	13,200	17,700	59,700	80,800	4.5	4.6
Madhya Pradesh	800	9,00	39,200	24,600	49.0	27.0
Maharashtra	5,800	6,500	1,74,400	5,52,500	30.0	85.0
Orissa	10,700	NA	2,17,500	NA	20.3	NA
West Bengal	7,200	8,700	2,41,900	2,45,700	33.5	29.1
Others	8,600	10,600	1,59,100	1,99,800	18.5	-
Total	**73,200**	**73,000**	**25,90,400**	**25,68,200**	**35.1**	**35.2**

Papaya ranks sixth in area and production with 0.073 million ha of the total area and 2.57 million tonnes of the total production under fruits respectively (Table 1.24). Major production of papaya takes place in Andhra Pradesh, followed by Maharashtra, Gujarat and Karnataka,

while the highest fruit productivity was observed in Tamil Nadu followed by Maharashtra and Andhra Pradesh. Between 2001-02 and 2004-05 growth in area and production has shown declining trend (Table 1.25).

Table 1.25. Growth in area, production and productivity of papaya in India

(2001-02 to 2004-05) (Per cent)

States	Area	Production	Productivity
Andhra Pradesh	-0.86	-9.32	-8.54
Assam	-3.21	-3.91	-0.23
Gujarat	15.62	15.37	0.25
Karnataka	0.00	-2.35	2.48
Kerala	10.27	10.61	0.74
Madhya Pradesh	4.00	-14.39	-18.02
Maharashtra	3.87	46.87	41.50
West Bengal	6.51	0.52	-4.59
Others	7.22	7.89	0.63
Total	**-0.09**	**-0.29**	**0.09**

1.3.3.9. Pineapple

Major pineapple growing countries in the world are Thailand, Philippines, Brazil, China and India. India ranks second in area and fifth in production of pineapples in the world. In India, pineapple is cultivated in an area or 0.081 million ha with a total production of 1.23 million tonnes. It is abundantly grown in West Bengal, NE region, Kerala, Karnataka, Bihar, and Maharashtra with maximum area in Assam. Productivity of pineapple is the highest in Karnataka followed by Tamil Nadu, Bihar and West Bengal. Productivity of pineapples in most of the NE states is less than the average national pineapple productivity, which needs to be improved through suitable management practices (Table 1.26).

Table 1.26. Area, production and productivity of pineapple in India

State	Area (ha)		Production (MT)		Productivity (MT/ha)	
	2001-02	2004-05	2001-02	2004-05	2001-02	2004-05
Assam	14,000	12,839	2,20,000	1,98,600	15.6	15.5
Bihar	4,100	4,214	1,01,300	1,22,500	25.0	29.1
Karnataka	2,000	2,144	81,200	86,900	40.0	40.5
Kerala	9,500	11,484	68,300	95,000	7.2	8.3
Manipur	10,300	10,600	75,600	88,600	7.3	8.4
Meghalaya	9,200	9,500	81,700	91,700	8.8	9.7
Nagaland	2,950	2,000	83,200	24,800	28.2	12.4
Tripura	3,700	4,980	82,700	1,05,100	22.3	21.1
West Bengal	11,500	12,850	3,22,000	3,49,800	28.0	27.2
Others	9,800	10,589	66.300	66,400	6.8	-
Total	**77,200**	**81,200**	**11,82,300**	**12,29,400**	**15.3**	**15.1**

1.3.3.10. Pomegranate

Pomegranate is an important fruit crop of India. Presently it is being cultivated in 0.11 million ha area with a total production of 0.79 million tonnes. India occupies top position among pomegranate growing countries in the world, producing 50% of the total world production. Maharashtra is the leading pomegranate producing state having an area of around 88,500 ha followed by Karnataka (12,700 ha). Pomegranate is also grown as wild in forests of Jammu and Kashmir and Himachal Pradesh and 400 and 100 tonnes of *Anardana* is marketed from Jammu and Kashmir and Himachal Pradesh, respectively (Table 1.27).

Table 1.27. Area, production and productivity of pomegranate in India

State	Area (ha)		Production (MT)		Productivity (MT/ha)	
	2003-04	2004-05	2003-04	2004-05	2003-04	2004-05
Andhra Pradesh	-	5,800	-	47,800	-	8.2
Gujarat	-	4,100	-	38,400	-	9.4
Himachal Pradesh	500	600	300	100	0.6	0.2
Karnataka	11,200	12,700	1,16,900	1,24,900	10.4	9.8
Maharashtra	84,300	88,500	53,300	5,68,200	6.3	6.4
Rajasthan	400	400	1,800	1,700	4.5	4.3
Tamil Nadu	500	400	12,900	11,100	25.8	27.8
Total	**96,900**	**1,12,500**	**6,64,900**	**7,92,500**	**-**	**-**

1.3.3.11. Sapota

Sapota or sapodilla is one of the important tropical fruit crops of India. It is cultivated in 1,33,100 ha with a total production of 10,60,200tonnes (2004-05). Major sapota producing states are Karnataka, Maharashtra and Gujarat. Maximum area and production of sapota is also in these state. It is also produced to some extent in Andhra Pradesh, West Bengal, Orissa and Tamil Nadu. The productivity is more or less the same in all the states, except that it is very high in Tamil Nadu and very low in Orissa (Table 1.28).

Table 1.28. Area, production and productivity of sapota in India

State	Area (ha)		Production (MT)		Productivity (MT/ha)	
	2001-02	2004-05	2001-02	2004-05	2001-02	2004-05
Gujarat	-	24,600	-	2,45,300	-	10.0
Maharashtra	18,000	59,900	1,80,500	2,44,300	10.0	4.1
Karnataka	19,800	21,000	2,11,200	2,23,900	10.6	10.6
Tamil Nadu	2,800	5,500	72,100	1,38,600	25.8	25.0
Andhra Pradesh	7,200	14,000	71,100	1,36,900	9.9	9.8
West Bengal	3,300	3,900	39,700	45,400	12.2	11.5
Orissa	-	3,300	-	14,300	-	4.4
Haryana	600	400	16,500	8,300	28.2	19.8
Tripura	-	100	-	1,200	-	10.0
Pondicherry	100	100	1,000	1,000	10.0	10.0
Others		200	-	1,000	-	3.8
Total	**52,000**	**1,33,100**	**5,93,400**	**10,60,200**	**11.4**	**8.0**

1. 3.3.12. Walnut

Walnut is grown in Jammu and Kashmir and Uttaranchal. It is also cultivated in a sizeable area in Himachal Pradesh and Arunachal Pradesh. Walnut is presently grown in 84,700 ha with a total production of 107,200 tonnes. Highest cultivated area and production of walnut is in Jammu and Kashmir followed by Uttaranchal. The production of walnuts has just started in Himachal Pradesh. The productivity of walnut is highest in Jammu and Kashmir (1.39 tonnes/ha). However, in Uttaranchal, it varies from 0.27 to 0.54 tonnes/ha, whereas in Himachal Pradesh it is quite low, i.e 0.25 tonnes/ha. Production in Arunachal Pradesh is yet to start.

1.3.3.13. Other fruits

There are several under exploited and indigenous fruits such as aonla, ber, pomegranate, annona, jackfruit (*Artocarpus heterophyllus*), jamun (*Syzigium cumini),* bael (*Aegle marmelose*), kamrakh (*Averrhoa carambola*), phalsa (*Grewia subinaequalis*), wood apple (*Limonia acidissria*) mulberry (*Morus alba*) and Lasooda (*Cordia mixa*). These fruits have diverse uses, besides being hardy and well adapted to different agro-climatic conditions and

stress situations. There has been a steady increase in the area and production of some of these fruits in the country as a result of identification and development of suitable varieties and production technologies. In addition to these, date palm and fig cultivation are also finding favour in suitable areas.

In recent years, olive and kiwi fruits have been successfully introduced in the temperate areas of Jammu and Kashmir, H.P. and U.P. Other useful introductions have been kinnow mandarin and low chilling varieties of pear, peach and plum, which have become very popular in the sub-tropical zone of northern plains. A number of tropical, sub-tropical fruits like avocado, macademia nut, mangosteen and rambutan though introduced in the country have yet to be commercially exploited. There is also need to give priority to nut fruit production, e.g. almond, walnut, pecan nut and pistachio nut in suitable areas in temperate regions of the country. Being low volume, high value crops having a long shelf life, these nuts will find favour with farmers in Jammu and Kashmir, Himachal Pradesh and Uttaranchal particularly in far-flung areas.

1.4 STATUS OF VEGETABLE CROPS

During 21st century, which is an era of food and nutritional security, vegetables including tuber crops are the only alternative crops capable of providing both food and nutritional security owing to their high yield, energy, nutrient/health building substances and high yield potential/ unit land, time and water. Besides, based on their micronutrients, vitamins, antioxidants and medicinal properties, enhancing their consumption can go a long way in alleviating poverty, dietary deficiency ailments, and hunger. India is the second largest producer of vegetables after China in the world with 11% production share in the world vegetable production. Vegetables including spices have significant role in export, corporate, contract, organic, cluster and periurban vegetable farming. These crops not only have great potential in improving health of our countrymen, but also are capable of economically empowering them and raising country's GDP. Total vegetable production in India before independence was 15 million tonnes and since independence, for decades, the growth rate was stabilized near 0.5%. The impetus on vegetable research and policy interventions to promote vegetable crops witnessed sudden growth rates of 2.5%, a hike of five times in the last decade. The potential technological intervention with improved gene pool and precise management can very well enhance the growth rate to near 6% per annum.

Keeping the high nutrient status of vegetable crops, high bio-availability of nutrients compared to cereals, public awareness/ literacy mission focused on dietary knowledge empowerment of rural poor during XI five year plan need to be initiated nationally to appraise masses about balanced diet and advising making their diet vegetable based so as to shed load from cereals by increasing vegetable consumption.

1.4.1 Global Scenario

China is the leading producer of vegetables in the world. India is the second largest vegetable producer with 11% production share in the world and Brazil is the third. India is also the second largest producer of most of the important vegetable crops at global level, namely brinjal, cabbage, cauliflower, pea, onion and tomato except for potato and okra where its ranking is number 3 and 1, respectively (Table 1.29). However, it falls behind in productivity in most of the crops except for tomato where India is ranking at number 1. In okra, it is at par with world productivity and in cauliflower it is quite close to the world productivity.

1.4.2 Indian Scenario

Total vegetable production in India before independence was 15 million tonnes and since independence for decades the growth rate was stabilized around 0.5%. The impetus on vegetable research and policy intervention to promote vegetable crops witnessed a sudden spurt in growth rate of 2.5%, a hike of five times during the last decade. The potential

Table 1.29. Production and productivity of major vegetable crops in the world

Crops	Production (000'Mt)			Productivity (MT ha) (2004-05)				
	World	India	Rank	World	India	Top 3 countries		
Brinjal	29,339	8,477	2	17.6	16.4	45.3 (Spain)	34.0 (Japan)	29.4 (Italy)
Cabbage	68,220	6,148	2	21.6	21.2	63.0 (Korea)	42.4 (Poland)	40.9 (Germany)
Cauliflower	15,981	4,990	2	18.9	17.1	22.6 (China)	19.8 (USA)	18.2 (Poland)
Pea	8,998	1,972	2	8.1	7.1	18.2 (Belgium)	16.3 (Netherlands)	14.1 (UK)
Onion	56,806	7,515	2	18.4	12.7	54.2 (USA)	52.8 (Spain)	48.9 (Japan)
Tomato	1,24,112	8,638	2	27.5	73.9	73.9 (India)	63.5 (Spain)	58.8 (Brazil)
Potato	3,30,519	29,189	3	17.6	18.0	45.7 (Netherlands)	45.4 (France)	44.2 (Germany)
Okra	4,990	3,525	1	6.4	9.8	14.2 (Egypt)	10.0 (Burkina Faso)	9.8 (China & India)

technological interventions with improved gene pool and precise management can very well take growth rate to nearby 6% per annum. This may lead to increased production of vegetable crops close to 140 million tonnes by 2012, which may go in a long way to achieve the much-awaited target of making available 300 g vegetables per capita per day.

Table1.30. Area, production & productivity of vegetable crops in India during different plan period

Year	Area (000'ha)	Increase (Per cent)	Production (000't)	increase (Per cent)	Productivity (MT/ha)	Increase (Per cent)
1991-92	5,593.0	-	58,532.0	-	10.5	-
1996-97	5,515.4	-1.4	75,074.4	28.0	13.6	29.5
2001-02	6,155.7	11.6	88,622.0	18.0	14.4	5.9
2004-05	6,755.6	9.7	1,01,433.5	14.5	15.0	4.2

The perusal of Table 1.30 indicates that although there has been minor reduction in area during VIII plan the production and productivity increased by 28 and 29.5%, respectively due to technological adoption. In the following plans it has almost become static where from big leap forward suggested to be launched is needed which is possible only with integrated vegetable development programmes suggested to be launched during the XI plan.

Table 1.31. Area, production and productivity of vegetables in leading states (2004-05)

States	Area (000'ha)	Production (000't)	Productivity (MT/ha)
West Bengal	1,189.00	18,103.20	15.23
Uttar Pradesh	840.90	15,792.80	18.78
Bihar	816.60	13,349.10	16.35
Orissa	655.90	8,045.60	12.27
Tamil Nadu	215.30	6,218.30	28.88

While West Bengal continues to be the leading state in area and production, the productivity is higher in Tamil Nadu followed by Uttar Pradesh and Bihar (Table 1.31). From the perusal of the Table 1.32, it is clear that potato has the highest share in total vegetable production of the country (28.8%) followed by brinjal (8.6%), tomato (8.5%), tapioca (7.8%), onion (7.4%) and cabbage (6.1%).

Table 1.32. Crop wise area, production and productivity of major vegetable crops in India (2004-05)

Crop	Area (000'ha)	Production (000'MT)	Productivity (MT/ha)	Production share (%)
Brinjal	530	8,703	16.4	8.6
Cabbage	290	6,147	21.2	6.1
Cauliflower	238	4,507	18.9	4.4
Okra	358	3,524	9.8	3.5
Onion	593	7,515	12.7	7.4
Pea	276	1,971	7.1	1.9
Potato	1,542	29,188	18.9	28.8
Tomato	497	8,637	17.4	8.5
Sweet potato	136	1,211	8.9	1.2
Tapioca	281	7,900	28.1	7.8

1.4.3 Crop-wise Status

1.4.3.1 Brinjal

There has been increase in area and production of brinjal during VIII plan, but productivity declined. During IX plan although increase in area and production had been marginal a big jump in productivity was evident (Table 1.33). Development of F1 hybrid varieties and their adoption by the farmers led to increase in productivity.

Table 1.33. Area, production and productivity of brinjal during different plan periods

Year	Area (000'ha)	increase (Per cent)	% of total Veg. Area	Production (000' MT)	Increase (Per cent)	% of total Veg. Production	Productivity (MT/ha)	increase (Per cent)
1993-94	300.7	-	6.2	4,612.2	-	7.0	15.3	-
1996-97	464.0	54.3	8.4	6,585.6	42.80	8.7	14.2	-7.2
2001-02	502.4	8.27	8.2	8,347.7	26.76	9.4	16.6	16.9
2004-05	530.3	5.35	9.0	8,703.8	4.26	10.3	16.4	-1.2

Table 1.34. Leading brinjal producing states (2004-05)

States	Area (000'ha)	Production (000'MT)	Productivity (MT/ha)
West Bengal	148.3	2,701.7	18.2
Orissa	127.7	1,852.2	14.5
Bihar	53.7	1,073.0	20.0
Gujarat	49.2	745.6	15.2

While West Bengal is leading in area and production of brinjal, Bihar is leading in productivity followed by West Bengal, Gujarat and Orissa.

1.4.3.2. Cabbage

Cabbage has shown a big leap forward in area, production and productivity during VIII and IX plans owing to especially F_1 hybrid cultivars, which can be used as a model to be followed for other vegetable crops. However, the percent increase in area and production declined when compared to the previous plan periods(Table 1.35).

Table 1.35. Area, production and productivity of cabbage

Year	Area (000'ha)	Increase (Percent)	% of total Veg. Area	Prod-uction (000 MT)	Increase (Percent)	% of total Veg. Production	Productivity (MT/ha)	Increase (Percent)
1991-92	177.3	-	3.2	2,771.2	-	4.7	15.6	-
1996-97	210.2	18.6	3.8	3,613.4	30.4	4.8	17.2	10.3
2001-02	258.1	22.8	4.2	5,678.2	57.1	6.4	22.0	27.9
2004-05	290.3	12.5	4.9	6,147.7	8.26	7.2	21.2	-3.6

West Bengal occupies the coveted position in area and production of cabbage and in closely followed by Orissa in productivity (Table 1.36).

Table 1.36. Leading cabbage producing states (2004-05)

States	Area (000'ha)	Production (000't)	Productivity (MT/ha)
West Bengal	71.3	1,863	26.1
Bihar	59.7	955	16.0
Orissa	33.7	931	27.6

1.4.3.3 Cauliflower

The area and production in cauliflower increased during VIII and IX plan periods, however productivity increased significantly during IX plan (Table 1.37).

Table 1.37. Area, production and productivity of cauliflower

Year	Area (000'ha)	increase (Per cent)	% of total Veg. Area	Production (000 MT)	increase (Per cent)	% of total Veg. Prod.	Productivity (MT/ha)	increase (Per cent)
1991-92	202.8	-	3.6	2998.1	-	5.1	14.8	-
1996-97	233.9	15.3	4.2	3419.0	14.0	4.6	14.6	-1.3
2001-02	269.9	15.4	4.4	4890.5	43.0	5.5	18.1	24.0
2004-05	238.2	-11.7	4.0	4507.9	-7.8	5.3	18.9	4.4

West Bengal continues to rule the cauliflower in all the three sectors i.e. area, production and productivity. Orissa and Bihar occupy the second and third position (Table 1.38). Development of thermo-sensitive varieties of varied maturity in cauliflower has made it possible to grow cauliflower all the year round almost throughout the country and has contributed significantly towards increase in area and production.

Table 1.38. Leading cauliflower producing states of India (2004-05)

States	Area (000'ha)	Production (000't)	Productivity (MT/ha)
West Bengal	64.6	1685.2	26.1
Orissa	45.0	637.9	14.2
Bihar	36.5	598.8	16.4

1.4.3.4. Okra

The increase in area and production in okra during VIII plan, however productivity increase was not commensurate. There has been consistent increase in area and production of okra during successive plan periods, the most significant being between 1991-92 and 1996-97 (Table 1.39). The productivity has also been increasing. Development of yellow vein mosaic resistant varieties has also contributed significantly to the increase in production and productivity of this crop.

Table 1.39. Area, production and productivity of okra

Year	Area (000'ha)	Increase (Per cent)	% of total Veg. Area	Production (000' MT)	Increase (Per cent)	% of total Veg. Production	Productivity (MT/ha)	Increase (Per cent)
1991-92	222.0	-	4.0	1886.5	-	3.2	8.5	-
1996-97	323.2	45.6	5.9	3040.1	61.1	4.0	9.4	10.6
2001-02	347.2	7.4	5.6	3324.7	9.4	3.8	9.6	2.1
2004-05	358.3	3.2	6.1	3524.9	6.0	4.2	9.8	2.1

West Bengal has highest area and production in okra (Table 1.40), whereas Bihar leads in productivity followed by Orissa.

Table 1.40. Leading okra producing states (2004-05)

States	Area (000'ha)	Production (000't)	Productivity (MT/ha)
Bihar	56.2	730.2	13.0
West Bengal	63.7	5,677.3	10.6
Orissa	71.4	619.7	8.7

1.4.3.5. Onion

There has been a constant increase in area under onion during VIII, IX and X plan periods. The percentage of increase in production and productivity was remarkable during IX and X plan periods (Table 1.41). Kharif onion technology with varieties, especially N 53, Agrifound Dark Red and Arka Kalyan have contributed significantly to area expansion, increase in production and productivity. In spite this, there have been period of stringent shortages of onion in the country.

Table1.41. Area, production and productivity of onion

Year	Area (000'ha)	Area Increase (Per cent)	% of total Veg. Area	Production (in 000' MT)	Production Increase (Per cent)	% of total Veg. Production	Productivity (MT/ha)	Productivity Increase (Per cent)
1991-92	331.8	-	5.9	4705.8	-	8.0	14.2	-
1996-97	410.0	23.6	7.4	4180.0	-11.2	5.6	10.2	-28.2
2001-02	495.8	20.9	8.1	5252.1	25.6	5.6	10.6	3.9
2004-05	593.9	19.8	10.1	7515.4	43.1	8.9	12.7	19.8

Maharashtra has maximum area and production in onion followed by Karnataka in area and Gujarat in production. However, Gujarat leads in productivity followed by Bihar (Table 1.42).

Table 1.42. Leading onion producing states (2004-05)

States	Area (000'ha)	Production (000'Mt)	Productivity (MT/ha)
Maharashtra	121.7	1422.3	11.7
Gujarat	58.5	1340.6	22.9
Bihar	48.8	975.2	20.0
Karnataka	115.2	724.5	6.3

1.4.3.6. Pea

There has been highest increase in area, production and productivity in garden pea during the VIII plan due to development and adoption of improved varieties by the farmers, but production and productivity fell drastically during IX plan. The productivity, however, again attained a positive trend during the X plan period due to availability of powdery mildew resistant varieties.

Table 1.43. Area, production and productivity of peas

Year	Area (000'ha)	Area Increase (Per cent)	% of total Veg. Area	Production (in 000' MT)	Production Increase (Per cent)	% of total Veg. Production	Productivity (MT/ha)	Productivity Increase (Per cent)
1991-92	177.7	-	2.9	851.6	-	1.7	4.8	-
1996-97	254.4	43.2	4.6	2,339.2	17.4	3.1	9.2	91.7
2001-02	303.3	19.2	4.9	2,038.2	-12.9	2.2	6.7	-27.2
2004-05	276.7	-8.8	4.7	1,971.8	-3.3	2.3	7.1	6.0

Uttar Pradesh occupies maximum area under pea and has highest production, but J & K leads in productivity followed by Himachal Pradesh.

Table 1.44. Leading pea producing states (2004-05)

States	Area (000'ha)	Production (000'Mt)	Productivity (MT/ha)
Uttar Pradesh	129.2	1,033.2	8.0
Himachal Pradesh	15.4	182.1	11.8
West Bengal	25.0	122.0	4.9
Jammu & Kashmir	7.3	112.2	15.4
Punjab	16.7	100.5	6.0

1.4.3.7. Tomato

Highest area and production increase in tomato was witnessed during VIII plan, however maximum productivity increase was during IX plan which is being closely followed by X plan (Table 1.45). Large-scale adoption of protected cultivation in tomato has significantly added to the production and productivity

Table 1.45. Area, production and productivity of tomato

Year	Area (000'ha)	Area Increase (Per cent)	% of total Veg. Area	Production (in 000' MT)	Production Increase (Per cent)	% of total Veg. Production	Productivity (MT/ha)	Productivity Increase (Per cent)
1991-92	289.0	-	5.2	4,243.4	-	7.2	14.7	-
1996-97	391.2	35.3	7.1	5,787.8	36.4	7.7	14.8	0.7
2001-02	458.1	17.1	7.4	7,462.3	28.9	8.0	16.3	10.1
2004-05	497.6	8.6	8.4	8,637.7	15.7	10.2	17.4	6.7

Orissa has highest area and production in tomato; however Karnataka is leading in production followed by Maharashtra.

Table 1.46. Leading tomato producing states (2004-05)

States	Area (000'ha)	Production (000'Mt)	Productivity (MT/ha.)
Orissa	100.3	1,330.8	13.3
Andhra Pradesh	69.5	1,251.0	18.0
Karnataka	35.5	954.8	26.9
Maharashtra	33.5	884.0	26.4
Bihar	46.0	735.8	16.0
West Bengal	46.1	694.9	15.1

1.4.3.8 Potato

There has been a steady increase in the area and production in potato over different plan periods. The increase was substantial between IX and X plan periods. The productivity was stagnant between VIII and IX plan periods.

Table 1.47. Area, production and productivity of potato in India

Year	Area (000'ha)	Area Increase (Per cent)	% of total Veg. Area	Production (in 000' MT)	Production Increase (Per cent)	% of total Veg. Production	Productivity (MT/ha)	Productivity Increase (Per cent)
1991-92	1135.1	-	20.3	18195.0	-	31.1	16.0	-
1996-97	1248.8	10.0	22.6	24215.9	33.1	32.3	19.4	21.25
2001-02	1259.5	0.9	20.5	24456.1	1.0	26.1	19.4	0.0
2004-05	1542.3	22.4	26.1	29188.6	19.35	34.4	18.9	-2.6

Uttar Pradesh is the leading state in area, production and productivity of potato followed by West Bengal and Bihar (Table 1.48).

Table 1.48. Area, production and productivity of potato in leading states (2004-05)

States	Area (000' ha)	Production ('000' t)	Productivity (t/ha)
Uttar Pradesh	440.0	9821.7	22.3
West Bengal	320.6	7106.6	22.2
Bihar	318.1	5656.7	17.8
Punjab	72.9	1470.2	20.2

1.4.3.9 Sweet potato

The increase in area under sweet potato was steady under different plan periods. However, the production was constant during VII, VIII and IX plan periods. Whereas, the increase during X plan period was significant (Table 1.49).

Table 1.49. Area, production and productivity of sweet potato

Year	Area (000' ha)	Per cent increase	Production (000' MT)	Per cent increase	Productivity (MT / ha)	Per cent increase
1991-92	136.5	-	1130.7	-	8.3	-
1996-97	129.9	-4.8	1102.2	-2.5	8.5	2.4
2001-02	131.9	1.5	1130.3	2.5	8.6	1.2
2004-05	136.5	3.5	1211.0	7.14	8.8	2.3

The state of Orissa is leads in area and production of sweet potato, but Uttar Pradesh has the highest productivity. West Bengal is the third largest producer of sweet potato (Table 1.50).

Table 1.50. Area, production and productivity of sweet potato in leading states (2004-05)

States	Area (000'ha)	Production (000'MT)	Productivity (MT/ha
Orissa	47.1	394.3	8.4
UP	20.0	240.8	12.1
WB	26.1	193.7	7.4

1.4.3.10 Tapioca

The area under tapioca increased during VII, VIII plan periods, which declined during IX plan period. There is a significant jump in area during XI plan period. The reduction declined marginally during the VIII plan but improved during the IX and X plan periods (Table 1.51).

Table 1.51. Area, production and productivity of tapioca

Year	Area ('000' ha)	Area Increase (Per cent)	Production ('000' Mt)	Production Increase (Per cent)	Productivity (Mt / ha)	Productivity Increase (Per cent)
1991-92	250.9	-	5832.5	-	23.2	-
1996-97	256.1	2.1	5662.8	-2.91	22.1	-4.7
2001-02	238.9	-6.7	6515.9	15.1	27.3	23.5
2004-05	281.3	17.7	7900.8	21.2	28.1	2.9

The state of Tamil Nadu leads in area, production and productivity of tapioca followed by Kerala (Table 1.52).

Table 1.52. Area, production and productivity of tapioca in leading states (2004-05)

States	Area ('000' ha)	Production ('000' MT)	Productivity (MT/ha)
Tamil Nadu	110.6	4563.8	41.3
Kerala	104.4	2436.8	23.3

1.5 STATUS OF MUSHROOMS

1.5.1 Global Scenario

Mushroom is a non-traditional horticultural crop having high quality of proteins, high fibre value, vitamins and minerals. World produces 61.16 lakh tonnes of cultivated mushrooms annually. The ranking of mushroom production world-wide is button (31%), shiitake (24%), oyster (14%), black ear mushroom (9%), paddy straw mushroom (8%) and milky/others (the rest). China produces 63% of the world production of mushrooms and ranks first among world's mushroom producing countries.

1.5.2 Indian Scenario

India produces more than 70,000 MT of mushroom. In India button, oyster, milky and paddy straw mushrooms are grown but button mushroom contributes highest share of production of mushroom. Commercial scale button mushroom cultivation started in India in seventies when some units at Chail and Kasauli (Himachal Pradesh) started growing mushrooms on a large scale. The button mushrooms grown on hills of Himachal were marketed fresh in big cities like Delhi and Mumbai (using insulated ice pack cold stored box transport system). But now button mushroom is grown all over the country, mostly in tropical areas, where raw materials and labour are available at competitive rates as compared to hilly regions. The mushrooms produced in the large commercial units in India are processed and packed in cans/jars for export. This is necessary as button mushroom has short shelf-life of less than a day.

1.6 STATUS OF SPICE CROPS

Spices, mostly grown under tropical farming systems, have an important position among the horticulture crops with regard to huge domestic consumption, sizeable export earnings and substantial employment generation particularly in the rural sector. India has been a traditional producer and exporter of spices. In fact, the word, India is associated with spices. Spices are export oriented; low volume and high value crops and are of great commercial importance for India.

1.6.1 Global Scenario

The global spices industry is poised for a major leap in the 21st century. Global trade in spices is expected to attain even higher levels due to the anticipated advances in the global food industry. However with growing opportunities, challenges are also immense. All the concerned implication of the WTO, the growing green sentiment, the Agreement on Sanitary and Phytosanitary Measures (ASPS), the Agreement on Technical Barriers to Trade (ATBT)

and the Treaty on Intellectual Property Rights (TRIPS) are some of the issues, which may have impact on the global spices trade.

Annual world import of spices over the years 1998 – 2002, averaged 1.25 million tonnes (excluding garlic, turmeric, and oils and oleoresins), valued at US $ 2.59 billion. Imports, mostly into the developed world, have recorded strong growth averaging 6 per cent a year in terms of quantity over the past five years. The main cause for the growth of consumption of spices has been the increasing trend towards eating ethnic or oriental foods in the developed countries and the increasing affluence of consumers in Asian, Latin American and Middle Eastern developing countries. The usage of spices and herbs by consumers is also increasing as these are completely natural products rather than artificial additives.

1.6.2 Indian Scenario

The area and production of these spices increased gradually over the various plan periods. There was a quantum jump in area and production during the VII, VIII and IX Plan periods (Table 1.53). During the X plan period in spite of reduction in the area the production improved over the pervious plan period.

Table 1.53. Area and production of spices in India

Year	Area ('000 ha)	Production ('000 tonnes)
1991-92	2,005.00	1,900.00
1996-97	2,372.21	2,805.00
2001-02	2,764.79	3,343.85
2004-05	2,571.77	3,817.90

Area and production of spices in the country have registered substantial increase over the last fifteen years with average annual growth rate of 2.7% and 6.2% in area and production respectively.

Table 1.54. Plan-wise average annual growth rate (%) in area and production of Spices in India

Plan Periods	Growth rate (%)	
	Area	Production
IV (1969-74)	-0.5	0.4
V (1974-79)	4.0	9.6
VI (1980-85)	3.9	6.9
VII (1985-90)	2.2	6.0
Annual Plans (1990-92)	-0.5	-4.4
VIII (1992-97)	3.8	8.5
IX (1997-2002)	3.4	4.0
X Plan (2002-07)*	-2.1	6.1

**** Data are available only for 1st three years***

The spices production in India is of the order of 3.72 million tonnes from an area of about 2.66 million ha. Chilli is the major spice crop occupying about 29 percent of area under cultivation and contributing about 34 percent of total spices production in the country. Turmeric accounts for 14% of production and 6 % of area, while garlic accounts for 19% of production and 5% of area. Seed spices contribute 17% of production and occupy 41% of area while Pepper contributes 2 % of production and occupies 9 % of area of the total spices in the country (Table 1.55-56).

Table 1.55. Area, production and productivity of spices in India 1991-92 Vs 1996-97
(Area:'000 ha, Production:'000 tonnes, Productivity: kg/ha)

Spices	1991-92			1996-97		
	Area	Production	Productivity	Area	Production	Productivity
Pepper	184.20	52.01	282	180.26	55.59	308
Ginger	59.83	182.65	3,053	70.29	232.51	3,308
Chillies	846.30	617.50	730	944.20	1,066.40	1,129
Turmeric	120.30	373.20	3102	135.20	528.90	3,912
Cardamom	117.72	9.52	81	98.99	12.61	127
Garlic	94.30	370.70	3,931	94.30	437.90	4,644
Coriander	349.70	158.50	453	452.70	255.50	564
Cumin	163.59	64.89	397	307.05	117.91	384
Fennel	20.09	25.14	1,251	25.90	28.98	1,119
Fenugreek	22.95	25.96	1,131	36.32	51.06	1,406
Other seeds[1]	4.00	4.00	1,000	4.60	6.00	1,304
Clove	1.48	1.50	1,014	2.30	1.78	774
Nutmeg	3.58	3.40	950	6.30	1.49	237
Cinnamon	0.39	0.30	769	0.83	0.37	446
Others[2]	16.57	10.73	648	12.97	8.00	617
Total	**2,005.00**	**1,900.00**		**2,372.21**	**2,805.00**	

1. *Other seed spices Dill Seed, celery etc.*
2. *Others include Tejpat, Saffron etc.*

Table 1.56. Area, production and productivity of spices in India 2001-02 Vs 2004-05
(Area:'000 ha, Production:'000 MT, Yield: kg/ha)

Spices	2001-02			2004-05 (Provisional)		
	Area	Production	Yield	Area	Production	Yield
Pepper	219.38	62.44	285	257.02	79.64	310
Ginger	90.50	317.90	3513	100.27	397.99	3,969
Chillies	880.00	1,069.00	1215	737.12	1,185.29	1,608
Turmeric	167.10	562.80	3368	161.23	716.84	4,446
Cardamom	95.10	17.80	187	95.48	16.60	174
Garlic	92.20	386.30	4190	144.74	658.50	4,550
Coriander	429.20	319.40	744	373.90	326.60	873
Cumin	526.64	206.42	392	521.25	134.76	259
Fennel	39.92	38.53	965	23.01	27.78	1,207
Fenugreek	115.60	136.64	1182	50.60	64.22	1,269
Ajwan	13.88	9.41	678	10.38	1.63	157
Other seed spices[1]	15.27	13.43	880	9.41	7.99	849
Clove	1.89	1.05	554	2.43	1.81	745
Nutmeg	7.85	1.99	253	10.01	2.53	252
Tamarind	60.77	184.40	3034	61.70	179.31	2,906
Cinnamon	0.73	1.66	2281	0.76	1.66	2,192
Tejpat	6.05	14.63	2419	6.05	14.62	2,416
Others[2]	2.71	0.06	23	6.42	0.14	22
Total	**2,764.79**	**3,343.85**		**2,571.77**	**3,817.90**	

i. *Other seed spices Dill Seed and Celery*
ii. *Others include Saffron and Vanilla*

Rajasthan occupies the major area under spices owing to seed spices cultivation in the State followed by Andhra Pradesh, Kerala, Karnataka, Madhya Pradesh and Gujarat. Andhra Pradesh, which is the foremost state producing chilli and turmeric in the country, ranks first in terms of production followed by Rajasthan, Madhya Pradesh, Tamil Nadu, Orissa, Karnataka and Kerala.

1.7 STATUS OF ORNAMENTAL CROPS

The floriculture industry in India is characterized by growing traditional flowers (loose flowers) and cut flowers under open field conditions and protected environment conditions respectively. India also has a strong dry flower industry, which provides major contribution to the overall trade. Other segments like fillers, potted plants, seeds and planting material, turf grass industry and value added products also contribute a share in the overall growth of the floriculture sector. The traditional flower cultivation, comprising of growing loose flowers mostly for worship, garland making and decorations, forms the backbone of Indian floriculture, which is mostly in the hands of small and marginal farmers.

The domestic industry is growing at an annual rate of 7-10% per annum. During 2003-04 the turnover was Rs. 500 crores. The area under production of flowers is around 1,06,000 hectares concentrated mostly in Tamil Nadu, Andhra Pradesh, Maharashtra, and West Bengal. This sector is still an unorganized one with lots of scope of systematizing it with the involvement of all the agencies. The industry is characterized by sale of mostly loose flowers (roses, chrysanthemum, jasmine, marigold, crossandra, tuberose etc.,) and the export surplus (rose, carnation, gerbera, orchids, anthuriums etc) from the cut flower industries.

In India nearly 98.5% of flowers are grown under open cultivation and hardly 1.5% flowers are grown under greenhouse cultivation out of the total area of 94,000 hectares. Hi-Tech floriculture industry in India, is still in its infancy. The corporate sector started its entry into the floriculture sector in the early 1990's. Most of the floriculture projects have adopted technology from either the Netherlands or Israel. Presently the total investment in this sector is Rs. 1,000 crores and is spread over 110 hitech floriculture companies covering an area of 500 ha mostly under rose cultivation. An additional 60 Hi-tech projects have been planned covering around 200 ha. The average investment in each floriculture project ranges between Rs. 3 to 4 crores per hectare. Most units are around 3 to 4 hectares each in size. One of the largest projects is CCL Flowers Ltd., Bangalore, which has more than 25 hectares of area under rose production.

1.7.1 Area, Production and Productivity

1.7.1.1 Traditional floriculture sector

India is the second largest producer of flowers after China. About 1,15,921 ha of area is under floriculture producing 6,54,837 MT of loose flowers annually (2004-05). The loose flower sector grew over the Plan periods with the production of flowers almost doubling (1.84 times) between VIII Plan and end of X Plan. The area expansion during the same period was to a tune of 1.64 times (Table 1.57). The traditional flower sector registered an impressive growth during the VIII, IX and X plan periods which grew from 71, 000 ha at the end of VIII Plan period to 1,06,000 ha by the end of IX plan. During X plan an additional 10, 000 ha has been brought under the traditional flowers by the end of 2004-05 to register an overall area of 1,16,000 ha. The production during the corresponding periods was 3,66,000, 5,35,000 and 6,55,000 MT respectively.

Table 1.57. Growth trends in floriculture during various plan periods

S.No	Plan Period	Area (ha)	Production ofLoose flowers (000 MT)
1.	VIII Plan 1992-1997	71,000	366
2.	IX Plan 1997-2002	1,06,000	535
3.	X Plan 2002-2007	1,16,000	655

Tamil Nadu is the leading producer of loose flowers closely followed by Karnataka both in terms of area and production (Table 1.58). The productivity per hectare was highest in Bihar (17.05 MT) followed by Haryana (11.55 MT). On the other hand the productivity of flowers was the least in Rajasthan (0.59 MT) followed by (0.78 MT) The overall productivity of the country during 2004-05 was recorded at (5.64 MT).

Table 1.58. Area, Production and Productivity of Flower Crops in different states during 2004-05

State/ union territory	Area (ha)	Production Loose flowers (000' MT)	Productivity (MT/ha)
Tamil Nadu	23,233	1,87,342	8.06
Karnataka	18,458	1,45,890	7.90
Andhara Pradesh	13,909	57,875	4.16
West Bengal	17,925	44,674	2.49
Maharashtra	8,660	51,705	5.97
Delhi	4,490	25,007	5.56
Haryana	4,810	55,583	11.55
Uttar Pradesh	7,968	11,905	1.49
Gujarat	6,956	41,811	6.01
Himachal Pradesh	407	2,243	5.51
Punjab	615	3,075	5.00
Rajasthan	3,312	2,604	0.78
Madhaya Pradesh	1,829	1,097	0.59
Bihar	103	1,757	17.05
Uttaranchal	525	558	1.06
Jammu & Kashmir	226	922	4.07
Manipur	535	701	1.31
Others	9,323	64,142	6.87
Total	**1,15,921**	**6,54,837**	**5.64**

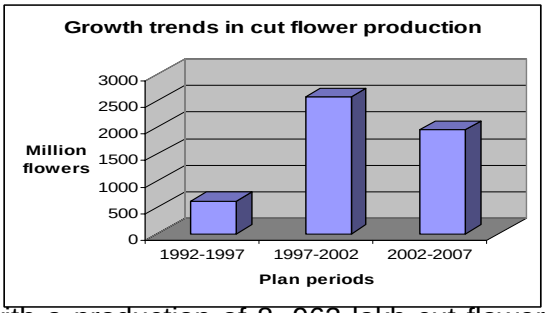
Nearly 77% of area under floricultural crops is mainly concentrated in seven states comprising of Tamil Nadu, Karnataka, Andhra Pradesh, West Bengal, Maharashtra, Haryana, Uttar Pradesh and Delhi.

1.7.1.2 Cut flower sector

Even though there has been a sporadic increase in the production of flowers, India's share in global trade is hardly 0.4% compared to the Netherlands (60%), Kenya (10%), Columbia (5%) and Israel (2%). Of the 100 large green houses, 12 green houses are near New Delhi (covering 50 hectares), where the climate is extreme during winter and summer. There are nearly 38 green houses in Bangalore, covering 200 ha. The Maharashtra state has 99 units of greenhouses, of which 15 large greenhouses cover 115 ha and 84 small greenhouses cover 35 ha.

The production of cut flowers increased over plan periods to attain a production of 1952 million flowers during X plan period from 615 million cut flowers during the end of VIII Plan period (Fig 1.1).

Fig 1.1 Growth trends in cut flower production during various plan periods



The West Bengal leads with a production of 8, 963 lakh cut flowers followed by Karnataka with 4,134 lakh cut flowers. Other major cut flower producing states include Uttar Pradesh, Maharashtra, Gujarat, Himachal, Uttaranchal etc(Table 1.59).

Table 1.59. All India Production of cut flowers (2004-05)

State/ Union Territory	Cut Flowers	State/ Union	Cut Flowers

	(millions)	Territory	(millions)
Andhra Pradesh	896.3	Maharashtra	-
Bihar	-	Manipur	4.0
Delhi	50.8	Punjab	-
Gujarat	18.2	Rajasthan	-
Haryana	352.7	Tamil Nadu	413.4
Himachal Pradesh	-	Uttar Pradesh	196.9
Jammu & Kashmir	-	Uttaranchal	11.0
Karnataka	7.1	West Bengal	-
Madhaya Pradesh	1.1	Others	1,951.5
Total			3,903.0

1.8 STATUS OF MEDICINAL AND AROMATIC CROPS

During the course of biological and cultural evolution, the value and potential of biodiversity, which encompasses innumerable life forms has been duly recognized by human beings for meeting the basic needs of life such as food, fuel feed, medicines, condiments, clothing and shelter, etc. Over 80,000 species of plants are in use throughout the world.

1.8.1 Global Scenario

The medicinal plants based industry is growing at the rate of 7-15% annually. According to a conservative estimate, the value of medicinal plants related trade in India is to the tune of about Rs 5,000 crores per annum while the world trade is about 62 billion US dollars and is expected to grow to the tune of 5 trillion US dollars by the year 2050. The present international situation in the production and trade of essential oils and aroma chemicals is very complex and vibrant. No doubt, the developing countries have a dominant position in world production, but still the competition from developed countries remains very strong. The world production from the developing countries accounts for 55% followed by developed countries (10%).India's contribution in the world production of essential oils has always been significant and showing a steady rise. At present India's position has been rated as third with 16-17% share in terms of production (quantity) and second with 21 to 22% share in value in the world production. This has been ascribed to the production of menthol mint oil particularly in north India, in huge quantities.

1.8.2 Indian Scenario

India is one of the top twelve mega-bio-diversity centres of the world with two hot spots located in the Eastern Himalayas and Western Ghats containing 3,500 and 1,600 endemic species of higher plants, respectively. The Indian biodiversity is immensely rich in medicinal and aromatic plants occurring in diverse eco-systems. These medicinal plants are used both for primary health care and for treating chronic diseases such as cancer, hepatic disorders, heart and old age related diseases namely memory loss, osteoporosis, and diabetes. India has been a location for man's cultural evolution and thus has a number of well recognized indigenous (traditional) systems of medicine abbreviated as "AYUSH" – Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homoeopathy, which are simultaneously practiced for total health care of the people with modern system of medicine (Allopathy). The tribal/ethno or folk medicines are still quite prevalent in the remote and far flung areas where above facilities are not available. All these systems of medicine are predominantly dependant upon plant drugs and some of these plants are also source of certain clinically useful prescription drugs used in allopathy.

The Indian medicinal and aromatic plants sector faces many problems and constraints and is affected by a number of factors which include absence of well defined policies, guidelines and strategies for promotion of cultivation, with quality planting material and post harvest technology, including storage, processing, manufacturing, quality, safety and efficacy assessment, research priorities, organized marketing and patenting in face of changing world's scenario.

Aromatic plants and essential oils and aroma chemicals obtained from them have been greatly valued for flavour and fragrance and restorative therapeutic values due to emergence of other modes of therapies viz. aroma and massage therapy, naturopathy and natural healing etc. In recent times, the Indian biodiversity has been depleting at a relatively higher rate mainly due to increase in human interference with environment and consequently the future of a large number of plant species jeopardized. The growing preferences and demands of herbal drugs, throughout the world have also created an unprecedented pressure particularly on wild populations of medicinal and aromatic plants (MAPs), leading to threat, extinction or genetic loss of many valuable drugs of plant origin.

Majority of the medicinal plants (over 90%) required in the indigenous drug industries in India are still collected from wild sources. Since these are mostly cross pollinated, these cannot ensure consistent quality due to lot of genetic variability found in the natural populations. Moreover, the collection of plants from the wild has many disadvantages like unstable supply, unreliable botanical identification, poor post harvest handling and higher chances of adulteration and substitution.

1.8.2.1 Area, production and productivity

Paradoxically, there is hardly any reliable data available on area, production and productivity of cultivated medicinal species since these are not recorded at the grass root level for want of adequate knowledge and interest by the record keeping authorities. All species are considered as one commodity and sometimes some data are taken by some states. The area of 2,72,150 ha presented here for some of the important medicinal plants are on the basis of consolidation made from the fragmented information available in literature and also estimates made based on the vast experience and public discussions of the sub group (Table 1.60). National Medicinal Plant Board has identified 32 prioritized medicinal plants. The cumulative annual demand of all 32 plants is estimated to be 141398.6 MT during 2004-05.

Table 1.60. Area under important medicinal plants

Sl. No.	Botanical Name	Vernacular name(s)	Area (ha)	Cultivating States and area
1.	*Acorus calamus*	Bhoja, Bauj	500	Madhya Pradesh, Bihar, Haryana and Andhra Pradesh.
2.	*Adathoda vasica*	Adusa, Ardusa	1,000	
3.	*Aegle marmelos*	Bael, Bili	3,000	Bihar, West Bengal, Uttar Pradesh and Maharshtra.
4.	*Aloe vera*	Gritkumari	1,000	Rajasthan, Gujarat, Maharashtra, Andhra Pradesh and Tamil Nadu.
5.	*Andrographis paniculta*	Kalmegh	2,000	many states
6.	*Artemisa annua*		100	parts of Maharashtra and Gujarat
7.	*Asparagus recimosus* *A. adscendus*	Satavari	1,000	Maharashtra, Gujarat, West Bengal and Uttar Pradesh
8.	*Azadirachta indica*	Neem	2,000	Maharashtra, Gujarat, Rajasthan, Andhra Pradesh and Karnataka etc as road side plantation
9.	*Bacopa monnieri*	Jal Brahmi	100	West Bengal, Uttar Pradesh and Andhra Pradesh
10.	*Baliospermum montanum*	Danhtimul	50	-
11.	*Cassia absus*	Chaksu	50	-
12.	*Cassia angustifolia*	Senna	25,000	Rajasthan, Gujarat, Tamil Nadu, Karnataka, Andhra Pradesh and Maharashtra
13.	*Centella asiatica*	Brahmi	150	Assam, West Bengal, Bihar and Uttar Pradesh.

14.	*Chlorophytum borivilianum*	Safed musli	40,000	Madhya Pradesh, Maharashtra, Gujarat and Rajasthan. At present almost all the states have sizable area.
16.	*Coleus forskohlii*		1,000	Tamil Nadu, Karnataka and Maharashtra
17.	*Commiphora wightii*	Guggal	2,000	Gujarat, Madhya Pradesh, Maharshtra and Rajasthan.
18.	*Curculigo orchioides*	Kali Musli	100	Kerala, Tamil Nadu, Madhya Pradesh and Karnataka
19.	*Datura metal*	Dhatura	200	-
20.	*Desmodium gangeticum*	Salparni	1,000	Tamil Nadu, Kerala, Maharashtra, West Bengal and Uttar Pradesh
21.	*Emblica officinalis*	Amla, Amloki or Anwala	20,000	Uttar Pradesh, Gujarat, Rajasthan, Andhra Pradesh, Karnataka and Maharashtra
22.	*Garcinia gummi-gutta*	Bilatti-Amla	50	Kerala, Tamil Nadu and Maharashtra
23.	*Gloriosa superba*	Kalihari Vachnag	1,000	Tamil Nadu and Himachal Pradesh
24.	*Hemidesmus indicus*	Ananthamul	100	-
25.	*Kaemperia galanga*	Chandramula	300	Kerala and West Bengal
26.	*Lawsonia inermis*	Mehandi	35,000	Rajasthan and to some extend Andhra Pradesh.
27.	*Mucuna pruriens*	Kaunch	1,000	Andhra Pradesh, Karnataka, Himachal Pradesh, Gujarat and Maharashtra
28.	*Ocimum sanctum*	Tulsi	1,000	Uttar Pradesh, Jammu and Kashmir and Karnataka
29.	*Phyllanthus fraternus*	Jar-amla, Bhuni amla	100	Tamil Nadu and Karnataka
30.	*Piper longum*	Pipal, Pipli	1,500	Maharashtra, Kerala, Tamil Nadu, Assam and West Bengal
31.	*Plantago ovata*	Isobgul	1,20,000	Gujarat, Rajasthan and Madhya Pradesh
32.	*Plumbago zeylanica*	Chitrak Chitawar	100	Kerala and Tamil Nadu
33.	*Psoralea corylifolia*	Babchi	50	Uttar Pradesh, Madhya Pradesh and Rajasthan
34.	*Rauvolfia serpetina*	Chota Chand, Sarpagandha	1,000	West Bengal, Orissa, Madhya Pradesh, Bihar, and Uttar Pradesh
35.	*Solanum surattense*	Kateli, Bhoiringini	100	
36.	*Trachyspermum ammi*	Ajowan	100	Rajasthan, Madhya Pradesh and Gujarat
37.	*Vetiveria zizanioides*	Khas-Khas, Khas	500	Border crop in Uttar Pradesh, Rajasthan and Bihar
38.	*Withania somnifera*	Ashwagandha	10,000	Madhya Pradesh, Uttar Pradesh, Gujarat, Rajasthan, Maharashtra and Andhra Pradesh.
	Total		**2,72,150**	

1.9 STATUS OF PLANTATION CROPS

There are two groups of plantation crops namely coconut, arecanut , oil palm, cocoa, cashewnut dealt by Ministry of Agriculture and tea, coffee, rubber dealt by the Ministry of Commerce. The combined volume of output of tea coffee and rubber is about 2 million tonnes and constitute about 3 per cent share of the total value of agricultural output in India. These are discussed below.

1.9.1 Coconut

1.9.1.1 Global status

Coconut is grown globally over an area of 12.19 million ha producing 13.68 million MT (copra equivalent) in 93 countries of the world. Asia and Pacific region accounts for a major share of area and production occupying 10.7 million ha (88%) and 9.6 million MT of copra equivalent (70.18%). Indonesia, Philippines and India are the major producers of coconut in the world. The area, production and productivity of coconut have increased at the global level (0.89, 4.36 and 3.79% per year) during the past 15 years (1990-2004). Compared to this, there has been increase in area, production and productivity in the APCC region to the tune of (1.06, 2.09 and 1.07% per year). Among 15 APCC member countries, both positive and negative trends in area and production have been reported (Table 1.61).

Table 1.61. Area, production and productivity in APCC countries (1980-2004)

(Growth rate %)

Area, production and productivity all positive				Area positive/ production productivity negative				Area /production negative productivity positive			
	A	Pn	Py		A	Pn	Py		A	Pn	Py
India	2.41	2.84	0.22	F.S. Micronesia	+5.06	-0.70	-1.18	Malaysia	-3.56	-3.66	+0.13
Indonesia	1.61	5.04	3.22	Fiji	+1.44	-8.90	-9.33	Solomon Islands	-0.16	+13.23	+41.24
Kiribati	2.00	8.85	6.20	Papua New Guianea	+0.59	-1.28	-4.98	Sri Lanka	-0.94	-0.37	+1.91
Marshal Islands	3.57	100.00	9.11	Philippines	+0.36	+0.26	-0.10	Thailand	-0.29	+5.57	+18.96
Vanuatu	1.30	2.61	3.42	Samoa	+5.80	-1.88	-4.22	Vietnam	-4.01	-3.26	+33.42

There was a positive increase in area, production and productivity in India, Indonesia, Kiribati, Marshal Islands and Vanuatu. However, there was significant increase in productivity in Solomon Islands, Thailand and Vietnam despite progressive decrease in area.

1.9.1.2 Indian scenario

Coconut farming and associated activities provide food and livelihood security to more than 10 million people in India. The Crop contributes to about Rs. 70,000 million to the country's GDP and about 6 per cent to the edible oil pool. Similarly, coconut industries in the country help to earn foreign exchange to the tune of Rs. 5,000 million per annum. Coconut is also a permanent source of raw material for more than 1,000 oil mills, 15,000 coir industries, 50 Desiccated Coconut industries and equal number of other industries like Activated Carbon manufacturing industries, shell powder manufacturing units, solvent extraction units etc which provide continuous employment to nearly 6.5 lakh workers of which 80 per cent are women folk. The ever increasing fragmentation of coconut holdings make them unviable to adopt scientific management practices resulting in lower levels of returns per unit holdings. It is estimated that there are 5 million coconut holdings in the country of which 98 per cent are less than 2 ha in size. Majority of the coconut holdings in the country are adopting rain-fed farming and are hence vulnerable to the vagaries of nature.

It was noted that as a result of the thrust on Area Expansion in the VIII Plan, there was a quantum jump in the area under coconut cultivation from 1.54 million at the end of the VII Plan to 1.89 million in the VIII Plan registering an increase of 3,50,000 hectares in absolute terms. Production also crossed 13,000 million nuts registering an increase of 16% over the previous plan period. However, productivity declined from 7,304 in VII Plan to 6,908 in the VIII Plan mainly due to the fact that the additional area brought under coconut in the VIII Plan had not reached yielding stage. In the IX Plan period the thrust has been on productivity improvement and production of quality planting material and Technology

transfer. During this Plan there was a definite slow down in area expansion with the area increasing by only 40,000 hectares as against 3,50,000 hectares in the VIII Plan. Although productivity improvement programme was implemented in an area of nearly 86,000 hectares, two major events caused a set back to the over all productivity namely i) super cyclone which destroyed nearly 44,000 hectares in prime coconut areas in Andhra Pradesh and ii) outbreak and fast spread of Eriophyid mite to all coconut growing states. The production, therefore, stagnated at 13,000 million nuts. Productivity declined further from 6,908 to 6,709 nuts per hectare. A significant gain at the fag end of the IX Plan was the launch of Technology Mission on Coconut. The impact of this Mission however has begun to be felt only in the X Plan. The first 3 years of the X Plan was the years of drought. The impact of drought was felt in coconut for a period of 3 years. As a result the production and productivity figures for 2004-05 showed a decline in production (12,832 million nuts) and productivity (6,632 nuts.) from 1.94 million ha area However, the crop forecast done by CPCRI for 2006-07 points to an increased production of 14,370 million nuts. Productivity is therefore expected to reach 7,358 nuts per hectare by 2006-07. During this period infrastructure has been created for production of 52 lakh planting material. The X Plan has witnessed an improvement in the processing sector by commercialization of newly developed technologies and promotion of 24 integrated units with a capacity to process nearly 1 billion nuts for value added coconut products. Consumption of nut for the purpose of Tender Nut Water has increased from 10 to 15%. Nevertheless the production and productivity targets of 15, 000 billion nuts and 8,000 nuts per hectare will still not be met. Among the various factors that have limited the productivity, the foremost are the growing diminution of the operational size of holding, the lack of management, the high incidence of aged, senile and unproductive palms and the extreme vulnerability to pest and disease. The market uncertainties and the violent fluctuations have also been indirectly inhibiting investment, leading to a decline in productivity.

The relative distribution of area under coconut has also changed during the period. The share in area of the major coconut growing state of Kerala, which was 61.11% in 1981-82 slipped down to 46.4% in 2004-2005. The share of Karnataka which was 16.17 percent in 1981-82 has increased to 19.92%, Tamil Nadu from 10.65% to 18.46 percent and that of Andhra Pradesh, from 3.97% to 9.35% during the period. The share of other states, which was 8.09% in 1981-82, has increased to 9.86% in 2004-05. The trend in coconut area in the country indicates that the elative prominence of Kerala state is on the decline. The reason for this declining trend is mainly due to lack of adequate land for new planting due to socio-economic changes in the state including the rapid pace of urbanization. During the last decade, apart from the four southern states, coconut cultivation has also been gaining momentum in other states in eastern and Western Ghats, central, north and north eastern regions in the country.

With the annual production of 12, 833 million nuts (2004-2005) India continues to be one of the leading coconut producers in the world. The trend in coconut production is also on the increase, as compared to 5,940 million nuts in 1981-82 showing an annual growth rate of 3.26 percent. Similar to the area, distribution of production has also undergone a change over the period. In 1981-82 Kerala accounted for 50.60 percent of coconut production whereas in 2004-2005 the share declined to 44.63%. Karnataka's share which was 15.45% eroded to 9.43%; Tamil Nadu, which accounted for 23.33% of the production during 1981-82 has improved its position to 25.27 in 2004-2005. The share of other states, which was 7.66%, increased to 11.32% during the period.

The national productivity of coconut was 6,632 nuts in 2004-05. Since 1981-82 coconut productivity was showing an increasing trend with an annual growth rate of 0.79 percent. There is a wide variation in productivity among the various states, varying from 1,333 nuts per ha in Nagaland to 19,630 nuts per ha in Lakshadweep. In terms of productivity, Lakshadweep recorded the highest productivity of 19630 nuts per ha followed by Maharashtra 15,189 nuts/ha, West Bengal 12,794 nuts/ha and Andhra Pradesh 11,532

nuts/ha against the national average of 6,632 nuts per ha. The states of Kerala and Karnataka have a low productivity of 6379 nuts and 3,139 nuts per ha.

The state-wise area and production of coconut in the country is given in Table 1.62.

Table 1.62. Area, production and productivity of coconut in India (2004-05)

States/Union Territories	AREA ('000 ha)	% share	Production (Million nuts)	% share	Productivity (Nuts/ha)
Andhra Pradesh	104.0	5.4	1,199.3	9.5	11,532
Assam *	21.3	1.1	154.3	1.2	7,244
Goa	25.2	1.3	123.5	1.0	4,901
Gujarat	16.4	0.9	138.3	1.1	8,433
Karnataka	385.4	19.9	1,209.6	9.4	3,139
Kerala	897.8	46.4	5,727.0	44.6	6,379
Maharashtra *	18.0	0.9	273.4	2.1	15,189
Nagaland	0.9	0.1	1.2	0.01	1,333
Orissa	50.8	2.6	274.8	2.1	5,409
Tamil Nadu	357.1	18.5	3,243.5	25.3	9,083
Tripura *	3.3	0.2	7.0	0.1	2,121
West Bengal	24.3	1.3	310.9	2.4	12,794
A & N Islands	25.6	1.3	87.1	0.7	3,402
Lakshadweep *	2.7	0.1	53.0	0.4	19,630
Pondicherry	2.2	0.1	30.0	0.2	13,636
All India	**1,935.0**	**100**	**12,832.9**	**100**	**6,632**

Source: Directorate of Economics & Statistics, Ministry of Agriculture, Govt. of India.
@ Final / Revised estimate for Gujarat, Kerala, Tripura and Lakshadweep
** For 2004-2005. 2003-2004 figures used.*

1.9.2 Cashew

1.9.2.1 Global scenario

Cashew is grown in India, Brazil, Vietnam, Tanzania, Mozambique, Indonesia, Sri Lanka and other tropical Asian and African Countries. The area under cashew in the world is 30.62 lakh ha. The world production of cashew is estimated to be around 20.82 lakh MT. India's share in the world raw nut production accounts to about 25%. Raw nut production in South East Asian Countries has registered approximately 10 fold increase since 1980. Latin American countries have registered approximately 3 fold increase during the same period. In recent times, India is facing stiff competition from Vietnam and Brazil in international cashew trade.

1.9.2.2. Indian scenario

In India cashew is grown mainly in Maharashtra, Goa, Karnataka and Kerala along the west coast and Tamil Nadu, Andhra Pradesh, Orissa and West Bengal along the east coast. To a limited extent it is grown in Manipur, Meghalaya, Tripura, Andaman and Nicobar Islands and Chattisgarh and also in plains of Karnataka. At present Maharashtra ranks first in area, production and productivity in the country. In 1955, cashew in India was grown in an area of 1.1 lakh ha. In the year 2005, cashew was grown over an area of 8.20 lakh ha. Thus India's share in cashew area is about 25% of cashew area of world. Over the last 45 years, area under cashew has registered an increase of 600 per cent. Area under cashew has been steadily increasing. Between 1970 and 1980, although area under cashew increased, the per cent increase in production was negative. This is possibly due to a large acreage being in a juvenile phase.

India's raw nut production has increased from 0.79 lakh MT in 1955 to 5.39 lakh MT in 2005. Between 1990 and 2005, the raw nut production has almost doubled. The share of India in rawnut production is about 25% of world. During last 10 years 1995-2005, increase in both area and production is phenomenal. In order to sustain in the international market,

productivity has to be increased. Upto 1970, the productivity of cashew was around 630 kg/ha. Between 1975 and 1985, the productivity was low (430 kg/ha). Since, 1985, the productivity has been steadily increasing from 430 kg/ha to 810 kg/ha in 2005. This is mainly due to improved technologies available and replanting of large areas of old plantations with high yielding planting material available in abundance from various government agencies and private nurseries. Research institutions and private nurseries are producing annually 60 to 70 lakh grafts. While most of the area under cashew is in east-coast and west-coast regions of the country, cashew is also being grown to a limited extent in non-traditional areas such as Bastar region of Chattisgarh and also Kolar region of Karnataka. It has been estimated that about 40 thousand hectares of area can be brought under cashew in Chattisgarh state (The present area under cashew is negligible (about 2,813 ha) in that state)**.** In cashew growing states like Karnataka, cashew is fast expanding in non traditional areas (Table 1.63 and 1.64).

Table 1.63. Area, production and productivity of cashew in India (2005-06)

State	Area (ha)		Production (MT)		Productivity (kg/ha)	
	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06
Andhra Pradesh	1,50,000	1,70,000	83,000	92,000	840	880
Goa	55,000	55,000	26,000	27,000	660	690
Gujarat	-	4,000	-	4,000	-	900
Karnataka	95,000	1,00,000	43,000	45,000	680	700
Kerala	1,02,000	80000	64,000	67,000	900	900
Maharashtra	1,60,000	1,60,000	1,74,000	1,83,000	1,200	1,300
NE States	-	14,000	-	10,000	-	640
Orissa	1,26,000	1,20,000	74,000	78,000	810	860
Tamil Nadu	1,05,000	1,21,000	53,000	56,000	610	640
West Bengal	9,000	10,000	8,000	10,000	800	950
Others	18,000	3,000	14,000	1,000	300	400
TOTAL	8,20,000	8,37000	5,39,000	5,73,000	810	815

Table 1.64. Comparative analysis of cashew industry

Component	1997-98	2002-03	2005-06
Area (lakh ha)	6.75	7.70	8.37
Production (lakhs MT)	3.60	5.00	5.73
Productivity (Kg/ha)	740	760	850
Processing units (No)	1100	1707	1800
Trade (crores)	76.6	104	115

1.9.3 Cocoa

1.9.3.1 Global scenerio

World cocoa production has registered 131.7% increase in past 30 years and was estimated at 3.52 million tonnes during 2004-05. The global production was 1.6 million tonnes in 1974, 1.8 million tonnes in 1984 and 2.7 tonnes in 1994. Africa has the world's largest cocoa producing area. The world's largest cocoa bean producer is Côte d'Ivoire, currently producing more than 1.45 million tonnes beans, which has a growth rate of 2.3 percent/ year. However, yields in Côte d'Ivoire are well below levels than Asia partly because of less use of agricultural inputs. The other major producers are Ghana (0.67 million tonnes), Indonesia (0.49 million tonnes), Nigeria (0.37 million tonnes), Brazil (0.17 million tonnes), Cambodia (0.13 million tonnes) and Ecuador (0.09 million tonnes). The variety Forastero comprises 95% of the world production of cacao, and is the most widely used. Overall, the highest quality of cacao comes from the variety Criollo which is considered a delicacy. However, Criollo is harder to produce, hence very few countries produce it, with the majority

of production coming from Venezuela (Chuao and Porcelana). The Trinitario is a mix between Criollo and Forastero.

Netherlands is the leading cocoa processing country, followed by the U.S. Cocoa and its products (including chocolate) are used world-wide. Belgium had the highest per-capita consumption at 5.5 kg, 10 times the world average namely a decade back (1995-96).

Table 1.65. Cocoa production in world

Country	Production (lakh tonnes)	Valuation (Million $)
Cote d' ivoire	14.50	2,175
Ghana	6.70	1,005
Indonesia	4.85	728
India	0.09	1
Others	9.10	1,365
Total	**35.24**	**5,274**

1.9.3.2 Indian scenario

In India, cocoa is mainly grown in the states of Kerala, Karnataka, Tamil Nadu and Andhra Pradesh. It is cultivated mainly as an intercrop in arecanut and coconut gardens. It has great potential to be introduced in other states where coconut and arecanut are grown. Cocoa cultivated in an area of 27,811 ha with an annual production of 10,175 MT with a productivity of 530 kg/ha during 2005-06. In India, a trend of increasing consumption of chocolates and other cocoa based products has emerged especially among the middle class. The production of cocoa beans hardly meets 30% of the demand projected by the processing industry in India. Thus there is a potential of area expansion under cocoa in the country.

Kerala is the leading producer of coco with 10,220 ha of area and 6,490 MT of production (Table 1.66). However, Karnataka with 825 kg/ha leads in productivity. Kerala was the only state in the past plan periods to promote cocoa on a large scale. The states of Karnataka, Tamil Nadu & Andhra Pradesh have come into the fold during the 90's. Now in India there are nearly 27,811 ha of area under cocoa with production of nearly 10,175 MT of dry beans. It is evident that since last 5 years area under cocoa increased by 15% per annum and production by 11% per annum. In Andhra Pradesh & Tamil Nadu since the plantations are in pre-bearing stage productivity is less. The area production and productivity of cocoa for the year 1991-92, 2001-02 and 2005-06 in Table 1.67.

Table 1.66. Area, production and productivity of cocoa in India during 2005-06

State	Area (ha)	Production (MT)	Productivity (kg/ha)
Kerala	10220	6490	770
Karnataka	6000	2750	825
Tamil Nadu	1421	220	330
Andhra Pradesh	10170	715	187
Others	-	-	-
total	**27,811**	**10,175**	**530**

Table 1.67. Growth in area production and productivity of cocoa in India

Year	Area (ha)	Production (MT)	Productivity (kg/ha)
1991-92	13900	7400	435
2001-02	16130 (16%)	6780 (-8%)	500
2005-06	27811 (72%)	10175 (50%)	530

1.9.4 Arecanut

Arecanut (*Areca catechu* L.) is one of the important commercial crops of India. Arecanut industry forms economic backbone of nearly 10 million people of India and for many of them it is the sole means of livelihood. The country produces arecanut valued at Rs 3,000 crores annually. India accounts for 56% and 58% of the total area and production of arecanut in the world. The crop is cultivated in India mainly in small and marginal holdings and also as a homestead crop. Arecanut finds a place in all religious, social and cultural functions in India; and is used as a masticatory either with betel leaves or plain or as scented *supari*. Arecanut has limited uses in ayurvedic and veterinary medicines because of its several alkaloids. Its cultivation is concentrated in the states of Karnataka, Kerala, Assam, Maharashtra, Meghalaya, Tamil Nadu, West Bengal, Andhra Pradesh and Andaman & Nicobar Islands. Although the production of arecanut is localized in a few States, the commercial products are widely consumed all over the country by all classes of people.

Production of Arecanut in the country which stood at 2,56,600 MT from an estimated area of 2,26,600 ha during the first year (1992-93) of Eighth plan, has reached 4,56,600 MT from an area of 3,74,300 ha during the third year (2004-05) of Tenth Plan (Table 1.68). Karnataka, Kerala and Assam are the three major states producing Arecanut (Table 1.69).

Table 1.68. Area, production and productivity of arecanut in India

Year	Area ('000 ha)	Production ('000 MT)	Productivity (kg/ha)
1992-93	226.60	256.60	1,131
1997-98	273.60	333.50	1,218
2002-03	354.30	415.90	1,174
2004-05	374.27	456.64	1,220

Table 1.69. Area and production of arecanut in India

(Area: 000'ha, Production: 000' tonnes)

State	Assam		Karnataka		Kerala		All India	
	Area	Prodn	Area	Prodn	Area	Prodn	Area	Prodn
1992-93	70.3	55.3	66.5	97.5	63.9	70.7	226.6	256.3
1997-98	73.8	56.7	93.1	133.3	76.1	94.0	273.6	333.5
2002-03	73.7	51.6	144.1	192.8	97.5	107.3	354.3	415.9
2004-05	74.0	69.0	153.0	203.9	107.6	110.3	374.3	456.6
% change over 1992-93	5.3	24.8	130.1	109.1	68.4	56.0	65.2	78.2

It can be seen that the area and production of arecanut in the country has increased by 65.2% and 78.2% respectively during the period, 1992-93 to 2004-05. Karnataka registered an increase of 109% in production and 130% in area during the above period. Ninth Plan recorded a high annual growth rate in both area and production of arecanut in the country (Table 1.70). But the productivity of arecanut did not increased significantly and the production increase was mainly due to the increase in area during the period. The attractive price prevalent during the period in between 1994-95 and 1999-2000 encouraged the farmers to go in for new plantings of arecanut. Further, it enthused the growers to adopt intensive cultivation methods resulting in higher productivity from the existing plantation.

Table1.70. Growth in area, production and productivity of arecanut in India

Plan Periods	Growth rate (%)		
	Area	Production	Productivity
VIII (1992-97)	3.3	4.2	0.8
IX (1997-2002)	5.5	5.8	0.2
X Plan (2002-07)*	3.2	4.3	1.1

** Data are available only for 1st three years*

1.9.5 Coffee

1.9.5.1 Global scenario

The unique feature of the global coffee industry is that the production is confined to 60 odd developing countries, whereas, it is largely consumed in the developed countries. The major coffee producers in the world are Brazil (30%), Vietnam (11%), Columbia (10%) and Indonesia (6%). Global coffee production for 2005-06 was placed at 109 million bags, which showed a decline from that of last year, which was around 115 million bags as per ICO estimates. India's coffee production are in the region of just over 4%. Arabica and Robusta coffee are the two species that are commercially cultivated in the world. Of these, nearly 70% is Arabica and the balance 30% Robusta.

The global coffee consumption is placed at around 116 million bags during 2005-06, which essentially meant that there was a deficit. The phenomenon of global production outstripping demand that prevailed during the years between 1999 and 2003 left sufficient quantity of stocks with the consuming countries that had serious negative impact on the international coffee prices especially with respect to producer realizations.

The 2006-07 production estimates are currently placed at 120 million bags whereas with an annual growth rate of over 1%, the global consumption is estimated to be around 118 million bags. Because of the healthy supply demand position from the beginning of 2004 onwards, the coffee prices have stabilized at moderately remunerative levels for the producing countries in the last two years. The prevailing scenario forecast a favourable environment as far as producer realizations are concerned during the next 2-3 years.

1.9.5.2 Indian scenario

In India, coffee is cultivated in about 3.80 lakh ha mainly confined to the southern states of Karnataka (59%), Kerala (22%), Tamil Nadu (8%) which form the traditional coffee tracts and the remaining area (11%) in the non-traditional areas such as Andhra Pradesh, Orissa and the north eastern states. In India, coffee is largely a micro enterprise and out of a total number of over 2.1 lakh coffee holdings in the country, around 2.08 lakh holdings (about 99%) belong to the small farmers having less than 10 ha. coffee area.

The unique feature of the Indian coffee industry is that, it is largely cultivated in the bio-sensitive regions of Western and Eastern Ghats, which contribute significantly to the preservation of forest eco-system comprising vast number of fauna and flora. The small grower sector (below 10 hectare coffee area) have an area share of 65% and a production share of around 60%, whereas the large growers (above 10 ha. area) have an area share of 35% but contribute to 40% of coffee production in the country. This phenomenon is mainly on account of lower farm productivity prevailing among small growers compared to large growers.

The Indian coffee production in 2005-06 was 2.74 lakh MT comprising 94,000 MT of Arabica and 1,80,000 MT highest level of 3.01 lakh MT during the end of IX plan i.e. 2001-02. The current productivity levels of Indian coffee are placed at around 620 Kg per hectare for Arabica and 948 Kg per hectares for Robusta during 2005-06 (Table 1.71). While the combined productivity level of 803 kg/Ha compares well with the global coffee productivity across all the coffee producing countries (500 kg/ha), the major coffee producing country like Vietnam (Robusta) Brazil (Arabica) have much better productivity levels and stronger competitiveness compared to India.

As may be seen from the table coffee production rose steadily from 1950-51 onwards and reached the peak in 2000-01 but subsequently slumped between 2001-02 and 2005-06 mainly on account of global coffee price crisis and impact of adverse weather conditions which prevailed during that period. Likewise, the farm productivity also moved up during the past five decades and the peak was during 2000-01 both in case of Arabica and Robusta, thanks to the remunerative prices that prevailed during the second half of 1990's which

encouraged the growers to expand coffee area and take up intensive cultivation techniques in an attempt to augment production and productivity. As in the case of production, the farm productivity slumped during crisis years (from 2002-03 onwards) however; the production and productivity have shown signs of recovery in 2006-07 the last year of X Plan (Table 1.72).

Table 71. Planted area, bearing area and No. of holdingsin coffee**

Name of the Region	Planted Area (ha)			Bearing Area (ha)			No. of Holdings		
	Arabica	Robusta	Total	Arabica	Robusta	Total	< 10 Ha	> 10 Ha	Total
Karnataka state									
Chikmagalur	56,590	31,078	87,668	51,895	26,080	77,975	14,243	1,180	15,423
Hassan	25,250	9,040	34,290	23,975	8,375	32,350	8,832	407	9,239
Kodagu	27,434	73,795	1,01,229	25,644	69,850	95,494	40,451	446	40,897
Total	1,09,274	1,13,913	2,23,187	1,01,514	1,04,305	2,05,819	63,526	2,033	65,559
Kerala state	3,992	80,579	84,571	3,597	80,048	83,645	75,714	310	76,024
Tamil Nadu state	25,708	5,636	31,344	24,588	5,553	30,141	15,364	351	15,715
Traditional State (total)	1,38,974	2,00,128	3,39,102	1,29,699	1,89,906	3,19,605	1,54,604	2,694	1,57,298
A.P. & Orissa state	31,773	268	32,041	17,089	268	17,357	49,013	7	49,020
N.E. Region	7,241	3,174	10,415	4,439	1,490	5,929	5,285	3	5,288
Grand Total	**1,77,988**	**2,03,570**	**3,81,558**	**1,51,227**	**1,91,664**	**3,42,891**	**2,08,902**	**2,704**	**2,11,606**

**Note: Above statistics are based on recent findings but are provisional and subject to revision.

Table 1. 72. Growth of Coffee Production and Productivity in India

Year	Production (MT)			Productivity (kg/hectare)		
	Arabica	Robusta	Total	Arabica	Robusta	Total
1950-51	15,511	3,382	18,893	229	136	204
1960-61	39,526	28,643	68,169	559	577	567
1970-71	58,348	51,883	1,10,231	725	943	814
1980-81	61,262	57,384	1,18,646	625	623	624
1990-91	78,311	91,415	1,69,726	722	795	759
2000-01	1,04,400	1,96,800	3,01,200	713	1,175	959
2001-02	1,21,050	1,79,550	3,00,600	812	1,046	937
2002-03	1,02,125	1,73,150	2,75,275	696	996	859
2003-04	1,01,950	1,68,550	2,70,500	687	954	832
2004-05	1,03,400	1,72,100	2,75,500	675	956	826
2005-06*	94,000	1,80,000	2,74,000	620	948	803
2006-07*	1,03,700	1,96,600	3,00,300	685	1,025	875

* Provisional

1.9.6 Tea

1.9.6.1 Global scenario

At the world production level of 3.38 billion kgs in 2005, global tea supply runs ahead of apparent absorption by 3.4%. Since the crisis has stemmed from the twin pressures of declining prices and rising costs, the FAO Inter Governmental Group in their last three sessions have stressed on focusing on demand growth initiatives and stopping the unbridled expansion of tea areas and increasing productivity through replantation/rejuvenation to reduce the high age profile of the existing areas and boost consumption of tea through promotion of tea and repositioning as a contemporary beverage. India ranks second in area and production of tea in the world contributing 19 % share in area and 27 % share in production (Table 1.73).

Table 1.73. Comparative area, production, exports and consumption of tea (in 2005)

	World	India	Rank	% share
1. Area under tea (million ha)	2.8	0.523	2nd	19%
2.Production in million kgs	3376	930	2nd	27%
3. Consumption(million kgs)	3219	757	1st	23.5%

1.9.6.2 Indian scenario

With 521,403 hectares under tea cultivation and production of 930 million kgs (during 2005-06), India accounts for 1/5th of the global tea area and nearly 1/3rd of the total world production. India consumes about 23.5% of total world consumption of tea, which constitutes about 81% of the tea produced in the country.

1.9.6.3 Employment

The tea industry provides direct employment for more than one million workers of which approximately half are women. In addition a significant number of persons derive their livelihood from ancillary activities associated with production, value addition and marketing of tea. Estimated number of permanent labour directly employed in tea plantations is 12,57,610 consisting of 6,20,750 women workers, 5,97,835 male workers and 39,025,adolescents (>15 yrs).

The tea plantations also play a critical role in the development of the rural and far flung underdeveloped regions in the country. In fact, development of many of the remote regions is highly dependent on the fortunes of the plantations not only in terms of income and employment generation but also on account of the potential linkages on the social infrastructure development, which is pivotal to a sustained growth.

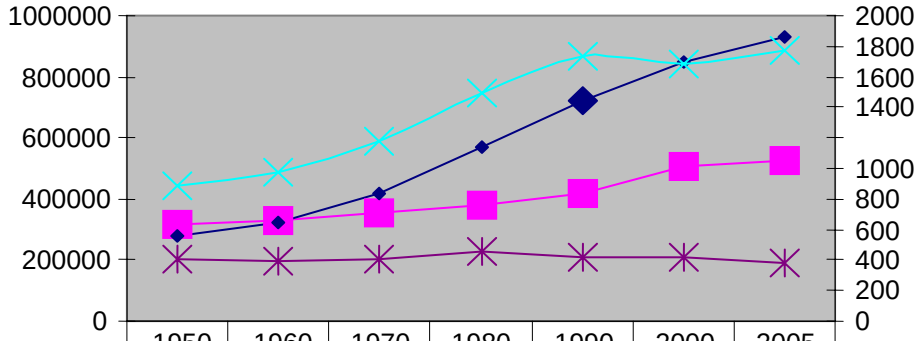
It is also significant to note that in the districts where these crops are grown, they account for quite a sizable share of the gross cropped area as would be evident from the table 1.74 and Table 1.75:

Table 1.74. Relative share of tea in the gross cropped area

State	Share of tea %	District	Share of tea %
Assam	5.76%	Dibrugarh	42%
		Sibsagar	39.5%
		Cachar	21%
		Darrang	15%
West Bengal	1.14%	Jalpaiguri	18%
		Darjeeling	9%
Kerala	1.22%	Idukki	13%
Tamil Nadu	0.77%	Nilgiris	50.45%

During the X Plan period there was a steady increase in area, production and productivity of tea in India

Fig 1.2. Area, Production, Exports& productivity during 1950 to 2005



	1950	1960	1970	1980	1990	2000	2005
Area in ha	3,15,656	3,30,738	3,54,133	3,81,086	4,16,269	5,04,366	5,23,500
Production '000 kgs	2,78,212	3,21,077	4,18,617	5,69,172	7,20,338	8,46,922	9,27,984
Exports '000 kgs	2,00,780	1,93,063	2,02,336	2,24,780	2,10,024	2,06,816	1,87,610
Poductivity kg/ha	881	971	1,182	1,494	1,730	1,679	1,773

Table 1.75. Area, Production & Productivity during X Plan period in India

Year	Area (ha)	Production (million kg)	Productivity (kg/ha)
2002-03	515832	845.97	1640
2003-04	5,19,598	878.65	1,691
2004-05	5,21,403	906.84	1,739
2005-06	5,23,000^	930.85	1,778

^provisional

1.9.7 NATURAL RUBBER

1.9.7.1 Global Scenario

India is the fourth largest producer and consumer among all rubber producing countries, while 2nd in productivity in the world. With regard to rubber area India's position is 5th. The following charts illustrate the position. The largest area is in Indonesia followed by Thailand while production in more in Thailand than Indonesia.

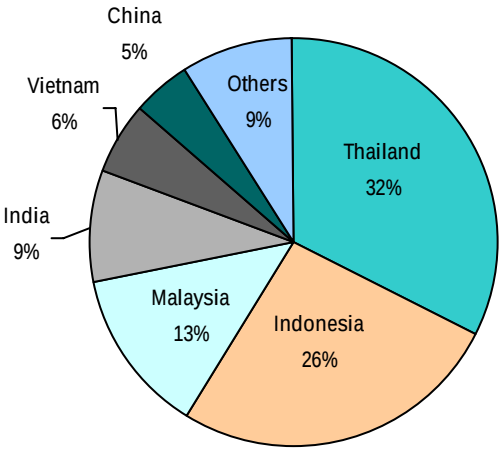
1.9.7.2. Indian Scenario

Natural rubber (NR), which forms the raw material for manufacturing over 35,000 items in this country and around 50,000 items the world over, is obtained from the latex of the tree, *Hevea brasiliensis,* native to Brazil. In India planting of this tree on a commercial scale was started by European Planters in 1902. Rubber was mainly cultivated in large plantations initially. Subsequently much structural transformation took place in the sector and now, small farmers account for 89% of the area and 92% of the production. (In India, plantations of size 20 hectares and below are considered as small holdings). The number of such plantations exceeds one million. Average size of smallholdings is around 0.50 hectare.

Production
(‘000 tonne)

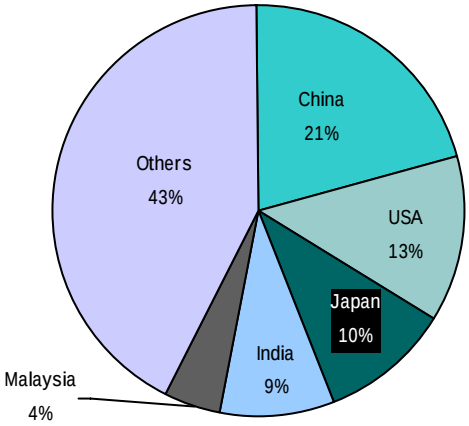
- Thailand 2832
- Indonesia 2271
- Malaysia 1126
- Vietnam 510
- China 428

Others 764
World 8703



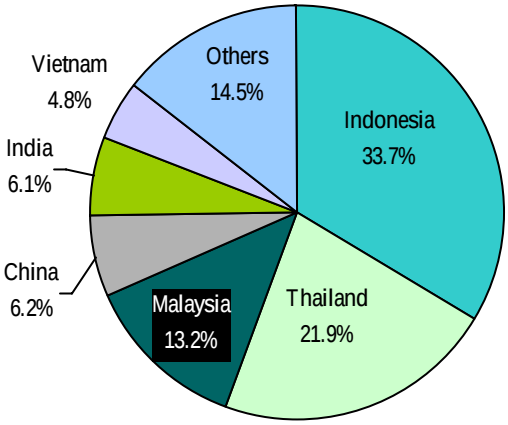
Consumption
(‘000 tonne)

- China 1826
- USA 1159
- Japan 857
- India 789
- Malaysia 386
- Others 3760
- World 8777



Area
(‘000 tonne)

- Indonesia 3279
- Thailand 2133
- Malaysia 1250
- China 600
- India 594
- Vietnam 465
- Others 1399
- World 9720



Number of large plantations (above 20 hect.) is 267 and they account for only 11% of the total area and 8% of the total production. Rubber Plantation Sector provides direct employment to around 4 lakh persons and a large number of indirect employment opportunities are created ancillary to rubber plantations. This is mostly in the areas of rubber nurseries, rubber trading, manufacture and distribution of plantation input items, rubber wood cutting, trading, processing and furniture making, collection, processing and sale of rubber honey, seeds of rubber and cover crop etc.

Most of the plantations are located in far-flung villages and they play a major role in rural development of the country. Women are employed in plenty in rubber plantations and this contributes to their empowerment. In employment generation, rubber manufacturing industry also plays an equally important role.

Though rubber is traditionally grown in the southern states of Kerala and parts of Tamil Nadu and Karnataka, the crop has now gained acceptance among the people of non traditional regions as well, especially the North-east. Rubber plantations are quite environment friendly as these provide full green cover to the soil, both as a green mat on the soil and a green umbrella over that. In addition to natural rubber, rubber plantations provide honey, rubber, seed oil, seed oil cake and rubber wood. Treated rubber wood is a good substitute for the scarce forest timber. Natural rubber recorded phenomenal growth rate in area expansion, production and productivity in comparison to the other major crops in the country.

Being a natural product, NR has a number of advantages over synthetic rubber (SR), the manufacture of which involves use of non-renewable petroleum feed stocks. NR is produced mainly by small growers in developing/underdeveloped nations as a livelihood activity, whereas SR is mainly manufactured by multi-national companies.

Practices involved in the production of NR are eco-friendly with very little interference with the soil and rubber plantation is a strong candidate to be brought under Clean Development Mechanisms (CDM) that are tradable under the Kyoto Protocol to the United Nations Framework Convention on Climatic Changes (UNFCCC), which entered into force on 16th February 2005.

In India, over a million smallholdings account for 89 percent of planted area and 92 percent of production of NR. Being size constrained, with the average holding size less than 0.50 ha, cultivation of rubber is a subsistence activity that provides livelihood to over a million smallholder families in the country. Rubber plantations also generate additional income through inter-crops, honey, biogas from processing effluents, rubber seed oil, oil cake and finally through the timber obtained when trees are uprooted for replanting on expiry of economic life.

Rubber plantations provide regular direct employment to about 0.4 million people in the country by way of cultivation, farm management operations and crop harvesting. Apart from this, various activities such as trading, packing, transporting, processing, etc. provide employment to an equal number of people. Rubber production and processing sector contributes significantly to economic empowerment of rural women as a sizable portion of people employed in cultivation, harvesting and processing of rubber are rural women. In the North Eastern region, rubber cultivation contributes to rural development and ecology restoration by providing tribal shifting cultivators (*jhumias*) with settled life, regular employment and ensured income.

Rubber plantations occupy 0.4 percent of the gross cropped area in India, and accounts for 0.19 percent of the country's GDP. Rubber-based manufactured products sector is one of the few sectors for which India has positive trade balance. Exports of rubber products from the country during 2004-05 were Rupees 31,990 million whereas the imports were only Rupees 9260 million. In export of NR, though India is a new entrant, the country holds 1.1 percent of the global share compared to the global share of only 0.8 percent in the total merchandise exports of India.

Today the Indian rubber goods manufacturing industry has a total turnover of more than Rs.220,000 million providing direct employment to more than four lakh people. The contribution by the Indian rubber sector to the national exchequer in the form of cess on indigenous production of NR was Rs.962.6 million during 2005-06. The contributions of the sector to the exchequer in the form of central excise, customs duties, corporate tax, agricultural income tax and VAT are substantially large.

On account of the strategic importance of NR sector in the national economy and its socio-economic and environmental contributions, the sector has received prime importance in the national agricultural and rural development programmes, which have been implemented in the country under various five-year plans. As NR comes from a perennial tree that requires high initial development cost, seven-year long gestation phase followed by its economic life spanning for about 25 years, there are well-defined limits for increasing or contracting its supply in the short run. The smallholder-dominated structure of the production sector is another factor that limits the possibility of short-term supply adjustments. Owing to these rigidities, investments in the sector have long-term implications, which make planning crucial in the rubber sector.

1.9.7.3 Area, Production and Productivity

The growth in expansion of area under cultivation of rubber was rather slow during the period up to 1953-54. However, the period from 1954-55 to 1962-63 witnessed tremendous growth in area expansion because of various factors such as the proposal under the agrarian reforms in Kerala to exempt rubber and other plantation crops from the purview of land ceiling, widespread prevalence of root-wilt disease for coconut trees in the central Kerala and a relatively remunerative price for rubber. The average annual growth in area was 10.9 percent during the Second Plan (1956-61) and 5.4 percent during the Third Five-year Plan (1961-66).

During the Fourth (1969-74) and the Fifth Plan (1974-79), the growth in area slowed down to 2.1 and 2.2 per cent respectively mostly as a result of unremunerative prices. By late 1970s, because of the revival of NR prices coupled with the introduction of a scheme to promote new planting introduced on a pilot scale by the Rubber Board in 1979 and later with the implementation of the Rubber Plantation Development Scheme in 1980, rubber cultivation received renewed attraction among small and marginal growers. As a result, area under the crop increased at an average annual rate of 6.4 percent during the Sixth Plan (1980-85) and 4.9 percent during the Seventh Plan (1985-90).

From the Eighth Plan (1992-97) onwards, on account of the limited availability of land for further expansion of the cultivation in the traditional region (Kerala and Kanyakumari District of Tamil Nadu), area expansion slowed down with 1.8 percent annual growth during the Eighth Plan and 1.2 percent growth during the Ninth Plan (1997-2002). The average annual growth during the first three years of the Tenth Plan was 0.7 percent. However, the area continued to increase in absolute terms and reached 597,000 ha during 2005-06. The growth in area under cultivation of rubber during each five-year plan up to the 9th Plan period is given in Table 1.76.

The Indian rubber plantation industry, which was dominated by large estates during the period up to 1956-57, subsequently underwent structural change leading to dominance by smallholdings. Today smallholdings account for 89 percent of the area and 92 percent of the production. Despite the dominance of smallholdings, more than 98 percent of the total area under the crop is occupied by high yielding varieties of planting materials and in adoption of short-term productivity enhancement measures also smallholdings are at par with the estates. As a result, the productivity measured in terms of average yield per unit hectare, which was as low as 284 kg during 1950-51, increased sharply over the years with the average productivity of 1,756 kg/ha realized during 2005-06 (Table 1.77) , India occupies one of the leading positions among the major producers of NR in the world.

Table 1.76. Growth pattern of Indian NR Sector during each Five-Year Plan

Year	Percentage growth in			
	Area	Productivity	Production	Consumption
First Plan (1951-52 to 1955-56)	2.8	4.5	8.5	8.1
Second Plan (1956-57 to 1960-61)	10.9	0.7	1.6	11.2
Third Plan (1961-62 to 1965-66)	5.4	4.2	14.6	5.9
Fourth Plan (1966-67 to 1973-74)	2.1	5.6	12.0	8.9
Fifth Plan (1974-75 to 1978-79)	2.2	-1.1	1.7	5.0
Annual Plan 1979-80	4.7	8.4	9.7	0.4
Sixth Plan(1980-81 to 1984-85)	6.4	2.8	4.7	5.7
Seventh Plan(1985-86 to 1989-90)	4.9	3.0	9.8	9.5
Annual Plan1990-91	3.2	4.6	10.9	6.6
Annual Plan 1991-92	2.8	5.0	11.3	4.3
Eighth Plan(1992-93 to 1996-97)	1.8	5.9	8.4	8.1
Ninth Plan(1997-98 to 2001-02)	1.2	1.0	2.8	2.6

Since the average growth in production in India during the past five decades was faster than the corresponding global rate, the relative share of India in the global output of NR increased from an insignificant level of 0.8 percent during 1950 to 8.9 per cent during 2005. India now ranks fourth in production of NR, next to Thailand, Indonesia and Malaysia.

Table1.77. Area, productivity, production and consumption of rubber

Year	Total area (ha)	Productivity (kg/ha)	Production (MT)	Consumption (MT)
1990-91	4,75,083	1,076	3,29,615	3,64,310
1991-92	4,88,514	1,130	3,66,745	3,80,150
1992-93	4,99,374	1,191	3,93,490	4,14,105
1993-94	5,08,420	1,285	4,35,160	4,50,480
1994-95	5,15,547	1,362	4,71,815	4,85,850
1995-96	5,24,075	1,422	5,06,910	5,25,465
1996-97	5,33,246	1,503	5,49,425	5,61,765
1997-98	5,44,534	1,549	5,83,830	5,71,820
1998-99	5,53,041	1,563	6,05,045	5,91,545
1999-00	5,58,584	1,576	6,22,265	6,28,110
2000-01	5,62,670	1,576	6,30,405	6,31,475
2001-02	5,66,555	1,576	6,31,400	6,38,210
2002-03	5,69,667	1,592	6,49,435	6,95,425
2003-04	5,75,980	1,663	7,11,650	7,19,600
2004-05p	5,84,090	1,705	7,49,665	7,55,405
2005-06p	5,97,000	1,796	8,02,625	8,01,110

p: Provisional

The achievements by the Indian rubber plantation industry during the post-independence period are attributable to the promotional policies followed by the Government of India at the level of price protection coupled with the strong R&D and extension supports and other development schemes implemented through the Rubber Board under the various five-year plans. The enterprising nature of the small growers who were highly receptive to technological innovations, also contributed substantially to the impressive growth rate in the NR production sector. Investments in the production sector were also facilitated by the efficiency of the Indian NR market. Because of the highly competitive structure of the market and the grassroot level dissemination of the price information, the efficiency of the Indian NR market is very high with the growers at the village level realising more than 90 per cent of the terminal market price at their farm gates.

With the expansion of tapped area and the improvement in productivity, production of NR in the country registered consistent increase over the years to reach 8,02,625 MT during 2005-

06. The average annual increase in production during the first four years of the X Plan was 6.2 percent as compared to 2.8 per cent attained during the IX Five-Year Plan (1997-2002). For the entire X Plan period estimated production growth rate is around 6% (Table 1.78)

Table 1.78. Performance of rubber sector during the X Plan period

Year	Total area (ha)	Growth in area (%)	Tapped area (ha)	Prod-uctivity (Kg per ha)	Growth in prod-uctivity (%)	Prod-uction (tonnes)	Growth in prod-uction (%)	Consu-mption (tonnes)	Growth in Consum. (%)
2002-03	5,69,670	0.5	4,07,953	1,592	1.0	6,49,435	2.9	6,95,425	9.0
2003-04	5,76,000	1.1	4,27,935	1,663	4.5	7,11,650	9.6	7,19,600	3.5
2004-05	5,84,000	1.4	4,39,720	1,705	2.5	7,49,665	5.3	7,55,405	5.0
2005-06	5,97,000	2.2	4,47,000	1,796	5.3	8,02,625	7.1	8,01,110	6.0
2006-07*	6,07,000	1.7	4,54,000	1,857	3.4	8,43,000	5.0	8,29,000	3.5
Average growth* (%)		**1.38**			**3.3**		**5.9**		**5.4**

* - Anticipated.

World natural rubber production is projected to reach 10.1 million tonnes in 2010. The annual growth rate would be 6 percent in the current decade, which is significantly above the 2.9 percent during the past decade. On the demand side, with economic growth, developing countries have become increasingly important importers in the world market and therefore the demand is likely to grow steadily in the current decade.

1.10 CONCLUSION

The status of horticulture would reveal that significant strides have been made in area expansion, overall increase in production productivity of horticultural crops. The per capita consumption of fruits and vegetables has increased over the plan periods. As against the recommended dose of per capita consumption of 120 gm of fruits and 280 gm of vegetables the present availability of fruits is 97 gm and 195 gm of vegetables. However we are long way to go. We are yet to produce adequate fruit and vegetable to satisfy the per capita supply of fruits and vegetables for the growing population. Not much emphasis was made on crops which can prevent vitamin deficiency. The processing sector is not happy either with the uniform quality or the quantity of the produce even to run the installed capacities of the industry to the fullest extant. Our share in export sector is insignificant due to inadequate production and poor quality standards to satisfy the international standards. There is a disparity in Horticulture development in different parts of the country. Potential of Arid Horticulture is not adequately exploited. Many crops like ber, mulberry, jamun, beal, aonla etc., are yet to be exploited. Future horticulture gains are thus expected to come from large states like Orissa, Madhya Pradesh, Bihar, Rajasthan and Gujarat besides newly formed states like Chattisgarh, Jharkhand, Uttaranchal.

CHAPTER II
HORTICULTURAL RESEARCH

2.1 INTRODUCTION

Horticultural R&D was at very low ebb till the third Five-year Plan and received meager attention even thereafter. However, the plan investment in horticulture research increased significantly since the VIII Five-year Plan, which resulted in considerable strengthening of the horticultural R&D programmes and infrastructure in the country.

A separate Plan allocation for research on Horticultural crops by the Indian Council of Agricultural Research (ICAR) was first made in IV Five-year Plan with a modest allotment of Rs. 34.8 million. Since then the allocation has been enhanced to Rs. 4,080 million during X Five-year Plan. The present allocation for research on Horticulture is about 7.6 per cent of the total outlay for agricultural research for the ICAR. As a result the increase in budgetary allocation from IV to X Plan was 117 times for research, it was 5800 times in respect of development programmes (refer Chapter III).

As a result a very strong infrastructure has been created resulting in several new varieties and technology. In this chapter an attempt has been made to describe the infrastructure and technologies developed, major gaps and thrust areas to be achieve the objectives set for development of this sector during XI Plan.

2.2 RESEARCH INFRASTRUCTURE

The ICAR is the main research organization which at the national level is entrusted with the responsibility to develop varieties and technologies in different crops and livestocks. It has a network of institutions working on different aspects of horticulture crops.

Rapid expansion in infrastructure was, however, witnessed in the Seventh and Eighth Plan. At national level a full-fledged Horticulture Division was created at the ICAR Headquarters at New Delhi headed by a Deputy Director General during 1987. The research infra-structure in horticulture existing in the country was strengthened and at present there are 10 Central Institutes with 27 regional stations, 14 National Research Centres on important horticultural crops, 9 Multi-disciplinary Institutes working on horticultural crops, 15 All India Coordinated Research Projects with 223 centres, One full fledged State Agricultural University on Horticulture & Forestry, 25 State Agricultural Universities with Horticulture discipline, 5 network projects, 330 Ad-hoc research projects and 29 Revolving fund schemes. Several regional stations in horticulture, started by the ICAR in its early phase now form the nuclei of our research efforts. A list of institutes/NRC/AICRP is given in Annexure 2.1.

Besides, ICAR and other central Government institutions and organizations around forty State Agricultural Universities, Deemed to-be Universities and a Central University are also carrying out research, teaching and extension on different aspects of horticultural crops. The first university solely devoted to horticultural research was established at Solan (H.P.). Furthermore, several traditional universities and other central organizations namely Department of Biotechnology (DBT), Bhabha Atomic Research Centre (BARC) and Indian Space Research Organization (ISRO), Defence Research and Development Organisation (DRDO) are also undertaking basic and strategic research on horticultural crops.

In addition, the Ministry of Commerce established one Research Institute each for Coffee, Rubber and Spices and two for Tea to carry out research exclusively on these crops. Different State governments funded institutions also exist on different horticultural crops of regional importance.

The ICAR still continues to act as the main funding agency to several non-ICAR institutes through a large number of time bound ad-hoc mission mode projects which have been initiated to solve specific problems. During the last few years, several programmes under National Agriculture Technology Project (NATP) were also sanctioned on different aspects. ICAR has also developed International collaborations and is a partner in several foreign-aided projects/ initiatives to undertake horticultural research in certain specific crops/areas. Currently in a National Agriculture Innovative Project (NAIP) is under operation in ICAR to promote end-to-end research.

2.3 VARIEITES DEVELOPED

Systematic research efforts over the years have led to the development of several improved varieties and hybrids, improved crop production and protection technologies for varying agro-climatic regions of the country as well as post-harvest management and processing of different horticultural crops. Major achievements made in different horticultural crops/crop groups during the past two decades are given below.

2.3.1 Introduction of New Crops and their Commercial Cultivation

New crops like Kiwi fruit, strawberry, olive, gherkin, oil palm, anthuriums, orchids and vanilla have shown promise and there is expansion in their area these are under commercial cultivation.

2.3.2 Release of Improved Varieties

Due to systematic research effort several improved varieties in over 100 horticultural crops are available to the farmers of the country. There varieties and hybrids are important in improving production, productivity and area expansion. Some of the development made is listed hereunder;

2.3.2.1 Fruits

Over 50 varieties in different fruit crops comprising of *aonla* (2), acid lime (1), apple (4), banana (5), custard apple (1), grape (6), guava (3), litchi (3), mango (10), papaya (6), pomegranate (4) and sapota (2) have been released during the last two decades. Some of the newly developed varieties are given below:

i) Mango

- Pusa Arunima (Amrapali x Sensation) and Pusa Surya released by IARI, New Delhi, Ambika (Amrapali x Janardhan Pasand) released from CISH, Lucknow, and Gangian Sindhuri, a sucking variety released from PAU, Ludhiana.
- Mango cv. Mallika was recommended for commercial cultivation in south and eastern Indian states. CISH-M-2, a cross-developed from Dashehari and Chausa, is dark yellow in colour with firm flesh and scanty fibre. It is a late season variety and has good commercial value.

ii) Banana

- A new variety named ‘Udhayam’ belonging to Pisang Awak (ABB) group has been released for cultivation during 2005. It is a high yielder (35% more yield over local Karpuravalli), early maturing, with sturdy stature and good bunch quality. Kovur Bontha has been recommended from ANGRAU, Hyderabad. Kullan (ABB) accessions of banana was continuously observed to be cold tolerant, with short crop cycle and good fruit quality.
- Plantain varieties Chakkel, Chinia, Kothia and Bersain have been recommended for commercial cultivation. Varieties Dakhnisagar, Kothia, Chakkel and Chinia were found suitable for chip making.

iii) Citrus

- Kinnow has been found most promising citrus variety for north India particularly Punjab and adjoining states. Balaji, a high yielding lemon cultivar has been developed by ANGRAU, Hyderabad.

iv) Grape

- Flame Seedless, Pusa Urvashi and Pusa Navrang were found most suitable for commercial cultivation under north Indian conditions. Sweta Seedless was released from IIHR, Bangalore for southern India. Variety Centennial Seedless a loose bunch type and a red coloured variety Flame Seedless have been identified for cultivation in north India.

v) Guava

- Two open-pollinated superior seedling selections of coloured guava namely, Lalit (CISH-G-3) and Shweta (CISH-G-4) have been released for commercial cultivation.

vi) Papaya

- Surya (Sunrise Solo X Pink Flesh Sweet) has been developed which is superior in both yield and quality in comparison to Coorg Honey Dew and Sunrise Solo. A hybrid line CP-81 (Coorg Honey Dew X CP-85) has been identified for high yield and quality.

vii) *Ber*

- Goma Kirti has been developed for cultivation in tribal belts of Gujarat, Maharashtra and Madhya Pradesh. This is an early variety and escapes incidence of fruit borer and fruit-fly.

viii) *Aonla*

- A superior selection NA-10 by NDUA&T, Faizabad has been released for commercial cultivation.

ix) Pomegranate

- Ruby, a multiple cross hybrid has been released. The fruit has red bold arils, soft seeds, red ring, good keeping quality and high TSS even during summer. Coloured genotype like Arka released. A genotype Amlidana has been identified for *anardana* preparation.

x) *Bael*

- NB series selections have been released for commercial cultivation and new accessions have been collected for identification of promising varieties.
- CISH-B-1 and CISH-B-2 varieties were selected from the seedling population.

xi) *Phalsa*

- Rajendranagar has been developed by ANGRAU, Hyderabad.

xii) *Jamun*

- A high yielding superior quality genotype Konkan Bahdauli developed at KKV Dapoli.

xiii) Cashew

- Thirty seven high yielding varieties and Twelve hybrids have been developed and released.
- A promising accession, Goa 11/6, which escapes tea mosquito bug infestation, has been developed. A new variety, Goa-1 has been released for Goa.

xiv) Jackfruit

- Konkan Prolific from Dapoli and two selections from HARP, Ranchi have been developed.

xv) *Karonda*

- Konkan Bold, a high yielding selection was released by KKV, Dapoli.

Among temperate fruits the varieties released/ introduced are as follows:

i) Apple

- Cultivars Oregon Spur, Golden Spur and Prima have been identified as high yielding varieties.

ii) Pear

- Improved semi-soft varieties namely Punjab Beauty, Punjab Gold and Punjab Nectar released from PAU, Ludhiana for sub-tropical regions.

iii) Peach

- Four varieties Florda Prince, Earli Grande, Partap and Prabhat released for sub-tropical regions.

iv) Plum

- Satluj Purple variety identified for sub-tropics**.**

v) Walnut

- A high quality landrace LG-5 found promising for Kashmir region.

2.3.2.2 Vegetables

About 348 open pollinated varieties, 89 F_1 hybrids and 2 synthetics in different crops like tomato, brinjal, cucumber, capsicum, cabbage, musk melon, water melon etc. are available commercially for fresh consumption, culinary purpose, processing types, and nutritional rich and those suited for export purposes. Several varieties are also available with resistance to diseases and pests. Besides, some varieties for superior nutritional contents are also available. Some of the improved varieties are listed hereunder;

i.) Hybrids

There are 89 F_1 vegetable hybrids available in the country. The maximum number of hybrids are available in tomato (36) followed by brinjal (25), chilli (10), cabbage (7), okra (6), cauliflower (5) and others.

ii.) Pure line selections

At present there are 219 open-pollinated varieties developed in the country. Brinjal tops the list with 46 varieties, followed by tomato (36), garden pea (24), onion (17), chilli (16), cauliflower (14), bottle gourd (3), ridge gourd (3), bitter gourd (2), musk melon (2), water melon (1) and carrot (1).

iii.) Disease and pest resistant varieties

- **Disease resistant/ tolerant varieties:** There several disease tolerant varieties available in vegetable crops namely (**Tomato**: BWR-5, FMH-1, FMH-2, BT-10, BRH-2, LE-415 are bacterial wilt tolerant, while H-24, H-86 are virus (TYLCV) tolerant); **Brinjal v**arieties BB-7, BWR-12, SM-6-7, SM-6-6, BB-44, CHES-309 and BB-64 are bacterial wilt tolerant; **Chilli**: Pusa Jwala and Pusa Sadabahar are tolerant to CMV, TMV and leaf curl complex; **Okra**: P-7, B-57, Arka Anamika, Arka Abhay, HRB-55,

HRB-9-2, VRO-3, VRO-4, VRO-5, VRO-6, NDO-10, HRB-107-4, IIVR-11 are Yellow vein mosaic virus tolerant; **Pea**: PRS-4, JP-4, JP- 83, NDVP-4, Palam Priya, KS-245, NDVP-250, DPP-9411 are powdery mildew tolerant; **Muskmelon**: DMDR-1, and DMDR-2 are tolerant to Downy mildew. **Cauliflower:** Pusa Shubhra and Pusa Snowball K-1 are Black rot and curd blight Black rot resistant;

- **Pest resistant/ tolerant varieties:** Some of the pest tolerant varieties available in tomato are Pusa-120 and Pusa Hybrid-2, which are Root-knot nematode tolerant; Pusa Sawani and Pusa A-4 okra are shoot and fruit borer tolerant; Pusa Sem-2 and Pusa Sem-3 lab bean are jassid, aphid and fruit borer tolerant.

iv.) Nutritionally rich varieties

- **Vitamin A: Amaranth** (Pusa Kiran, Pusa Kirti, Pusa Lal Chaulai, Arka Arunima); **Carrot (**Pusa Meghali and Pusa Yamdagni), **Palak** (Pusa Jyoti, Pusa Bharati and Arka Anupama), **Pumpkin** (Pusa Hybrid, Pusa Vikas and Arka Chandan). **Sweet potato** (Hybrid Sree Kanaka).
- **Vitamin C**: **Bitter gourd** (Pusa Hybrid-1 and Pusa Hybrid-2), **Chenopodium** (Pusa Bathua-1), **Mustard green** (Pusa Sag-1), **Tomato** (Pusa Uphar, Pusa Hybrid-2 and Pusa Rohini).
- **Proteins**: **Broad bean** (Pusa Sumeet), **French bean** (Pusa Parvati), **Garden pea** (Arkel) and **Lablab bean** (Pusa Sem-2).
- **Iron and Calcium rich vegetables: Amaranth** (Pusa Kiran, Pusa Kirti, Pusa Lal Chaulai, Arka Arunima); **Chenopodium** (Pusa Bathua-1), **Palak** (Pusa Jyoti and Pusa Bharati), **Bitter gourd** (Pusa Hybrid-1 and Pusa Hybrid-2).
- **High lycopene**: **Tomato** (Arka Ashish) developed with high lycopene (10mg/100g).
- **Processing varieties**: High TSS mato (Punjab Chatk are) high TSS containing onion (Agri Found White Round, White Flat), ash gourd and pointed gourd.

2.3.2.4 Potato and Tuber Crops

Availability of indigenous varieties, good quality seed and right package agronomy practices triggered a revolution in potato production leading to very fast growth in area, production and productivity. Potato production jumped from 1.54 million MT in the year 1949-50 to 24.22 million MT during 1996-97, thus making India third largest potato producer in the World after China and Russia. During recent years (2000-2003) the annual compound growth rate (ACGR) for potato was 3.48 and 3.65% respectively, for production and yield that was highest among major crops. However, potato yield in India is better than both the countries i.e. China and Russia. About 34 high yielding varieties developed for different agro-climatic regions of the country. Varieties have also been developed for short growing period, resistant to late blight, tolerant to viruses, immunity to wart disease and resistant to cyst nematode. A few True Potato seed varieties have also been released.

- Five improved varieties namely Kufri Pukhraj, Kufri Anand, Kufri Giriraj, Kufri Chipsona -1 and Kufri Chipsona -2 have been released for commercial cultivation.
- High carotene sweet potato hybrid Sree Kanaka developed. A triploid cassava hybrid with high and stable starch yield released.
- 24 improved varieties of different tuber crops like cassava, sweet potato, yams and aroids have been released. Some of these are even suitable for industrial uses.

2.3.2.5 Spices

- Different improved varieties are now available in spices and are being adopted fast by the farmers. Some of these varieties are listed hereunder;

- Several improved varieties released so far include 22 in black pepper, 13 in ginger, 27 in turmeric, 56 in chilli, 19 in garlic, 6 in cinnamon, 3 in nutmeg, 5 in tamarind, 21 in coriander, 9 in fennel, 13 in fenugreek, 8 in ajowan and 4 in black cumin.
- Six hybrid lines and one cultivar have been identified in black pepper for high altitude areas of South India. Root knot nematode resistant pepper variety, Pournami has also been released.
- Two value-added turmeric varieties, IISR Prabha and IISR Pratibha, developed through open- pollinated progeny selection have been released for Kerala and Tamil Nadu.
- Sonali, a ginger variety resistant to rhizome rot, leaf blotch and scale insect has been developed. IISR Varada ginger was released, which is suitable for Kerala, Andhra Pradesh, and Orissa.
- Fenugreek HM-444 and HM-372, HM-376 have been released. HM-444 is resistant to downy and powdery mildew.
- Saffron CITH-S3 was found most promising under Srinagar conditions.

2.3.2.6 Mushroom

A new species of *Lysurus* as *L. himalayanesis* sp. has been reported from Himachal Pradesh, which is a new record in the world.

Two single spore strains, NCS 100 and NCS 101 and one hybrid strain, NCH 102 of white button mushroom (*Agaricus bisporus*) have been released for commercial cultivation. Two species, *Pleurotus florida* and *P. ostreatus* have been found superior in yield with 75% bio-efficiency. Two temperature tolerant strains, NCB 6 and NCB 13 of white button mushroom (*Agaricus bitorquis*) are found promising.

2.3.2.7 Ornamental Crops

- Presently, 57 varieties of rose, 35 of chrysanthemum, 42 of gladiolus, 150 of bougainvillea, 25 of hibiscus and 2 of orchids are available for commercial adoption.
- Several improved varieties released include 44 rose, 81 gladioli, over 150 chrysanthemums, 2 orchids, 5 jasmines, 7 tuberose, 8 China aster, 2 marigold and several bougainvillea varieties. In rose, 8 improved cultivars, namely Pusa Gaurav, Pusa Bahadur, Pusa Priya, Pusa Barahmasi, Pusa Virangana, Pusa Pitamber, Pusa Garima, Dr. Bharat Ram have been developed at IARI, New Delhi.
- In gladiolus, new varieties, Anjali, Archana, Bindiya, Chandani, Chirag, Sarang, Shweta, Sunayana and Vandana have been developed at IARI, New Delhi. Two varieties namely, Rajani and Chandrani from BCKV, Kalyani and hybrids Arka Suvarna and Arka Kesar from IIHR, Bangalore have been released for cultivation.
- Three chrysanthemum varieties namely, White Charm from Lucknow; Basanti and KS 16 from Kalyani have been released. A new no-pinch no-stake variety named Mother Teresa, which bears small white flowers of Argemone type, has also been released. One attractive hybrid Punjab Gold has been developed for pot culture.
- In carnation, cultivar Laurella at Ludhiana, Fambia at Pune and Arthur Sim at Kodaikanal were developed.
- The marigold hybrid MS-8 x Pusa Narangi Gainda has been developed in New Delhi.

2.3.2.8 Medicinal and Aromatic Plants

CIMAP, Lucknow brought out a list 45 medicinal plants namely *Aloe vera* (*Ghrita Kumari*), *Bacopa monnieri* (*Brahmi*), *Centella asiatica* (*Mandookparni, Gotu Kola*), *Rauwolfia serpentina* (*Sarpagandha*), *Catharanthus roseus* (*Periwinkle*), *Taxus baccata / Taxus*

wallichiana (*Himalayan Yew*) and *Artemisia annua, Mentha arvensis* (Menthol mint); *Mentha piperita* (Pepper mint); *Mentha citrata* (bergamot mint); *Mentha spicata* (Spear mint); *Mentha cardiaca* (Scotch spearmint); *Cymbopogon winterianus* (Citronella); *Cymbopogon martinii* (Palmarosa); *Cymbopogon flexuosus* (Lemon grass); *Pelargonium graveolens* (Geranium); *Rosa damascena* (Damask rose); *Matricaria chamomilla* (*Chamomile*); *Vertiveria zizanioides* (Vetiver); *Chrysanthemum cineriaefolium* (Pyrethrum); *Catharanthus roseus* (Periwinkle); *Withania somnifera* (*Ashwagandha*); *Phyllanthus amarus* (*Bhuin amlaki*); *Ocimum sanctum* (*Krishna Tulsi*); *Plantago ovata* (*Isabgol*); *Cassia angustifolia* (*Senna*), etc. which required effects for their commercial cultivation.

About 25 improved varieties of medicinal plants and 7 of aromatic plants developed by the ICAR/SAUs. In addition 89 varieties are developed by CIMAP, Lucknow (CSIR).

High yielding varieties of opium developed for latex and alkaloid collection are like BRI-1, NBRI-2, BROP-1, NBRI-5, NBRI-6, NBRI-9 and NBRI-10.

The germplasm of *Safed musli*, collected from north western, southern and hilly areas of western Madhya Pradesh has been characterized for exploitation. Gujarat Asalio I, a variety of garden cress has been identified for release.

2.3.2.9 Coconut, Arecanut and Cashew Nut

Several high yielding selections and 12 hybrids involving tall and dwarf parents released in coconut. Besides 4 high yielding arecanut varieties and 12 hybrids in cashew with high yield potential have been developed and released.

- Improved varieties like West Coast Tall, East Coast Tall, Lakshawdweep Ordinary, Lakshawdweep Micro, Andaman Ordinary, Andaman Giant, Kappadam and the ecotypes ‘Komadan’, ‘Kuttiyadi Tall’ and ‘Jappanam’ released for cultivation. Recently, Laccadive Ordinary, Philippines Ordinary and Pratap were released for commercial cultivation.
- Chowghat Green Dwarf, Chowghat Orange Dwarf, Malayan Yellow Dwarf, Malayan Green Dwarf, Malayan Orange Dwarf are the dwarfs, while Gangabondam and Ayiramkachi are semi-talls and Chowghat Orange Dwarf and Malayan Dwarfs are dwarf cultivars for tender nut purpose.
- Development of four high yielding cultivars and twelve hybrids (Hybrids with Tall x Dwarf and Dwarf x Tall combinations) in coconut for commercial cultivations.
- Development of four high yielding areca varieties namely Mangala, Sumangala, Sreemangala and Mohitnagar.
- Under All India Co-coordinated Research Project on Cashew, 37 high yielding varieties have been developed. 12 hybrids with a high yield potential have also been developed and released.

2.3.2.10 Tea

- Thirty high yielding clones released by Tea Research Association and UPASI and Tea Research Foundation. Of these UPASI TRF-1 is recently released in south India has yield potential over 11,000 kg/ha of processed tea.
- TTRI, Toklai developed 30 high yielding and superior quality clones and l4 hybrids. Till date, 154 region-specific clones are available, while UPASI developed and released 29 clones, five bi-clonal seed stocks and six clonal grafts for commercial cultivation in southern India.

2.3.2.11 Coffee

- Improved varieties like Kents, S.795, Cauvery and Sln. 9 are available to farmers.

- Twelve elite arabica varieties released. Of these, genotypes like S.795, Sln.5 and Sln.6 have high yield potential, tolerance to leaf rust and good cup quality.
- Three robusta varieties released for commercial cultivation, significant being the CXR an inter-specific hybrid.

2.3.2.12 Rubber

- Improved varieties like RRII 105, PB 217 and GT 1 available for commercial cultivation. Some of newly released varieties are RRII - 100 series, RRII - 200 series and RRII 400 series.
- Five high yielding clones of rubber have been introduced under Category III of planting material recommendation.

2.4 IMPROVED PROPAGATION METHODS

There has been a substantial improvement in vegetative propagation techniques of fruit and plantation crops and seed production technologies in vegetables and flowers crops. Some of the advancements made are as follows;

2.4.1 Fruit Crops

- Standardization of vegetative propagation techniques *viz.*, Veneer grafting, soft wood grafting and chip budding in crops like *aonla*, *bael*, *ber*, cashew, custard apple, *jamun*, mango, sapota, jackfruit, walnut etc. Rapid methods of production of rooted cutting and commercial production for micro-propagation developed in grape.
- Suitable rootstocks standardized for citrus, grape, mango, apple, plum, peach, tea etc.
- Nursery inoculation of VAM has been found effective in improving survival after transplantation in mango, citrus, cashew, etc.
- Production of virus-free planting material using shoot tip grafting and micro budding developed in citrus.

2.4.2 Vegetables, Tuber Crops and Spices

- Breeder seed production of over 120 open-pollinated high yielding varieties of vegetables. Improvement in hybrid seed production technology with development of male sterile lines in tomato, incompatible lines in cauliflower and gynoecious lines in cucumber and muskmelon.
- Technology developed for commercial production of hybrid TPS under short days conditions in plains. Three TPS populations namely HPS I/13, TPS C-3 and 92-PT-27 have been identified for release.
- Technology of serpentine layering for production of healthy planting material in black pepper, nutmeg through epicotyl grafting, approach grafting in clove and multiplication through healthy rhizome and tissue culture in ginger perfected.
- Technology for seed production in different seed spices standardized..

2.4.3 Ornamental Crops

Commercial production of tissue cultured plants in carnation, gerbera, orchids etc available, besides hybrid seed is being produced in marigold and other crops.

2.4.4 Medicinal and Aromatic Crops

Conventional plant multiplication technology perfected in most of the crops. Tissue culture technology standardized in several crops for their vegetative propagation.

2.4.5 Coconut, areca nut and oil palm

Seed gardens for production of TxD and DxT hybrids in coconuts and indigenous tenera seed in oil palm established. Elite plant seed multiplication technique standardized in areca nut.

2.4.6 Cashew and cocoa

Near self-sustainability achieved in production of planting material in cashew.

Soft wood grafting has been successfully adopted for producing cocoa grafts. It is possible to produce 6 lakh cocoa grafts per year at CPCRI.

2.4.7 Tea and coffee

Technique for vegetative propagation of tea by inter-nodal cuttings standardized. Tissue culture is also successful.

Vegetative propagation techniques like single-node cuttings and mallet cuttings standardized to obtain true-to-the-type planting material in coffee.

Grafting techniques at seedling stage to circumvent the problem of nematodes and top working to convert moribund plantations into productive ones developed in cocoa.

2.4.8 Rubber

Polyclonal seeds, budded stumps and poly bag plants are available as planting material. Poly bag plants are more popular since they start yielding a year earlier.

2.5 MICROPROPAGATION

Apart from conventional methods of propagation micropropagation has been standardized and it has also been commercialized in few crops. Some research leads in this direction are listed hereunder;

- Commercial production of tissue cultured plants in banana, strawberry and pine-apple successful.
- Production of virus-free planting material and shoot tip grafting in citrus a commeercial.
- Protocols proposition for mass multiplication of apple, grape and citrus rootstocks available.
- *In vitro* multiplication of superior potato clones for chip and finger making commercialized. Micro-tuber and True Potato Seed techniques also standardized for commercial exploitation.
- Virus elimination through meristem culture has been standardized in potato and taro.
- High frequency reproducible protocols for rapid propagation of rose, carnation, gerbera, orchids, chrysanthemum and gladiolus developed.
- *In vitro* propagation protocols available for different MAPs like *Rauvolfia serpentina* (Sarpgandha), *Dioscorea floribunda*, *Rosmarinus officinalis* (rosemary), *Azadirachta indica*, *Stevia* sp., *Celastrus paniculatus* Willd. *Aloe vera*, geraniums, neem, Pathouli, *Stevia* sp. *etc*.
- Protocols developed are not commercially successful but need refinement in coconut, areca nut and cashew.
- Protocols standardized for micro-propagation of superior tea, coffee and rubber clones. Field trials in each underway.

2.6 BIOTECHNOLOGY

The last two decades one has witnessed unprecedented technological advances in biological sciences/the techniques of plant tissue culture, recombinant DNA technology and DNA based markers. Rapid multiplication of elite genotypes through micropropagation and refining as well as compacting the breeding process using marker-aided selection are important technologies, which have already positively contributed to crop improvement and propagation programmes. The success achieved in different fruit crops is as follows;

- DNA fingerprinting using molecular techniques like RAPD, ISSR and SSR developed in mango, banana, grape, coconut, cashew, arecanut, oilpalm etc.
- Technique standardized for cryo-conservation of potato genetic resources. Over 1,500 germplasm accessions and being maintained and exchanged from *in vitro* repository.
- *In vitro* gene bank of tuber crops set up at Central Tuber Crops Research Institute. Cassava (985 accessions), sweet potato (250 accessions), *Dioscorea* (160 accessions) and several *Colocasia* germplasm are being transferred to *in vitro* active germplasm (IVAG) repository using slow growth conservation procedure.
- Transgenic lines carrying a *Bt* synthetic *cry1Ab* gene for tolerance to potato tuber moth and in shoot fruit borer in brinjal developed. Salinity tolerance tomato has also been reported.
- Virus diagnostic techniques using both molecular (PCR, RT-PCR, NASH) and serological (ELISA & Western) developed for the detection of viral infection in cassava, sweet potato, yam and colocasia.
- Transgenic potato lines by introduction of amaranth seed protein gene *AmA1* for improvement in protein quality and quantity.
- Transgenic potato lines with Osmotin (PR-S) gene have been developed for improving resistance of tuber moth and *Helicoverpa armigera* are under evaluation.
- A protocol for the cryo-preservation of tea seeds has been developed.
- DNA markers and hybridization using tissue culture techniques and technology for production of haploid lines standardized in tea.
- Plants derived from embryo culture of interspecific crosses between cultivated *Caffea canephora* (robusta) and indigenous wild species *C. bengalensis, C. travancorensis* and *C. wightiana* established in the field.
- The RAPD markers are being used for evaluating leaf rust in coffee using genetic fingerprinting.

2.7 IMPROVED PRODUCTION TECHNOLOGIES

Some of the key technologies developed for commercial adoption are listed hereunder;

- High density planting systems standardized in mango, banana, Kinnow, pineapple and papaya for higher productivity & profitability.
- Use of plant growth regulators / chemicals for flower production /regulation in mango, improvement of berry size and quality in grape, control of fruit drop in citrus, mango, ripening of fruits standardized.
- Off-season, round the year production technology in radish and tomato.
- Production technologies for *Kharif* season onion in North India and long day type onions for high altitudes.

- Technology has been perfected for low cost cultivation of mushrooms like *Agaricus, Pleurotus* etc. for different agro-climatic conditions.
- Technology developed for successful cultivation of high value medicinal mushroom Reishi or Ling Zhi (*Ganoderoma lucidum*).
- On-farm trials for mass cultivation of white button and oyster mushrooms on wide adoption in hilly areas.
- Agro-technique developed for open and protected cultivation of quality cut roses, carnation, gladioli, tuberose etc.
- Rootstocks recommended for different agro-climatic conditions like *Rosa indica* var*. odorata*, *R*. *multiflora*, IIHR-Thornless and *R*. *chinensis*.
- Spacing, fertilizer application and weed control techniques standardized for chrysanthemum, carnation, tuberose, marigold and different annuals.
- Growing media standardized for both Epiphytic and Terrestrial orchids.
- Agro-technique for cultivation of over 50 MAPs including Guggulu and Saffron (Kumkum) standardized.
- Technology for primary processing of different MAPs and their value addition developed. Technology for drying of flower and foliage, extraction technique of essential oils, pigments etc. developed.
- Multi-species cropping systems or multi-storeyed cropping systems standardized for coconut, areca nut and oil palm.
- In cashew, technologies like high density plantation, rejuvenation, drip irrigation and bio-control of Tea mosquito has been standardized.
- Standardization longer pruning cycle in tea for higher yield and better distribution of crop to increase production (7 to 20%).
- Development of compatible rootstocks in superior tea clones for increasing yields by 26 to 27%. Technique of rejuvenation, pruning, infilling and consolidation developed for increasing productivity by 2 to 4 times.
- Technology for organic production of tea developed.
- Planting density standardized for close planting (420 to 445 plants per ha) in the case of buddlings and 445 to 520 plants per ha in the case of seedlings in rubber.
- Intercrops such as banana, pineapple, ginger, turmeric, vegetables and medicinal plants recommended for rubber, norms for diagnosis and recommendation integrated system (DRIS) have been evolved and fertilizer recommendations and use of organic mulch have been recommended for resource conservation.

2.8 USE OF PLANT BIO-REGULATORS

- Use of plant growth regulators/chemicals for vegetative propagation, flower production/regulation in mango; improvement of berry size and quality in grape; control of fruit drop in citrus and mango; and ripening of fruits standardized.
- Use of GA (25 to 50 ppm) for berry elongation grape; calcium carbide and planofix (NAA) in pineapple for flowering, 5-25 ppm 2,4-D to reduce fruit drop in citrus and mango, 800 to 10,000 ppm ethephon in fruit ripening, use of Dormex and thiourea in grape and pomegranate, use of IBA and NAA in rooting of cutting and air-layers some of the many uses of plant bio-regulators for improving fruit production. In floriculture, use of GA as pre-treatment for seed germination, use of etherel and silver nitrate in F_1 hybrid seed production in vegetables are other uses.

- Application of growth promoters has increased yield by 12 to 14% in tea.
- Foliar application of plant growth regulators such as Planofix (0.025%) increases crop yield significantly in coffee.

2.9 CANOPY MANAGEMENT

- Rejuvenation technique for old and senile plantations in mango and cashew standardized and being adopted.
- Development of coconut and areca nut-based farming systems for sustainable development of homestead in different production clusters.
- Training and pruning practices standardized for canopy management in fruit trees like mango *ber* and different temperate zone fruits in sub-tropical regions and vine fruit crops, grape, kiwifruit, *phalsa*. Staggered pruning techniques for cut flower production standardized for rose and chrysanthemum.
- Use of paclobutrazol followed by mild pruning in mango recommended for inducing regularity in flowering.
- Technology for high density planting standardized in guava using pruning and chemical regulation.
- Pruning techniques for grape standardized for efficient production under tropical and sub-tropical regions.
- Inter-cropping and multi-strayed systems developed for different plantation crops using spices and MAPs for commercial plantations including backyard gardens.

2.10 IRRIGATION

- Micro-irrigation requirements and irrigation scheduling developed for different fruit crops like mango, citrus, sapota, banana, pomegranate, grape to avoid wastage of irrigation water.

2.11 PROTECTED CULTIVATION

- Standardized protected cultivation / greenhouse alteration techniques for strawberry, tomato, cucumber, capsicum, rose, gerbera, cactus, chrysanthemum, anthuriums and orchids.
- Use of low cost plastic houses, poly-tunnels, shade nets gaining popularity in different crops. These are now being used to produce off season crop and quality cut flowers for export,

2.12 HIGH DENSITY PLANTING

- The concept of HDP is possible using dwarf scion varieties, dwarfing rootstocks and inter-stocks, use of chemicals and training and pruning. It has been perfected in different fruit crops and there is a need to expand area under HDP. High density planting systems standardized in banana, pineapple, papaya, mango and Kinnow mandarin for higher productivity and profitability.
- Development of dwarf varieties, like Amrapali mango, Pusa Nanha papaya, Dwarf Cavendish banana, Red Spur, StarCrimson Spur, etc. apple, Read haven peach and PKM1 and PKM2 sapota have made HDP possible in these crops.
- High density planting standardized with various densities 4 m x 4 m (625 plants/ha) and 5m x 5m (400 plants/ha) in guava using different planting densities in Hedge row system and ultra high density in pineapple (63,758 plants/ha).

- High density planting the technology in apple on dwarfing rootstock adopted on a commercial scale in J&K.
- High density planting in cashew standardized with various densities 4 m x 4 m (625 plants/ha).

2.13 STANDARDIZATION OF ROOTSTOCKS

- In mango, Kurukkan for salt tolerance and Vellaikolumban for inducing dwarfing identified.
- In citrus, improved rootstocks for sweet oranges like Cleopatra mandarin for Blood Red, Pectinifera for Mosambi; and Troyer citrange for Kinnow mandarin has been recommended.
- In guava, rootstocks like Pusa Srijan and *Psidium friedrichthalianum* for wilt tolerance and dwarfing recommended.
- In grape, Dogridge A and B, Salt Creek etc. recommended for salt and nematode affected areas for different commercial varieties.

2.14 USE OF INM AND BIO-FERTILIZERS

2.14.1 Tissue Nutrient Standards

Fertilizer schedules standardized for a number of crops grown under different agro-climatic regions. Leaf nutrient guides developed in a number of crops for monitoring nutrient status and scheduling fertilizer application.

2.14.2 Control of Micro-Nutrient Deficiencies

Control of different micro-nutrient deficiency disorders like leaf scorching and spongy tissue in mango through use of potassium sulphate (5%) and boric acid (50 ppm), control of Exanthema, Yellow leaf and granulation by combined use of micro-nutrients like Zn + Fe+ Cu+ Mo (0.4%) in citrus, application of boric acid to control shot berries in grape, internal necrosis by application of 0.6% borax in *aonla*, minimizing fruit cracking in litchi, lemon and pomegranate by 0.4% boric acid, etc. have been in practices by the fruit growers. Use of micro-nutrient sprays for yield and quality improvement in vegetables and flowers standardized.

2.14.3 Integrated Nutrient Management Strategies

Fertilizer schedules standardized for a number of perennial crops grown in different agro-climatic regions. Leaf sampling techniques and critical limits developed in a number of fruit and plantation crops like mango, banana, citrus, guava, pomegranate, *ber*, sapota for monitoring nutrient status and scheduling fertilizer application. Region specific INM technology standardized in fruit crops like mango, banana, citrus, coconut, areca nut, cashew, guava, pomegranate, sapota, apple etc.

Combined application of 50 g/plant each of PSB, *Azospirillum* and *Trichoderma harzianum* along with 75% of recommended dose of fertilizer of 200 g N, 50 g P_2O_5 and 200 g K_2O/plant recommended for banana. Beneficial effects of mycorrhizal inoculation found in apple, litchi, mango, banana, citrus, strawberry, cocoa, coffee, tea etc. leading to 30- 40% saving in chemical fertilizers. Other successes achieved are listed below;

- Dual inoculation (VAM + PSBs) has proved to be effective in banana and pineapple.
- Combined application of VAM + PSBs + *Azotobacter* + *Azospirillum* recommended in papaya, citrus, mango, pomegranate and grape for disease tolerance, and improvement in fruit quality.

- Nursery inoculation of VAM suggested in mango, citrus, cashew, etc. for improved survival of plants in the field.
- Beneficial effects of VA mycorrhizal fungi have been reported in almost all the vegetables worldwide. PSBs are very effective in onion, garlic and spice crops. There use has shown to minimize chemical fertilizer use by 30 to 50%.
- Spices and MAPs have also shown marked improvement in quality due to bio-fertilizer inoculation along with considerable reduction in chemical fertilizers.
- Fertilizer requirements and fertilizer use efficiency worked out for different potato varieties grown in different agro-climatic zones. Integrated nutrient management strategies worked out using FYM, organic wastes, micro-nutrients. Doses of micronutrient application for soil application, spray application and tuber soaking worked out. Application of phosphor-bacteria and *Azotobacter* recommended for 25% saving in inorganic NPK fertilizers.
- Use of bio-fertilizers namely, *Azotobacter, Azospirillum* and *Microphos* gave significantly higher yields in mushrooms over untreated control.
- *Azospirillum* + VAM + *Phosphobacterium* + NPK @ 200:40: 200 ppm provided better growth, yield and post harvest life in chrysanthemum cvs. Bronze Spray and Red Spray.
- In tea and coffee, region-specific requirements of major and micro-nutrients optimized through balanced manuring with micro- and secondary nutrients like zinc, magnesium, boron, sulphur, etc.
- Drought tolerance in robusta coffee induced by foliar application of a nutrient mixture comprising Urea (0.5 %), SSP (0.5%), MOP (0.5%) and zinc sulphate (0.5%) during January and February. The cost benefit ratio was 1:3.

2.15 USE OF BIO-CONTROL AGENTS

- Entomopathogenic fungi (*Beauveria bassiana*) and nematode (*Heterorhabditis*) found effective against banana weevils under field conditions in mango.
- Combined treatment of *Paecilomyces lilacinus* along with organic amendment, neem cake @ 250g/ plant or FYM @ 500g/plant gave maximum reduction of nematodes in Robusta.
- Use of Trichoderma, NPV, etc. are now commercially adopted by vegetable growers.

2.16 MICRO-IRRIGATION & FERTIGATION

Drip irrigation/fertigation in banana, grape, papaya, pomegranate, mandarin, coconut, areca nut and cashew standardized for saving water and fertilizer by 30 to 40 % with increases in yield and fruit quality. In vegetables, it is successful in cabbage, cauliflower, tomato, gherkin, baby corn. Adoption of drip irrigation has resulted in high yields and better quality in most of the horticultural crops. Technology for growing quality cut-flowers under drip system has been perfected in rose, carnation and gerbera. Irrigation management using sprinkler and drip methods for overcoming dry conditions and for assured crops through blossom and backing irrigation developed in tea, coffee and rubber.

2.17 PROTECTED CULTIVATION

Standardized protected cultivation / green-house/low poly tunnels production techniques available for growing cut-flowers and vegetables etc. The crops which can be efficiently grown under protected conditions are tomato, cucurbit, cabbage, cauliflower, cucumber, lettuce, onion, spinach, brinjal, pepper, turnip, radish, capsicum etc. Technology for protected cultivation of flowers like roses, chrysanthemums, gerbera, carnations etc. in poly house, shade net etc. Low cost greenhouse technology developed for high quality flower

production in hilly states of J & K, Himachal Pradesh, Uttaranchal and North Eastern states as shade net/ rain shelter for export quality flower production and plains like Maharashtra & Karnataka for Commercial floriculture. Greenhouse cultivation of tropical mushrooms such as *Calocybe indica, Pleurotus* spp. and *Volvariella volvacea* has been standardized and adopted in India.

2.18 MULCHING

Use of black mulch has been found beneficial in mango, citrus, *ber* and apple besides different vegetables like tomato, cauliflower, cabbage, baby corn etc.

2.19 PLANT PROTECTION, IPM AND PESTICIDE RESIDUES

Plant protection schedules established for all commercially cultivated horticultural crops. Biological control methods standardized for control of mealy bug in grape, scale insects in citrus, rhinoceros beetle and leaf eating caterpillar in coconut. Integrated Pest Management (IPM) strategies in crops like cabbage (diamond back moth), tomato (fruit borer), potato (bacterial forecasting and tuber moth) standardized. Apple scale and potato late blight forecasting systems have been developed. Twenty four IPM packages including those for fruits, plantation and spice crops have also been developed for farmers. Shelf-life of grapes was enhanced with pre-harvest treatment with Chitosan alone or in combination with *Trichoderma*. Entomopathogenic fungi (*Beauveria bassiana*) and nematode (*Heterorhabditis*) were found effective against banana weevils under field conditions. Combined treatment of *Paecilomyces lilacinus* along with organic amendment, neem cake @ 250g/ plant or FYM @ 500g/plant gave maximum reduction of nematodes in Robusta. Apple scab forecasting system developed has been using computer aided programmes.

Integrated disease management schedules involving biocontrol agents like *Aspergillus niger* (AN 17) and *Penicillium citrinum* have been identified for the control of guava wilt. Co-cultivation with *Curcuma domestica*, *Allium sativum* and *Tagetis erecta* found effective in reducing the incidence of wilt in guava. Corn meal medium found best for multiplication of guava wilt antagonist (bioagent) *Trichoderma harzianum, Aspergillus niger* and *Penicillium citrinum*. Sclerotium wilt of chrysanthemeum controlled by the application of *Trichoderma viride* (20 g/m^2). Similarly, Foot/root rot in gerbera effectively controlled by the application of Benomyl 0.01% + Captan 0.02%, followed by Benomyl 0.01% and *Trichoderma viride* (20 g/m^2).

Use of biocontrol strategy, i.e. *Phytophthora* tolerant pepper lines, bio-control and chemical control measures have been standardized for pure crop as well as mixed cropping systems. Use of commercial formulation of *Bt* effective in controlling shoot borer of ginger, turmeric and *Metarrhizium* sp. and *Bauveria* sp. in control of root grub of cardamom. Bio-control of different diseases like damping off and soft rot using soil application of VAM, *Trichoderma* spp. in ginger, turmeric and cardamom of polyhedrosis virus (N-PV) and gramilosis viruses (GV) are important and specific in infecting only certain closely related species of caterpillars attacking various crop plants e.g., tomato and potato. Effective control measures developed for control of rhinoceros beetle using low cost traps as well as pheromones. Technology packages for use of bio-agents like *Trichoderma viride* and *T. harzianum* control *Poria hypobrunnea*, charcoal stump rot and Brown root rot diseases and *Bacillus subtilis* for black rot caused by *Corticium* sp. developed. In coffee, integrated pest management supplemented by using pheromone traps and parasitoids for control of major pests like coffee berry borer and mealy bugs gave better results. Use of bio-control agents *Trichoderma* sp. for root rot disease management in which crop was standardized. Use of pheromone to attract and kill the adult red palm weevil (*Rhynchophorus ferugineus*) in the IPM package. Integrated Disease Management (IDM) technology for Taro leaf blight with with *Trichoderma* + mulching and May planting of short duration varieties developed. Neem based pesticides found effective in controlling parasitic and competitor moulds of *Agaricus bisporus* mushroom.

2.20 POST HARVEST MANAGEMENT

Standardization of pre- and post-harvest chemical treatments to control post harvest diseases in citrus, mango and banana for long distance transport and storage. Post-harvest treatments including pre-cooling, passive evaporative cooling for increasing the shelf-life of fresh fruits, vegetables, floriculture products, processed fruits and vegetables standardized.

- Packing materials like Corrugated Fiberboard boxes (CFBs), perforated punnettes, cling film wraps, sachets, etc. standardized for packaging different fresh horticultural produce.
- Poly crates, mess bags, tetrapacks, laminated bags, multi wallpaper, sacks and flexible packaging substances developed for packaging of fresh and processed products.
- Development of new products like mango fruit kernel as cocoa substitute, essential oils from citrus, fruit wines, dehydrated products from grape, pomegranate, mango, apricot and coconut. Technologies for commercial production of value-added coconut products like vinegar, chips, snowball tender coconut, cream, milk, milk powder and pouched tender coconut water (coco jal) are avaialable.
- Development of multi-purpose copra drier, electronic copra moisture meter and tree climbing device in coconut, technology for manufacturing of disposable plates as well as cups from areca nut. Technology for manufacturing of activated charcoal from coconut shell and extraction of tannins from areca nut developed.
- Protocol for preparation of cashew jam, jelly, candy and juice.
- New blended products in tea like flavoured leaf and in coffee developed.
- A mango grader machine developed and is under commercial adoption by the exporters. This machine has been designed and developed on the basis of physical dimensions and shape of fruits.
- Post-harvest treatments like dip in Prochloraz (0.1%) and hot water treatment at 52ºC for 10 minutes recommended for minimizing post-harvest diseases in mango. Packaging line for Dashehari mango (1 tonne/hour capacity) was standardized for de-sapping, hot water dip, washing, drying and grading operations.
- Protocol for export of Dashehari and Chausa mango has also been developed. The CFB boxes with 0.5% ventilation were found very effective for prolonging the shelf-life in mango.
- Development of harvesters for mango, Kinnow, guava, lemon etc. and machine for their handling procedures available.
- Standardization of pre- and post-harvest chemical treatments to control post-harvest diseases in citrus, mango, banana during long distance transport and storage.
- Post-harvest treatments including pre-cooling, passive evaporative cooling for increasing the shelf-life of fresh fruits and processed fruits standardized.
- Packing materials like jute, laminated bags, multi-wallpaper, sacks and flexible packaging substances developed and being used commercially.
- Technology for canning of vegetables in brine solution and frozen food products like green peas, vegetable sprouts, etc. now common.
- Vase solutions standardized for longer shelf-life in different flowers like rose, gladiolus and carnation. Technology for drying of flowers, essential oil extraction perfected.
- Improved packaging of tea developed by using jute, laminated bags, multi-walled paper sacks and flexible packaging substances. ISO 9000 and HACCP as the package for

quality improvement introduced. Technology for value-added and blended coffee mixe is available for commercial exploitation.

- Biogas generation using rubber latex serum has been perfected and the technique has been commercialized. A semi-automatic cleaning machine for up-gradation of low quality sheet rubber developed. Integrated drying systems incorporating solar, biogas and smoke drying developed.
- Pilot plant-scale production of styrene grafted natural rubber (SGNR) using gamma radiation made and the material found acceptable by the footwear manufacturing industry as a substitute for the synthetic rubber.

2.20.1 New Product Development

- Tetra pack filled fruit juices are now house hold items. Frozen pea, packed mushrooms and baby corn, punnette packed strawberry, etc. are available. Ready-to-cook fresh cut vegetables and dehydrated vegetable greens and mixed vegetables are drawing buyers in urban shopping malls. Coconut water, fruit nectar, RTS, concentrates, are also very popular. Potato chips, spiced flakes and fingers, French fries are fast growing as fast food business.
- Semi-processed products like tomato puree, ginger, garlic and chilli pastes are now available in super markets.
- Commercial extraction of nutraceutical products from different vegetables.
- Recipes for preparation of guava-*aonla, jamun-aonla*, *phalsa-aonla* blended RTS drink was standardized.
- Technologies for composting of crop waste, technique for extraction of carotenoids from crude palm oil, fiber extraction from Oil Palm Empty Fruit Bunches developed.

2.21 MECHANIZATION

Different machines have been developed for effective cultivation, intercultural operations, harvesting, grading, packaging and value-addition. The growers are adopting development of mango harvester, Kinnow clipper, potato digger, coconut peeler, etc.. Machines developed for different purposes like cool sterilization (irradiation) for sprouting in potato and onion, dehydration of different produce, vapour heat treatment (VHT) in major mango growing belts, packaging of coconut water, banana fig and chip making machine, etc. need to be popularized. Development of small scale processing plants for areca nut and oil palm. A working model of raw cashew nut grader consisting of gravity separator and oscillating sieve separator has been fabricated. Machineries for primary processing of high value vegetables developed for making packaged vegetables shreds/pieces and being sold through chain of city retail outlets.

2.22 MAJOR CROP SPECIFIC PROBLEMS

I. Fruit crops

- Lack of superior varieties for different intended use like processing, export, etc.
- Lack of technologies to manage major problems like spongy tissue, alternate bearing and malformation in mango, wilt in guava, decline in citrus, wilt in banana, etc.
- Location specific technologies are not available.
- Lack of technologies for management of soil health techniques.

II. Vegetable crops

- Lack of improved varieties for processing, protected cultivation.

- Lack of F_1 hybrids in selected vegetables.
- Lack of technology for low cost environmental controlled greenhouse cultivation in marginal areas.
- Lack of varieties for growing under semi arid areas, under low moisture regime and mild problematic soil conditions.

III. Potato

- Lack of varieties for diverse processing problems.
- Low seed multiplication rate (5-10 times) from breeders' seed to certified seed.
- Rapid deterioration of varieties due to viral complexes.
- Lack of awareness of TPS technology.
- Lack of required cold storage space and non availability of low cost short term storage structure.

IV. Mushroom

- Available technology not cost effective.
- Lack of design of low cost mushroom houses.
- Inadequate availability of quality spawn of different strains.

V. Tuber crops

- Slow multiplication rate.
- Poor management practices for pests like sweet potato weevil and diseases like cassava mosaic and colocasia blight.

VI. Floriculture

- Lack of indigenous production techniques
- F1 hybrids not fully exploited.
- Narrow product range.
- High rate of tariff imposed by importing countries.

VII. Medicinal and Aromatic Plants

- Trade of medicinal and aromatic plants is very secretive due to absence of any regulatory mechanism.
- Very less number of plants under cultivation (out of 4000 identified plants only 20-30 are cultivated).

VIII. Spices

- Lack of variability for host resistance to biotic and abiotic stresses.
- Severe crop losses caused due to disease and pests.
- Vagaries of monsoon affect crop growth, productivity and sustainability.

IX. Coconut

- Large area of old and senile plantations and most of these plantations under rainfed condition.

- Rainfed cropping nature.
- Prevalence of diseases and pests like root-wilt, ganoderma wilt, Thanjavur wilt, tatipaka diseases and eriophide and red palm weevil pests pose severe threats to industry.
- Farm level processing is inadequate.

X. Arecanut

- Incidence of diseases like yellow leaf diseases.
- Lack of irrigation facilities.

XI. Oilplam

- Poor water management in the palm orchards.

XII. Cocoa

- Large areas of old and senile plantations.
- Lack of high yielding clones.
- Black pod rot in cocoa continues to be problems in production front.
- Farm level processing is inadequate.

XIII. Cashew

- Increasing level of senility of the existing plantation.
- Poor management of pests like tea mosquito bug and stem borer.
- Farm level processing is inadequate.

XIV. Tea

- Old age of tea bushes.
- Slower pace of replantation- the rate of replanting is less than 0.4% as against the desired level of 2.0%
- Poor drainage and lack of irrigation when needed greatly reduces the yield.
- Stagnation in productivity level compounded by high land labour ratio.
- Higher rate of taxation in the income from tea.
- Stiff competition from the soft drinks.

XV. Coffee

- Presence of large number of tiny growers with less than two hectare.
- Existence of old moribund plant material due to reluctance of replant with new varieties.

XVI. Rubber

- Unattractive financial assistance to meet out incentives for the growers to undertake scientific planting.
- Low price of rubber.
- Inadequate infrastructure for primary processing.
- Stiff competition from natural and synthetic rubber.

2.23 XI PLAN THRUST AREAS OF RESEARCH

Keeping the above status of research, following thrust areas in research can be taken up during XI Plan Period (2007-2012).

- Development of improved varieties/hybrids of fruits, vegetables, plantation crops, medicinal and aromatic plants with high production potential, biotic and abiotic resistance and suitable for introduction processing export with high nutrient value.
- Emphasis on indigenous minor fruits and seed spices. Need to develop varieties suitable for growing under protected cultivation in vegetables and flowers.
- Development of appropriate horticultural based cropping systems for different agro-climatic areas and crop clusters. Production technology, for matching export requirements and diversified use including processing and value addition.
- Protected cultivation for export-oriented vegetables and flowers.
- Research on efficient water management including micro-irrigation and fertigation. There is a need to develop low cost liquid fertilizers and use of computers in green house growing.
- Post-harvest technology including value-addition and product diversification of important horticultural crops
- Developing micropropagation of important horticultural crops for mass multiplication of quality planting materials. Devising technology for genetic manipulations in desired crops for introducing desirable traits of yield, quality and stress tolerance.
- Advanced research on national disease problem such as mango malformation, guava wilt, citrus decline, spongy tissue in mango, root wilt in coconut, *Phytophthora* diseases of different horticultural crops.
- Floriculture research for quality production of cut-flowers, post-production handling and transportation of floricultural products.
- Integrated management of nutrients, diseases and pests of important horticultural crops to reduce input costs, environmental pollution and to avoid pesticide-residue problems.
- Hi-tech horticulture should receive attention for improving production, productivity and quality in different horticultural commodity.
- Concerted efforts be made to conduct experiments in organic farming systems to make the findings more scientific.
- Research on market intelligence, use of information technology, e-commerce be taken up on different commodity.
- Mechanization for different operations in gardens should be made to make the operations more efficient and reduce the drudgery on farm labourers.

CHAPTER III
HORTICULTURE DEVELOPMENT

3.1 HISTORY AND INFRASTRUCTURE

The Department of Agriculture & Co-operation of the Ministry of Agriculture is the nodal department for overviewing horticulture development in the country. The Division of Horticulture was carved out of the Crop Division in 1981 and a position of Horticulture Commissioner was created in 1985. The Division of Horticulture in the Department is vested with the responsibility of over-seeing the overall development of horticulture at national level. It is supported by three Boards i.e., National Horticulture Board, Gurgaon, Coconut Development Board, Kochi and National Bee Board, Gurgaon besides, two Directorates i.e. Directorate of Cashew and Cocoa, Kochi and Directorate of Arecanut and Spices, Calicut. The National Committee on Plasticulture Application in Horticulture which has 17 centres to work on plasticulture intervention is also attached to the Division. A Central Institute of Horticulture for effective dissemination of technologies and capacity building has been established under the Department at Mediziphema, Nagaland. The Department implements its programmes through the State Departments of Horticulture and provides leadership and coordinates activities for the promotion of horticulture. The infrastructure available with the Horticulture Division is as follows:

3.1.1 Coconut Development Board (CDB)

The Coconut Development Board was established in 1981, after Government of India abolished the erstwhile Directorate of Coconut Development formed during 1966. The Board has a mandate for integrated development of coconut industry in the country through promoting production, processing, marketing and product diversification of coconut. The functions of the Board are: adopting measures for the development of coconut industry; recommending measures for improving marketing of coconut and its products; imparting technical advice to those engaged in coconut cultivation and industry; provide financial and other assistance for expansion of area improving productivity and product diversification; compile statistics on coconut; undertake publicity and publication activities; encouraging adoption of modern technologies for processing of coconut and its product. Recommending measures for regulating imports and exports for coconut and its product and fixing grades, specifications and standards for coconut and its products also fall under its ambit.

The Board has its headquarters at Kochi, Kerala, with three regional offices located at Bangalore (Karnataka), Patna (Bihar) and Chennai (T.N.) and six state centres each at Hyderabad (A.P.), Calcutta (West Bengal), Guwahati (Assam), Agartala (Tripura), Bhubaneswar (Orissa) and Port Blair (A & N Island). In addition, nine Demonstration cum Seed Production Farms have also been established in the states of Kerala, Karnataka, Andhra Pradesh, Orissa, Assam, Bihar, Tripura and Madhya Pradesh. The Board has been implementing various development programmes for the last 25 years. Efforts of the Board have been rewarding in terms of increased production and productivity and also towards diversification of products. The Board is now publishing Indian Coconut Journal in 5 languages and has established a good information system.

3.1.2 National Horticulture Board (NHB)

A National Horticulture Board was set up by the Government of India in 1984 as an autonomous society under the Societies Registration Act 1860 with its Headquarters at Gurgaon, Haryana with the mandate to promote integrated development of horticulture and

to help in coordinating, stimulating and sustaining the production and post-harvest management of fruits, vegetables and other horticultural crops. It has the following specific mandates:

- Develop high quality horticultural farms in identified belts and make such areas vibrant with horticultural activity which in turn will act as hub for developing commercial horticulture
- To develop post-harvest management infrastructure
- To strengthen market information system and horticulture database
- To assist R&D programmes to develop products suited for specific varieties with improved methods and horticulture technology
- To provide training and education to farmers and processing industry personnel for improving agronomic practices and new technologies and
- To promote consumption of fruits/vegetables in fresh and processed form etc.

The Board has its headquarters at Gurgaon, Haryana, with its offices spread across 36 centres in the country.

3.1.3 Directorate of Arecanut and Spices Development (DASD)

The Government of India established the Directorate of Cocoa, Arecanut & Spices Development at Calicut, Kerala with effect from 01.04.1966 as one of the subordinate offices of the Ministry of Agriculture (Department of Agriculture & Cooperation). The Directorate has the mandate to formulate appropriate development schemes on spices, medicinal & aromatic plants and arecanut at the national level. These schemes are implemented through State Governments, Agricultural Universities, ICAR Institutes as well as through Regional Research Laboratories under CSIR but monitored by the Directorate. The Directorate also collects compiles and publishes data on area, production, price trends, export and import of arecanut and spices in addition to keeping liaison with research and development agencies at the State and Central levels. Through the efforts of Directorate there has been unprecedented increase in production and quality of these products. Directorate of Arecanut and Spices Development, also publishes Indian Journal of Arecanut, Spices And Medicinal Plants, Arecanut and Spices Database at regular interval for circulation among farmers, extension workers, scientists, exporters, industrialists etc.

3.1.4 Directorate of Cashewnut and Cocoa Development (DCCD)

The Directorate of Cashewnut Development came into being with effect from 01.04.1966 at Cochin as a subordinate office of the Union Ministry of Agriculture with primary objective of development of cashewnut in the country. Development of cocoa was transferred to this Directorate during 1998. The Directorate of Cashewnut and Cocoa Development is responsible for formulation and coordination of schemes and programmes for development of cashewnut & cocoa in the country. The Directorate maintains a close liaison with the state Governments and other state level agencies in the course of development. It conducts comprehensive studies on various aspects of cashewnut & cocoa development including production, prices, marketing and other related problems. It has been instrumental in dissemination of technical information and research findings of practical value through publications. It has also helped in adoption of improved technology for production and supply of quality planting material. The Directorate also publishes a quarterly journal “The Cashew “.

3.1.5 National Committee on Plasticulture Applications in Horticulture (NCPAH)

This Committee is responsible for horticulture development through plasticulture intervention. While it was set up under the Ministry of Chemicals and Fertilizers, now it is under this Ministry of Agriculture since 1993 and is attached with the Division of Horticulture. NCPAH has 17 plasticulture development centers across the country working for popularization of drip irrigation, green house cultivation, mulching etc. to achieve improved production and productivity. The Union Minister of Agriculture is the Chairman of this Committee and the Horticulture Commissioner is the Member Secretary. The objectives of NCPAH are as follows:

- To prepare plans and recommend policy measures for accelerated adoption of plasticulture applications.
- Organise research and development in the area of plasticulture.
- Assist in prescribing quality standards for plastics used in agriculture sector.
- Supervise and monitor performance of Precision Farming Development Centres (PFDCs).
- Supervise and monitor development of plasticulture in the country.

3.1.6 National Bee Board (NBB)

With a view to accelerate the development of beekeeping in the country, the Ministry of Agriculture constituted a Beekeeping Development Board (BDB) under the Chairmanship of Secretary (A&C) in 1993. National Bee Board was constituted in July 2000 after abolishing the Beekeeping Development Board, with its office located in Gurgaon. The Board is headed by Secretary (Agriculture & Cooperation) while the Horticulture Commissioner is the member Secretary to the Board. The major objectives of the Board are as follows:

- Strengthening the quality control system
- Coordination and convergence of the programmes and facilities of various state departments, such as agriculture, horticulture, forest, KVIB industries etc.
- Research and development efforts
- Training and awareness

3.1.7 Externally Aided Projects

Support to horticulture development is also being provided through externally aided projects in critical areas. Projects on olive, propagation of walnuts, Green house technology in flower production, Banana production for small scale farmers and apple production improvement are some of the projects which have been implemented. The projects on litchi and saffron are in the process of finalization.

In addition to the Ministry of Agriculture, the Ministry of Commerce has been promoting research, development and export of cardamom, tea, coffee, and rubber through the Commodity Boards set up for the purpose namely, Spices Board, Tea Board, Coffee Board and Rubber Board respectively. Also, an Agriculture Produce Export Development Authority (APEDA) has been set up under this Ministry for promoting export of horticultural commodities both fresh as well as value added products. Indirect organizational support for horticulture development is also being provided by two agencies in the Ministry of Agriculture namely National Cooperative Development Corporation (NCDC) and National Agricultural Cooperative Marketing Federation (NAFED) with their headquarters in Delhi.

3.2 BUDGETARY ALLOCATION

Horticulture development was at very low ebb till the third Five-Year Plan and received meager attention even thereafter. However, the plan investment in horticulture development increased significantly from the VIII Five Year Plan onwards and resulted in considerable strengthening of the horticultural development programmes in the country.

Starting with a meager financial allocation of Rs. 2.05 crores for horticulture development in IV Plan, the Plan allocation rose to Rs.7.62 crores in V, Rs. 14.64 crores in VI, Rs. 25.0 crores in VII, Rs. 1000.00 crores in VIII (utilization Rs.7890 million) and Rs.1453.06 crores in IX Plan (Fig.3.1). The allocation for horticulture increased many folds during the X Plan with the launching of Technology Mission for Integrated Development of Horticulture in North East Region, National Horticulture Mission, Microirrigation Programme and National Bamboo Mission.

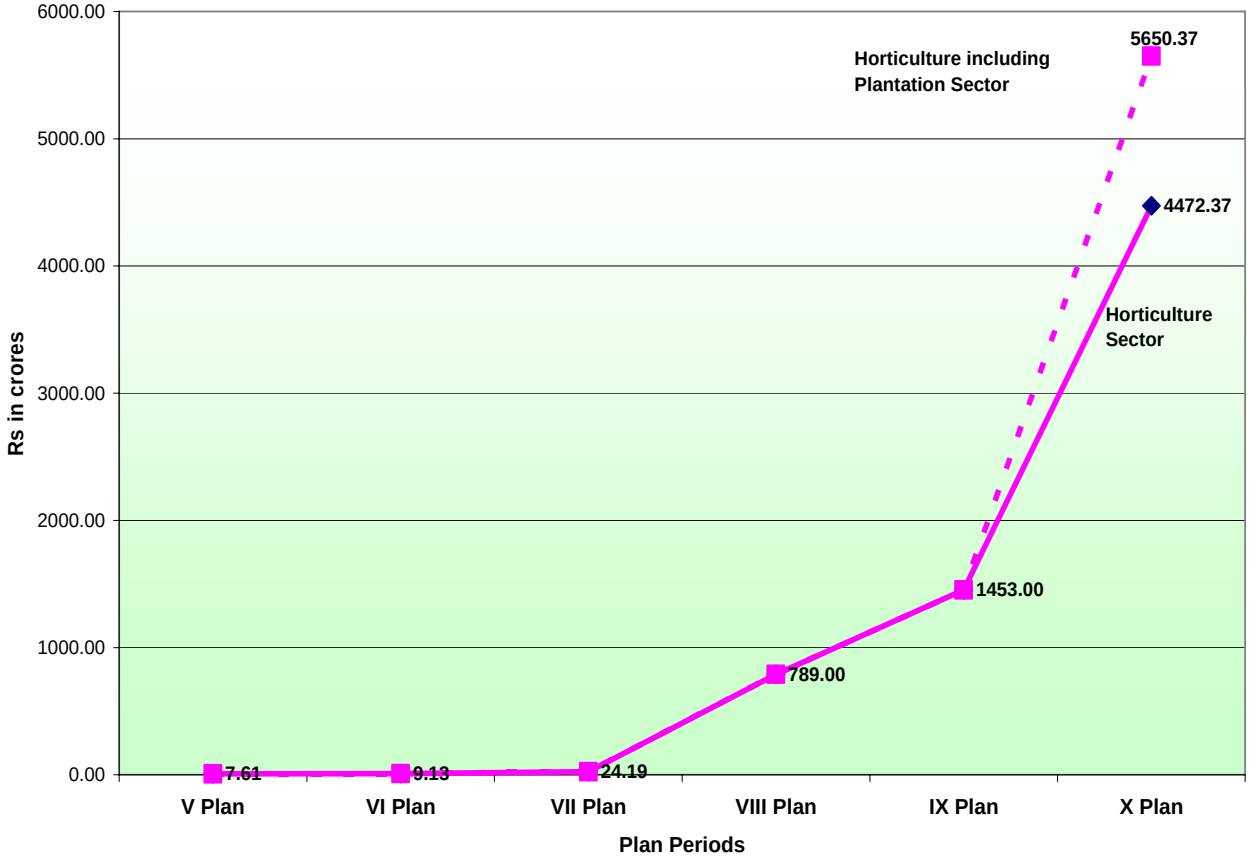


Fig. 3.1 Plan allocation for horticulture development in India

Total budgetary allocation for the development of horticulture and plantation sector in the country during X Plan period was Rs. 5,650 crores. The allocation for the horticulture development during X Plan period was stepped up to Rs. 4,472 crores, which was merely three times the allocation of Rs. 1,453 crores during IX Plan. In addition Rs. 1,178 crores was allocated to the commodity Boards of the Ministry of Commerce dealing with Tea, Coffee, Rubber and Spices. At present the horticulture crops programmes form around 30 per cent of the total outlay for agriculture development of the Department of Agriculture & Cooperation. The details of allocations and expenditure under different schemes during the X Plan are given in Table 3.1.

Table 3.1. Financial profile of horticulture schemes during X Plan

(Rupees in crores)

S. No.	Scheme/ Programme	BE	RE (Provisional)	Expenditure (Provisional)
	Ministry of Agriculture			
i.	Technology Mission on Horticulture Development for the North Eastern Region	829.62	875.41	849.51
ii.	Coconut Development Board Including Technology Mission	160.00	157.88	150.39
iii.	Hilly/Tribal Areas Development**	50.50	81.00	30.00
iv.	National Horticulture Board	471.65	361.80	391.30
v.	Hi-Tech Horticulture & Precision Farming*	33.50	0.50	0.00
vi.	Technology Intervention for Sustainable Development of Horticulture**	28.50		
vii.	Human Resources Development*	3.00	2.70	1.97
i.	National Horticulture Mission	1,680.00	1,630.00	1,630.00
ii.	Micro Irrigation	930.00	800.49	800.49
iii.	CIH, Mediziphema	5.60	3.30	3.30
iv.	National Mission on Bamboo Technology & Trade Development	280.00	90.00	90.00
	Sub Total	**4,472.37**	**4,012.08**	**3,946.96**
	Ministry of Commerce			
i.	Coffee Board	300.00		221.22
ii.	Rubber Board	415.00		447.70
iii.	Tea Board	463.00		462.98
	Sub Total	**1,178.00**		**1,131.90**
	Grand Total	**5,650.37**		**5,078.86**

**: Discontinued; * Merged with NHM & Microirrigation

Increase in budgetary allocation of horticulture development programme from IV to X Plan was more than 5800 times. Focused attention to horticultural research and development has paid dividend by way of increased production and productivity and enhanced exports. Large areas have been brought under improved cultivars of different crops with improved technologies resulting in considerable increase in production of quality planting material and seeds. A large number of farmers have been trained in innovative technologies like drip irrigation, green house cultivation, micro propagation etc.

3.3 PROGRAMMES AND PROGRESS

The activities carried out under different schemes during the X Plan are reviewed in this chapter:

3.3.1 Technology Mission for Integrated Development of Horticulture in North East Region & Himalayan States

The Technology Mission was launched during the financial year 2001-02 to achieve overall development of horticulture in 8 states to harness the potential that exists in the North East region. The scheme was further extended to three other hilly States namely Jammu & Kashmir, Himachal Pradesh and Uttaranchal during 2003-04.

3.3.1.1 Objectives

The broad objectives of the Technology Mission for Integrated Development of Horticulture in North East Region and Himalayan States are:

- Establish convergence and synergy among numerous ongoing governmental programmes.
- Achieve horizontal and vertical integration of these programmes.
- Ensure adequate, appropriate, timely and concurrent attention to all the links in the production, post harvest and consumption chain.
- Maximize economic, ecological and social benefits from the existing investment and infrastructure created for horticulture development.
- Promote ecologically sustainable intensification, economically desirable diversification and skilled employment.
- Generate value addition; promote the development and dissemination of eco-technologies.

3.3.1.2 Programmes

The potential for increasing the production and productivity of these crops is phenomenal. However, because of predominance of poor tribal farmers who have been depending on Jhum cultivation, lack of infrastructural facilities, less awareness about technology the productivity of crops in the region is extremely low. Therefore to achieve the goal and mandate of mission, programmes have been formulated under different Mini Missions.

i. Mini Mission–I : The first and foremost activity in the technology mission for the integrated development of horticulture in the NE region is the identification, development, standardization and adaptation of improved production technology such as high yielding varieties / hybrids, organic farming, high production technology which are appropriate to the specific agro-climatic conditions of this region.

ii. Mini Mission-II : This mini mission primarily aims at increasing the quantum of production and productivity of the horticulture produce in the region. This will be achieved by integrating the various factors and processes responsible for increasing the production and productivity. The major activities in this Mini Mission would be production and supply of quality planting material at reasonable cost to the farmers; utilization of maximum land resources (area expansion); watershed management; dissemination of appropriate production techniques to the farmers; product diversification through training; demonstrations and distribution of requisite information material; efficient utilization of human resources in the region (both men and women); promotion and popularization of integrated pest management; use of bio-fertilizers and mechanization.

iii. Mini Mission-III : This Mini Mission aims to create infrastructural facilities for post harvest management, marketing and export. For this purpose existing schemes of the NHB, DMI, NCDC, APEDA, NAFED etc either with the existing outlays or with enhanced outlays will be implemented. Considering the gap new components have been proposed in marketing.

iv. Mini-Mission-IV : This mini-mission will be implemented by Department of Food Processing Industries and will address all the issues of processing and marketing of processed products. The detailed pattern of assistance and cost norms is given in Annexure- 3.1.

3.3.1.3 Budgetary allocation

Against an outlay of Rs. 850 crores, an expenditure of Rs. 731 crores (86%) has been incurred during the X Plan period (till November, 2006).

3.3.1.4 Achievements

Major achievements of the Mission during the plan period are:

i. Area and production: Bringing additional area of 1,17,872 ha and 25,373 ha under various horticulture crops in 8 NE and three Himalayan states respectively. In North East region, the additional area of 54,973 ha was brought under different fruits, 20,979 ha under vegetables, 26,950 ha under spices, 4,039 ha under flowers, 5,252 ha under plantation crops, 1,652 ha under medicinal plants and 4,027 ha under aromatic plants. Whereas in Himalayan he States area expansion under fruits was 18,925 ha, 4,658 ha under vegetables, 587 ha under flowers, 898 ha under spices, 170 ha and 135 ha under medicinal & aromatic plants respectively. State-wise area expansion under various crops is given in 3. 2.

Table 3.2 State-wise and crop-wise expansion of area in north east and Himalayan states (ha)

NE States	Fruits	Veg.	Spices	Flowers	Plantation	Medicinal	Aromatic	Total
Arunachal Pradesh	9987.0	2460.0	5650.0	410.0	0.0	550.0	2307.0	**21364.0**
Assam	5515.0	1391.0	2404.0	281.0	1594.0	100.0	100.0	**11385.0**
Manipur	6456.0	2186.0	2468.0	348.0	170.0	90.0	135.0	**11853.0**
Meghalaya	4672.0	2042.0	1925.0	99.0	905.0	190.0	123.0	**9956.0**
Mizoram	10994.0	3427.0	2111.0	1272.0	670.0	115.0	334.0	**18923.0**
Nagaland	7891.0	2550.0	3102.0	507.0	1025.0	579.0	1009.0	**16663.0**
Sikkim	3730.0	4225.0	7533.0	994.0	0.0	10.0	10.0	**16502.0**
Tripura	5728.0	2698.0	1757.0	128.0	888.0	18.0	9.0	**11226.0**
Sub-Total	**54973.0**	**20979.0**	**26950.0**	**4039.0**	**5252.0**	**1652.0**	**4027.0**	**117872.0**
Himalayan States								
Jammu & Kashmir	7570.0	813.0	76.0	14.0	0.0	-	33.0	**8506.0**
Himachal Pradesh	5628.0	2033.0	301.0	230.0	0.0	130.0	92.0	**8414.0**
Uttaranchal	5727.0	1812.0	521.0	343.0	0.0	40.0	10.0	**8453.0**
Sub-Total	**18925.0**	**4658.0**	**898.0**	**587.0**	**0.0**	**170.0**	**135.0**	**25373.0**
Grand Total	**73898.0**	**25637.0**	**27848.0**	**4626.0**	**5252.0**	**1822.0**	**4162.0**	**143245.0**

ii. Planting material: To enhance production and productivity of horticultural crops emphasis was laid on availability of quality planting material. During the Plan period 553 nurseries were established. Of which 355 nurseries were established in North Eastern States and rest in Himalayan States.

iii. Focus crops: Potential 'Production Zones' in each state were identified in a cluster approach based on soil and agro climatic conditions. Focus fruits were identified and promoted in the identified zones. These are passion fruits, strawberry, kiwi fruit, pineapple and banana. Besides, off season vegetables production was promoted. Other focus crops are cut flowers, orchids, ginger, turmeric, bird's eye chilli and shiitake mushroom.

iv. Infrastructure/technologies: Emphasis was also laid on adoption of improved technologies. During the X Plan infrastructure facilities such as nurseries, tissue culture units, community water tanks, tube wells, drip irrigation, green houses, model floriculture centers, mushroom units, vermi-compost units etc. were created in the region which has helped in production & supply of quality planting material and also improving in production and productivity of horticulture crops in the region. Details of infrastructure created in the North East and Himalayan States are given in Table 3.3.

Table 3.3. Infrastructure facilities created in north east and Himalayan states

Programmes	NE	HS	Total

Production of Quality Planting Material			
Establishment of Nurseries (Nos.)	355	198	553
Creation of Water resources			
Community Tanks (Nos.)	3,637	1,031	4,668
Tube Wells (Nos.)	2,128	1,089	3,217
Drip irrigation (ha)	3,284	1,148	4,432
Mulching (ha)	1,493	19	1,512
Facilities for Improved Management practices			
Protected Cultivation			
Green Houses (500Sq.M)(No.)	1,611	90	1,701
Green houses (100Sq.m) (No.)	7,453	1,093	8,546
Model Floriculture Centres (No.)	11	2	13
IPM/INM			
IPM (ha)	2,766	1,170	3,936
Disease forecasting units (No.)	19	3	22
Biological labs (No.)	2	1	3
Leaf analysis labs (No.)	10	5	15
Plant health Clinics (No.)	11	9	20
Organic farming			
Organic farming (ha)	5,559	268	5,827
Earthworm units (Nos.)	4,056	628	4,684
Infrastructure for training			
Gardener training centers (No.)	51	4	55
Supervisory training centers (No.)	21	1	22

v. Marketing: Marketing of horticultural produce, a key issue has been successfully addressed during the period. Several markets like whole sale markets, rural primary markets, apni mandies and grading labs were established in different states as per in details given in Table 3.4.

Table 3.4 List of markets established in north east and Himalayan states

Programmes	Whole Sale Market	Rural Primary Market	Apni Mandies	Grading Lab.
North Eastern States				
Assam	2	25	-	7
Arunachal Pradesh	6	24		2
Mizoram	10	87	-	2
Nagaland	8	82	43	-
Sikkim	1	14	-	3
Manipur	-	-	-	-
Meghalaya	2	11	-	2
Tripura	-	-	-	-
Sub-Total	**29**	**243**	**43**	**16**
Himalayan State				
J&K	15	-	-	-
Himachal Pradesh	-	-	-	-
Uttaranchal	-	-	--	2
Sub-Total	**15**	**-**	**-**	**2**
Grand Total	**44**	**243**	**43**	**18**

vi. Post Harvest Management: During the plan period emphasis was laid on creation/ expansion of cold storage structures for horticultural produce in the state covered

under the project as per details given in Table 3.5.

Table 3.5 State-wise projects sanctioned for construction/ expansion/modernization of cold storage

State	Number of Projects	Subsidy released (Rs. in lakhs)
Assam	6	360
Tripura	1	60
Nagaland	1	60
Total	**8**	**480**

vii. Processing: During the period 11 processing units were established in North East and Himalayan States with an amount of Rs. 7.41 crores as per details given in Table 3.6.

Table 3.6 List of processing units established and upgraded in north east and Himalayan states

Sl. No.	Processing Units	Amount released (Rs. In lakhs)
	North Eastern State	
i.	Setting up of Spice Oil and Oleoresin Unit at Byrnihat, Meghalaya by J.G. Spices Ltd	75.00
ii.	Setting up of Ginger Processing Unit at Byrnihat, Meghalaya	50.00
iii.	Setting up of Fruit and Vegetable Processing Unit, Meghalaya by Mansan Fruit Products	16.69
iv.	Upgradation of Fruit Juice Center Plant Chhingchhip, Mizoram MIFCO, Aizwal	100.00
v.	Upgradation of Food Processing Plant at Sairang, Mizoram MIFCO, Aizwal. (Mizoram Food & Allied Industries Corporation Ltd.)	60.50
vi.	Setting up of Fruit and Vegetable Processing Unit, Wangoi, Manipur by Voluntary Service Center	33.22
vii.	Setting up of Ginger Processing Unit, Imphal- East District, Manipur, by United Development Agency	16.12
viii.	Post harvest Infrastructure and cold chain for fruit processing- Community Development Society, Imphal	39.00
ix.	Good Samaritan Social Service Association, Punanamei, Mao, Senapati	256.25
x.	Promotional activities (NERAMAC)	1.76
	Sub-Total	**648.55**
	Himalayan State	
i.	M/s. Aromatrix, Himachal Pradesh	78.78
ii.	Shiva Foods Industries-Nainital, Uttaranchal	4.85
iii.	JMHPMC (PM's recon. Plan for J&K)- DPR preparation	9.70S
	Sub-Total	**93.33**
	Grand Total	**741.87**

3.3.1.5 State-wise achievements of TMNE

i) Arunachal Pradesh

- The commercial cultivation of kiwi, apple, walnut, potatoes and off-season vegetables is in progress.
- Citrus, banana, pineapple, large cardamom, black pepper, citronella, patchouli and walnut identified as focus crops in clusters.

- Overall increase of 29.63% of area under above crops over the pre Mission period (fruits 19.54% and vegetables is 117.14%).
- Large scale cultivation of kiwi fruit of better quality.
- Hybrid off-season tomatoes and potatoes from Rupa in West Kameng District being exported to plains bringing good returns to the farmers.
- Commercial cultivation of medicinal and aromatic plants such as patchouli and citronella.
- Infrastructure facilities like small and big nurseries established for supply of quality planting material. Green houses and many poly houses in the farmers field established.

An amount of Rs.62.711 crores released, of which Rs.59.93 crores for production and productivity related programmes under Mini Mission-II.

ii) Assam

- Area and production of fruits in Assam is 1,10,800 ha and 13,35,100 metric tonnes, while the area and production of vegetables is 2,37,400 ha and 29,35,200 metric tonnes respectively.
- An additional area of 11,385 ha. was covered under different horticulture crops (Table 3.5) since inception of technology mission in the state.
- Assam has made good progress in cultivation of vegetables and flowers.
- Banana, ginger, oranges, black pepper, vegetables, Assam lemon are the focus crops identified in clusters. Commercial cultivation of banana, orange, patchouli and ginger established.
- Overall increase of 2.58 % of area under focused horticulture crops over pre Mission period. (fruit 5.15% and vegetables is 0.58%).
- Community tanks constructed under the scheme are being used for irrigation of off-season vegetable crops.
- State in the process of entering into MOU with M/s Zopar Exports for commercial cultivation of anthurium and orchids.
- Established 2 wholesale markets, 25 rural primary markets and 7 state grading laboratories.
- An amount of Rs. 58.963 crores released, of which Rs.52.74 crore for production and productivity related programmes

iii) Manipur

- Major vegetables include mainly cauliflower, cabbage, tomato, peas, radish, carrot, French beans, okra. Off-season cultivation of promising crops started in Mao area under Senapati District. Major achievements of the programme are:
- An additional area of 11853 ha. was covered under different horticulture crops (table 3.5).
- An overall increase of 34.28% in area under focused horticulture crops over pre Mission period, increase in under fruits 26.13% while vegetables is 22.54%.
- Fruits namely banana, passion fruit, orange/lime cashew besides vegetables crops like cabbage, garden pea, tomato, capsicum, potato, ginger, turmeric, chillies/bird's eye chillies the focus crops in identified clusters.
- Commercial cultivation of "Shitake" Mushroom by Integrated Shitaki Mushroom

Producing and Processing Society, Senapati district a successful venture in the state. About 180 self help groups mainly, women engaged in production of Shitake Mushroom in this district.

- Off-season cultivation of vegetables like tomato, cucumber and melon being cultivated under protected conditions (green-house) in the valleys. Large cardamom established as potential crop of the state.
- Crops e.g. olive, aonla, ber, pummelo, strawberry and kiwi fruit introduced in the Mao and Ukhrul areas. Launching of passion fruit farming in Senapati District.
- A passion fruit processing unit established by M/s Exotic Juices Ltd., at Punanmei, Senapati district with a capacity to process around 8,500 MT of passion fruits per annum. Started commercial processing of passion. So far 7MT of passion fruit concentrate produced by processing 150MT of fruits.
- An amount of Rs. 48.855 crores were released, of which Rs.45.96 crore for production and productivity related programmes.

iv) Meghalaya

- Area and production of horticulture crop in Meghalaya- fruits 24,000 ha and 1,86,900 metric tonnes, vegetables 35,700 ha and 83,900 metric tonnes respectively.
- An additional area of 9956 ha. was covered under different horticulture crops (fruits- 4672 ha., plantation crops- 905 ha, vegetables- 2042 ha., spices- 1925 ha., flowers- 1272 ha., Medicinal and plants- 190 ha, aromatic plants- 123 ha.).
- An overall increase of 13.94% of area under focused horticulture crops with fruit 19.38% and vegetables is 5.41%.
- Pineapple, banana, orange, plum, peach and strawberry under fruits, cabbage, tomato, carrot, sweet potato and tapioca under vegetables, ginger, turmeric and black pepper under spices, cashewnut and arecanut under plantation crops, carnations, bird of paradise and gerbera under flowers are focus crops grown in clusters.
- Commercial cultivation of strawberry and its marketing strategy one of the success stories in the state.
- Produces large quantities of potatoes and off-season vegetables. Steady progress in production of flowers. Community tanks constructed under the scheme proving beneficial for cultivation of off-season vegetables.
- Establishment of 253 vermi compost units for promotion of organic farming.
- Supports 1255 women's self help groups in horticultural activities, especially floriculture.
- Development of 2 wholesale markets and 11 rural primary markets with an assistance of Rs.95.25 lakhs.
- State has negotiated with M/s Dabur and M/s Priya Gold for promotion of processing of horticultural products.
- Breakup of the total fund utilized among different components are area expansion - 28.19%, production of planting materials - 10.2%, on farm water management - 10.33%, creation of water sources - 8.89%, organic farming - 4.9%, centre for excellence - 5.53%, agricultural mechanization - 5.57% and other activities -26.34%.
- An amount of Rs.55.50 crores released, of which Rs.53.47 crores for production and productivity related programmes under Mini Mission-II.

v) Mizoram

- Area and production of horticultural crops- fruits 19,000 ha and 63,400 metric tonnes and vegetables 6,800 ha and 44,100 metric tonnes respectively. Production of vegetable crops increased considerably with the help of improved technologies and irrigation facilities created through community tanks, particularly for cultivation of off-season vegetables. Large number of farmers particularly women involved in commercial cultivation of anthurium flowers under poly houses.
- An additional area of 18,923 ha covered under different horticulture crops (fruits- 10,994 ha, vegetables- 3,422 ha, spices- 2,111 ha, flowers- 1,272 ha, plantation crops- 670 ha, Medicinal and aromatic plants- 334 ha and 115 ha.).
- An overall increase of 70.6% of area under focused horticulture crops. (61.07% under fruits and 43.37% under vegetables).
- Commercial cultivation of fruits, namely passion fruits, papaya, grape, banana and mandarin oranges in identified clusters.
- Large scale cultivation of vegetables namely chow-chow and cabbage.
- Commercial cultivation of anthurium in identified clusters including contract farming arrangements.
- Development of 10 wholesale markets, 87 rural primary markets and 2 state grading laboratories with an assistance of Rs.878.75 lakhs.
- Upgradation of 2 processing units with an assistance of Rs.50.00 lakhs.
- An amount of Rs.72.752 crores released, of which Rs.62.99 crore for production and productivity related programmes under Mini Mission-II.

vi) Nagaland

- Area and production of fruits in Nagaland 25,000 ha and 3,02,000 metric tonnes and vegetables is 26,300 ha and 2,86,000 metric tonnes respectively.
- An additional area of 16,663 ha. covered under different horticulture crops (fruits- 7,891 ha., vegetables- 2,550 ha., spices- 3,102 ha., plantation crops- 1,025 ha., flowers- 507 ha., medicinal plants- 579 ha., and aromatic plants- 1009 ha.).
- Overall increase of 32.09% of area under focused horticulture crops. The increase in area under fruit being 31.94% and vegetables being 9.47%.
- Commercial cultivation of passion fruit, pineapple, orange and large cardamom taken up particularly in Jhum areas.
- Citrus, pineapple, passion fruit and banana focus crops identified in clusters.
- Large scale promotion of dry flower production involving group of women entrepreneurs.
- Development of 8 wholesale markets, 43 apni mandies, 82 rural primary markets with an assistance of Rs.816.25 lakhs.
- An amount of Rs. 68.013 crores released, of which Rs.59.54 crore for production and productivity related programmes under Mini Mission-II.

vii) Sikkim

- Area and production of fruits in Sikkim is 12,300 ha and 10,300 MT and vegetables is 14,200 ha and 60,000 MT respectively. Significant increase in vegetable production has resulted in reducing the inflow from outside the state and increasing outflow of

off-season vegetables. Off-season vegetable cultivation of cabbage, cauliflower, peas, beans and broccoli has picked up. Flower exports from state to other state started. Joint ventures for export of orchids and commercial cultivation of Gerbera flowers established.

- An additional area of 11,226 ha covered under different horticulture crops (fruits- 3,730 ha, vegetables- 4,225 ha, spices- 7,533 ha, flowers- 994 ha., medicinal plants- 10 ha and aromatic plants- 10 ha).
- Overall increase of 71.84% of area under focused horticulture crops (fruits 39.68% and vegetables 31.29%).
- Increase in area under fruits (39%), vegetables (70%), spices (113%) and flowers (100%).
- Commercial cultivation of passion fruit, khasi mandarin, large cardamom, cabbage, tomato and flowers like orchids, gerbera and carnations in identified clusters.
- Two joint venture floriculture projects, one for cymbidium orchids with M/s Natural Synergies, Chennai and another for carnation, lilium and anthurium with M/s Florence Flora, Bangalore set up. Floriculture unit of Mazitar produced 80,000 cut flowers of carnations and marketed in domestic market.
- Large scale production of tissue cultured plantlets of cymbidium orchids.
- Establishment of nurseries for large scale production of large cardamom.
- Large scale promotion of organic farming by development of 140 vermi-compost units and adoption of organic farming in 1,200 ha.
- Development of one wholesale market, 14 apni mandi/ rural primary markets and 3 state grading laboratories with an assistance of Rs.85.00 lakhs.
- Establishment of 6 outlets for sale of flowers in Gangtok.
- An amount of Rs.55.23 crores released, of which Rs.54.22 crore for production and productivity related.

viii) Tripura

- Area and production of fruits in Tripura 28,300 ha and 4,52,100 metric tonnes while area and production of vegetables is 31,300 ha and 3,53,200 metric tonnes respectively.
- An additional area of 11,226 ha. covered under different horticulture crops (fruits- 5,728 ha., vegetables- 2,698 ha., spices- 1,757 ha., flowers- 128 ha., plantation crops- 705 ha., medicinal plants- 76 ha and aromatic plants- 9 ha.) since inception of technology mission in the state.
- Overall increase of 15.56% of area under focused horticulture crops. Increase under fruits being 19.82% and vegetables being 8.48%.
- Banana, pineapple, mango, cashewnut, ginger, cabbage are the focus crops.
- Good impact in growing of vegetables, which are now easily and economically available to consumers. Potato production using True Potato Seed (TPS) picked up. The state created irrigation source for off-season cultivation of vegetables.
- One fruit processing unit namely M/s Pijush Agro Tech. Pvt. Ltd. established. Entrepreneurs invited for establishment of cashew processing units in cashew producing zone.
- An amount of Rs.48.09 crores released for production and productivity related programmes.

ix) Jammu & Kashmir

- An additional area of 8,506 ha. covered under different horticulture crops (fruits- 7,570 ha., vegetables- 813 ha., spices- 76 ha. and flowers- 14 ha). Focuss crops of the State are temperate fruits, nuts, cut flowers and saffron.
- Overall increase of about 29.63% of area under focused horticulture crops increase in area under fruit being 19.54% while vegetables being 117.14%.
- Large scale cultivation of apple in clusters.
- Establishment of nurseries for production of apple and walnut grafts.
- Commercial cultivation of flowers such as gladiolus, marigold.
- 362 low cost green houses established for promotion of protected cultivation of off season vegetables and flowers.
- Programmes under the mission helped in generating 6,608 employment opportunities in horticulture.
- An amount of Rs.43.76 crores released, of which Rs.34.33 crore for production and productivity related programmes while Rs.5.73 crore for rehabilitation of apple gardens under PM's reconstruction plan.

x) Himachal Pradesh

- An additional area of 8,414 ha. covered under different horticulture crops (fruits- 5,628 ha., vegetables- 2,033 ha., spices- 301 ha., flowers- 230 ha. medicinal plants- 130 ha. and aromatic plants- 92 ha.).
- Increase of 111% in coverage of poly houses for production of flowers such as carnations, orchids etc.
- An overall increase of about 29.63% of area under focused horticulture crops (fruit 19.54% and vegetables 117.14%).
- State is promoting private sector in PHM and processing activities. The projects in pipe line include:
- Cool chain project by M/s Adani Agri-fresh Ltd., Ahemdabad.
- Packaging unit at Baddi, Solan district, Himachal Pradesh by M/s Wimplast Ltd.,
- Two fruit based wineries, one each in Shimla and Kullu district by M/s Champagne Indage, Mumbai and apple pulp and concentrate unit by M/s Devabhumi Cold Chain Pvt. Ltd., New Delhi.
- An amount of Rs.36.724 crores released, of which Rs.30.50 crore for production and productivity related programmes.

xi) Uttaranchal

- An additional area of 8453 ha. covered under different horticulture crops (fruits- 5727 ha., vegetables- 1812 ha., spices- 512 ha., flowers- 343 ha., medicinal and aromatic plants- 10 ha.).
- Overall increase of about 29.63% in area under focused horticulture crops. (fruit 19.54% and vegetables is 117.14%).
- Mango, apple, off season vegetables, especially cabbage, cauli-flower, tomato and capsicum major crops covered under the Mission.
- An amount of Rs.32.805 crores released, of which Rs.26.40 crore for production and productivity related programmes.

3.3.1.6 Constraints

The major constraints in the mission programmes are as follows:

i) Administrative: Inadequate manpower support at the district level.

ii) Infrastructural: Hilly terrain, inadequate communication, less number of industries and poor road connectivity in the region.

ii) Technical: Inadequate technologies tailor made for terrace gardening, a typical feature of North Eastern region

iv) Financial

- Release of assistance for non perennial crops are released in three installments, instead of one installment, is a major limiting factor.
- Current level of assistance inadequate for all crops, post harvest and market infrastructure programmes; No provision of financial assistance for encouraging high density planting and no provision for financial assistance for purchase of appropriate tools & equipment for large scale rejuvenation.

3.3.1.7 Suggestions and future thrusts

i) Administrative

- Department of Agriculture & Cooperation (DAC) may constitute an Evaluation Committee to ensure application of appropriate technologies, use of appropriate material and maintain proper supervision and continuity in the execution of different components.
- Each state should set up a monitoring team comprising representatives of ICAR/SAU/SHG/ Implementing agencies in the state for on-the-spot verification of the actual status of implementation in the field and for further advice to the state government and also the DAC for improving outcome.
- Field functionaries in the departments of horticulture to maintain a proper record of the beneficiaries, status of crop, yield per unit area, returns obtained etc., which are essential for analyzing impact of technology and investments.
- To identify a single nodal agency in the centre and state for implementation of all the programmes involved in development of horticulture starting from production, post harvest management, market and processing, to ensure effective implementation of programmes and effective monitoring.
- At Grass root level institutions like Village Development Council/Panchayat, SDA to be actively involved in implementation of the programmes.

ii) Infrastructural

- Develop at least two-three common infrastructural facilities in each state for functional post harvest management activities with 100% assistance on sharing basis between Centre and state in the ratio of 90:10 and to hand over these infrastructure to Village Development Agencies/SDAs/Entrepreneurs to run the facilities with minimum profit basis, on the pattern of Food parks /IT parks.
- In each state at least 10 to 20 villages to be developed into model villages integrating all the components of different ministries, by an identified agency in the concerned states.
- Establishment of at least one terminal market including all the post harvest infrastructure.
- Development of one IT centre in each Block for marketing information on various produce, with connectivity to other country/state and outside markets.

iii) Technical

- Crops and the varieties identified for promotion in each zone after full consultation of ICAR Research Complex for NE, Barapani, Assam Agriculture University, Jorhat and Central Agriculture University, Imphal.
- Projection of year wise area to be expanded, requirements of seed/planting material of each crop and each variety, source of seed/planting material, inputs required, irrigation sources to be developed, extent of area to be covered under surface/drip/sprinkler irrigation systems etc.
- Estimate production of each crop to help in planning for marketing and processing infrastructure required.
- Exposure visits to other countries for enhancement of skills.
- Introduce desired crop varieties and technologies through import of planting material and technology.

iv) Financial and policy

- There is urgent need to revise cost norms for all the crops, green houses and shade nets, Microirrigation, post harvest management and market infrastructure.
- Need for releasing assistance in one installment for all non perennial crops.
- Need to provide financial assistance for high density orchards, purchasing appropriate tools and equipments for rejuvenation.
- Provision of assistance for seed production of vegetable crops including support for infrastructure for seed germination, cleaning, grading etc., trellis and other supports for crops like passion fruit and grape, fencing for all the perennial crops, erecting ropeways, lifting water to the site of production, demonstration of drip irrigation and hi-tech horticulture, setting up primary processing units and CA storage should be brought to provide accessibility to clusters, exposure visit to foreign countries, generate promotion through media, printing etc, organizing International Seminar, innovative schemes
- Need for providing one Horticulture graduate in each NHM block.
- Structure at District level need to be made more functional
- Activate National and regional level agencies like NAFED, NCDC, NDDB, SFAC, NERAMC, etc to promote marketing activities.
- Need to develop and promote entrepreneurship by
- providing financial assistance at consessional rates
- 3 year tariff subsidy for domestic and international trade
- Provision for transport subsidy for identified crops like passion fruit, orange, flowers etc. so that these commodities withstand competition in domestic as well export markets.
- Development of long term ‘Strategic Plan’ for the development of horticulture by each state, covering a period of at least 10 years identifying specific areas for focus crops in each district and response of farmers.
- Adequate support for credit, insurance and risk management.

3.3.1.8 Conclusions

Technology Mission for Integrated Development of Horticulture in North East and Himalayan

States, has largely succeeded in its objective to harness the potential of horticulture in the region. The programme, therefore, needs to be consolidated and strengthened so as to bring prosperity in these States and to bring them at par with other developed States of the country. The region is strategically located and touches boundary with many countries. Therefore due emphasis should be made to target the markets of neighboring countries and also to tap markets in the ASEAN countries. This programme therefore needs to be continued during XI Plan period after incorporating suggestions given in the report.

3.3.2 National Horticulture Mission (NHM)

This was a major initiative taken up during the X Plan, when a National Horticulture Mission was launched during the year 2005. The Mission envisages an end-to-end approach in covering production, post harvest management and marketing to assure appropriate returns to growers/producers; enhance acreage, coverage, and productivity in potential belts/clusters; adopt a coordinated approach and promote partnership, convergence and synergy among R&D, processing and marketing agencies in public as well as private sectors, at all levels; promote, where appropriate, National Dairy Development Board (NDDB) model of cooperatives to ensure support and adequate returns to farmers, facilitate capacity-building and Human Resource Development.

3.3.2.1 Objectives

The broad objectives of the Mission are follows:

- To provide holistic growth in horticulture through research, technology promotion, extension, processing and marketing.
- To enhance the horticulture production to the level of 300 million metric tonnes by 2011-12.
- To establish convergence and synergy among various on-going and planned programmes in the field of horticulture development.
- To promote the development and dissemination of technologies by blending traditional wisdom and frontier knowledge.

3.3.2.2 Programmes

NHM envisages doubling of horticulture production with following interventions:

- Production & Productivity
- Post harvest management and marketing
- Processing

Details of programmes and cost norms are given in Annexure-3.2.

3.3.2.3 Budgetary allocation

Against an outlay of Rs. 1630.0 crores an expenditure of Rs. 790.51 crores has been incurred. The expenditure under the scheme till November 2006 has been of the order of 48.49 per cent of the approved outlay during X Plan period.

3.3.2.4 Achievements

National Horticulture Mission is mandated for horticulture development in all States & Union

Territories excluding 11 States in the North East, HP, J&K & Uttaranchal. The programme is being implemented in 259 districts of 18 States. The Mission was launched during May 2005 and therefore it will be too early to expect significant physical achievements. However, salient features of the action plans during 2005-06 and 2006-07 are listed in Table –3.7. Detailed state wise physical and financial achievements are given in Table 3.8 & 3.9. Other activities that have been undertaken during the period are as follows:

- Three Chief Consultants appointed under the Technical Support Group. One Consultant has been engaged under Advisory Support Group (ASG) specially in the area of mango.
- Training programmes organised for the officers and SHM on organic farming and rejuvenation of senile orchards.
- Review of progress through review meetings and field visits by the officers of Department of Agriculture & Cooperation.
- Joint Inspection Team constituted including representative of State Agriculture Universities / ICAR, Precision Farming Development Centres, Directorate of Cashew and Coca Development and Directorate of Arecanut and Spices Development and concerned States to make intensive field visits to various States in the month of September/October, 2006.

3.3.2.5 Constraints

National Horticulture Mission was launched during May 2005 and therefore, It is too early to comment on constraints in the programmes. However, the following issues need to be addressed for successful implementation of the Mission programmes:

i) Administrative

- Dist. Collectors are extremely busy officers to do justice to this responsibility as District level Mission In charge.

ii) Technical

- Inadequate standards for planting material and root stock
- Inadequate raw material for enabling full utilization and value addition capacity of horticultural produce.
- Technical guidelines for uniform implementation of different components not available with field staff.

Table 3.7 Salient features of the action plans during 2005-06 and 2006-07

Activity during 2005-06	Achievement during 2005-06	Targeted Activity during 2006-07
259 Districts out of 462 were covered for identified crops having comparative advantage adopting cluster approach.	259 Districts out of 462 were covered for identified crops.	Programme was extended in 32 more districts covering total 291 districts in the country.

Setting up of 440 nurseries in public & private sector.	129 nurseries established in public & private sector.	Setting up of 1250 nurseries in public & private sector.
2.04 lakh hectares of new areas to be brought under horticulture and rejuvenation of 0.63 lakh ha of senile plantations.	0.80 lakh hectares of new areas brought under horticulture and 0.07 lakh ha of senile plantations rejuvenated.	4.09 lakh hectares of new areas to be brought under horticulture and rejuvenation of 0.54 lakh ha of senile plantations.
Organic Farming in 0.185 lakh ha.	0.04 lakh ha	Organic Farming in 0.52 lakh ha.
Protected cultivation in 0.031 lakh ha.	0.004 lakh area under protected cultivation	Protected cultivation in 0.14 lakh ha.
IPM in 0.683 lakh ha.	0.03 lakh under IPM	IPM in 1.44 lakh ha.

iii) Financial

- Inadequate financial assistance not available for high density plantations and for cultivation of high capital crops like grape, banana, strawberry, medicinal & aromatic plants.
- Assistance for non perennial crops being released in two installment instead of one.
- No provision of assistance for purchase of electric/ battery driven tools & equipment for large scale rejuvenation.
- Assistance for non perennial crops to be released in two installment instead of one.
- No provision of assistance for purchase of appropriate tools & equipment for large scale rejuvenation is necessary.
- Poor off take of post harvest management and market infrastructure owing to provision of low financial assistance.

3.3.2.6 Suggestions/ future thrusts

i) Administrative

- Programme on promotion of organic farming lacks focus and technology. It therefore needs to be detached and carried out under a special authority.
- Encouraging SHGs to take up post harvest activities with financial initiatives from Government of India
- Presently, one Agriculture / Horticulture graduate has been allowed in each NHM block. Further, strengthening would be needed on this front with relevant specialization as per needs of various clusters.
- Structure at district level needs to be made more functional as Dist. Collectors remain busy and therefore needs to be replaced by District Horticulture Officers as Mission in-charge in the District.
- NHM Directors in the States need to be technical people
- Programmes calls for massive deployment of technical manpower
- There is good scope to the Involvement of Krishi Vigyan Kendras in development of nurseries and providing training to the farmers on nursery management and other technologies.
- In the absence of plant breeders rights, many international breeders are hesitate to offer the latest varieties to Indian growers. In order to improve availability of latest varieties and remain competitive in global markets there is need to educate the

growers about the implications of PPV&FR Act. Protected varieties of ornamental crops have to be permitted for registration under PPV & FR Act so that new varieties can be registered, grown and exported to international destinations.

ii) Infrastructural

- There is need to support need based establishment of new tissue culture labs as the present assistance is available only for rehabilitation of existing labs.

iii) Technical

- Standards for planting material and root stock need to be developed.
- Identification of varieties suitable for organic production is necessary.
- There is need to introduce processable varieties to minimize post harvest losses and for enabling value addition of horticultural produce.
- Some additional fruit spices relevant to various districts and states need to be considered for inclusion.
- Area expansion to be allowed only with identified/ recommended varieties of different crops.
- There is need to make provision of accreditation of training centres having both manpower and field/lab facility and strengthen the same instead of setting of horticulture Institute in each state as envisaged at present.

iv) Financial

- Financial assistance do not allow remuneration for high density plantations and for cultivation of high capital crops like grape, banana, strawberry, medicinal & aromatic plants needs to be enhanced.
- Provision needs to be kept for establishment of new Tissue Culture labs.
- Assistance for creation of water resources need to be extended to individual farmers as well with 50% subsidy assistance for construction of tube wells, farm ponds and dug wells.
- Assistance for PHM infrastructure need to be enhanced to at least 40% of cost from the current level of 25% in general areas and to 50% of cost in the tribal & hilly areas.
- Separate allocations should be made for important crops like medicinal plants, spices and flowers, cashew and cocoa.
- Project activities involving subsidy assistance of less that Rs.5.00 lakh need not be credit linked.

3.3.2.7.Conclusions

The National Horticulture Mission was launched only during May 2005. The Scheme should be continued during XI Plan period. NHM needs to be technically more strong both at the Central and State level. Besides, yearly external technical monitoring should be ensured to find out gaps and also to make the process more effective and transparent at grass root level. A programme of such a dimension should be led by a technical person, well versed with ground realities of various programmes. The organizational structure of NHM therefore, needs to be reviewed.

3.3.3 National Bamboo Mission

The National Bamboo Mission was approved on 27th October 2006 as a Centrally Sponsored Scheme.

3.3.3.1 Objectives

The main objectives of the Mission are:

- To promote the growth of the bamboo sector through an area based regionally differentiated strategy;
- To increase the coverage of area under bamboo in potential areas, with improved varieties to enhance yields;
- To promote marketing of bamboo and bamboo based handicrafts;
- To establish convergence and synergy among stake-holders for the development of bamboo.
- To promote, develop and disseminate technologies through a seamless blend of traditional wisdom and modern scientific knowledge.
- To generate employment opportunities for skilled and unskilled persons, especially unemployed youths.

3.3.3.2 Programmes

The interventions for addressing the four major areas of bamboo development are as follows:

- Research & Development
- Plantation Development
- Handicrafts Development
- Marketing

3.3.3.3 Budgetary allocation

Allocation for the National Bamboo Mission during X Plan is Rs. 91.37 crores.

3.3.3.4 Achievements

The Mission was launched very recently i.e. 27th October 2006 and it will too early to expect any achievement. However, steps have already been taken towards preparation of action plans of respective states. The Mission will be implemented in 28 states across the country, however, North East region will be given priority. Progress made towards implementation of the mission is as follows:

- Consultation meeting with representatives of State Governments on 15 November 2006.
- In-session meeting of Consultative Committee of Parliament for Ministries of Agriculture, Consumer Affairs, Food & Public Distribution on 13 December 2006
- Guidelines of National Bamboo Mission prepared and circulated to all States
- Pre-launching orientation Workshops held at Solan, Dimapur and Bhubaneshwar

3.3.3.5 Constraints

It is too early to mention any constraints. However, looking at the vast potential that exists in

the country the budgetary allocation seems less.

3.3.3.6 Future thrusts

- Improvement of existing stock in 36,000 ha.
- Coverage of 1.85 lakh ha under pest and disease management.
- Coverage of 48,783 ha under micro irrigation.
- Setting up of 241 village linked micro processing Centers and 65 Cluster Facilitation Centers (CFCs) and
- Setting up of 194 Bamboo Bazaars.

3.3.3.7 Conclusion

The Mission should continue during XI Plan period as bamboo is an important crop related to socio-economic development of tribal and hilly regions. Besides, the budgetary allocation for Mission during XI Plan period needs to be enhanced if suitable returns are to be harnessed.

3.3.4 Microirrigation

To enable judicious use of the water resources a scheme on Micro irrigation was launched during March 2006 with a target to bring 6.2 lakh ha. under micro-irrigation. The Scheme, at present, is being implemented in 284 Districts only of 13 States.

3.3.4.1Objective

The main objective of this central sector scheme on Microirrigation is increasing the coverage of area under drip and sprinkler irrigation in the country.

3.3.4.2.Programmes

The major components of the scheme are:

- Coverage of area under drip and sprinkler irrigation,
- HRD of farmers and developmental staff, awareness and quality control.

Detailed programme and cost norms are given in Annexure 3.4.

Table 3.8 Details of action plan for different states approved for 2005-06

(P: Physical Target; F: Financial Target)

States	Area Coverage		Rejuv.		Nurseries		Protected Cultivation		Organic Farming		IPM		PHM		Markets	
	P (ha.)	F (lakh)	P (ha.)	F (lakh)	P (ha.)	F (lakh)	P (ha.)	F (lakh)	P (ha.)	F (lakh)	P (ha.)	F (lakh)	P (ha.)	F (lakh)	P (ha.)	F (lakh)
Andhra Pradesh	25398	2333	9670	1450.5	5	90.0	58.3	24.6	200	20.0	8000	80.0	_	_	_	_
Bihar	3320	326	13367	2005.0	17	156.0	108.6	90.2	-	-	2500	25.0	3	18.(	_	_
Chattisgarh	10740	859	2450	367.5	9	129.0	238.0	20.9	-	-	500	5.0	7	4.3	_	_
Delhi													_	_	_	_
Goa	155	13	1250	187.5	2	21.0	15.0	43.2	300	30.0	500	5.0	_	_	_	_
Gujarat	27032	2595	400	60.0	42	157.5	105.9	32.7	50	5.0	7000	70.0	_	_	_	_
Haryana	2780	627	200	30.0	6	48.0	1.0	12.0	60	6.0	600	6.0				
Jharkhand	7000	857	-	-	75	348.0	153.8	16.8	-	-			14	204.8	28	597.5
Karnataka	17010	1394	801	120.2	95	900.0	272.1	50.8	4800	480.0			_	_	_	_
Kerala	10830	944	7500	1125.0	48	184.5	30.0	180.0	2019	201.9	3000	30.0	_	_	_	_
Maharashtra	28495	3268	9000	1350.0	26	234.0	815.0	241.1	4400	440.0	19477	194.8	_	_	_	18.0
Madhya Pradesh	5950	680	1250	187.5	20	226.5			1668	186.8	11000	110.0				
Orissa	18900	1968	4500	675.0	35	288.0	13.9	12.0	100	10.0	200	2.0	_	_	_	_
Punjab	2480	322	3350	502.5	5	45.0	360.1	468.5	-	-	-	-	_	176.0	44	165.0
Rajasthan	11662	1300	70	10.5	15	105.0	54.5	17.0	500	50.0	1800	18.0	2	42.0	4	160.0
Tamil Nadu	8369	919	650	97.5	25	270.0	30.1	74.0	800	80.0	3300	33.0	6	94.2	_	45.5
U.P.	14940	1898	4850	727.5	11	108.0	606.4	106.9	1050	105.0	400	4.0	950	197.5	39	1231.3
West Bengal	8480	983	3900	585.0	4	72.0	192.8	39.8	2500	250.0	10000	100.0	33	919.7	5	18.8
Total	**203541**	**21288**	**63208**	**9481.2**	**440**	**3382.5**	**3055.5**	**1430.3**	**18447**	**1864.7**	**68277**	**682.8**	**1015**	**1656.7**	**120**	**2236.0**

Table 3.9 Action plans for different states approved for 2006-07

(P: Physical Target; F: Financial Target)

States	Area Coverage		Rejuv.		Nurseries		Protected Cultivation		Organic Farming		IPM		PHM		Markets		Beekeeping	
	P (ha)	F (lakh)	P (ha)	F (lakh)	P (ha)	F (lakh)	P (ha)	F (lakh)	P (ha)	F (lakh)	P (ha)	F (lakh)	P (ha)	F (lakh)	P (ha)	F (lakh)	P (ha)	F (lakh)
Andhra Pradesh	35788	2929.1	7077	1061.6	37	178.5	370	65.8	1670	167.0	22850	228.5	544	510.1	23	713.8	-	-
Bihar	17020	2029.0	-	-	100	630.0	467	852.0	2000	200.0	8000	80.0	30	236.8	59	2580.0	4000	32.0
Chattisgarh	30681	3447.1	1420	213.0	8	144.0	187	123.5	1100	110.0	14000	140.0	8	92.0	-	-	-	-
Delhi	150	37.6	-	-	3	13.5	1	10.2	-	-	-	-	20	286.3	3	6.0	300	2.4
Goa	751	48.2	951	76.5	2	4.5	2	0.1	450	45.0	0	0.0	1	6.0	4	22.5	0	0
Gujarat	34460	3586.2	1450	217.5	55	225.0	209	50.5	100	10.0	7500	75.0	76	1408.8	28	1105.0	1000	8.0
Haryana	3554	622.2	939	140.9	16	73.5	80	52.6	380	38.0	1781	17.8	10	195.8	6	578.2	7563	60.5
Jharkhand	28216	2404.5	-	-	87	327.0	1457	271.9	300	30.0	800	8.0	32	679.5	83	610.0	3000	24.0
Karnataka	37450	3683.4	2163	324.5	189	711.0	182	360.9	5500	550.0	45000	450.0	164	927.4	202	2855.8	121	0.97
Kerala	40645	3299.1	24417	3014.5	120	277.5	470	308.0	3000	300.0	5000	50.0	76	1481.9	232	5672.5	35625	285.0
Maharashtra	93541	6788.2	15208	2281.2	29	186.0	2074	1447	5420	542.0	19260	192.6	321	1132.9	145	553.8	0	0
Madhya Pradesh	21250	2563.2	2445	366.8	52	340.5	102	34.7	2332	233.2	15800	158.0	118	288.5	50	187.5	500	4.0
Orissa	19500	2264.0	1433	215.0	42	321.0	145	21.1	1000	100.0	1200	12.0	43	525.2	51	1845.0	1000	8.0
Punjab	9050	1035.0			2	12.0	150	75.0	3000	300.0			7	1050.0	19	167.5	2500	20.0
Rajasthan	28118	2832.9	98	14.6	32	159.0	116	44.7	1000	100.0	5623	56.2	21	459.0	5	118.8	4372	34.98
Tamil Nadu	39295	3547.7	2500	375.0	29	138.0	24	299.1	4200	420.0	14000	140.0	146	145.9	54	1245.8	1400	11.2
U.P.	27392	3266.4	1483	222.5	84	279.0	1859	168.2	14000	1400	15660	156.0	82	1109.6	75	2718.7	14150	113.2
West Bengal	18500	1561.0	2000	300.0	259	612.0	230	59.3	4000	400.0	11000	110.0	582	2979.6	44	178.7	100000	800.0
A&N Islands	582	64.7	100	15.0	2	21.0	108	23.4	70	7.0	100	1.0	-	-	-	-	100	0.8
Lakshdweep	-	-	-	-	10	30.0	2	1.4	5	25.0	-	-	-	-	-	-	-	-
Total	**485943**	**46009.3**	**63684**	**8838.5**	**1158**	**4683**	**8236**	**4269**	**49527**	**4977**	**187574**	**1875.1**	**2281**	**13515.1**	**1083**	**21159.4**	**175631**	**1405.0**

3.3.4.3 Budgetary allocations

Against an outlay of Rs. 800.49 crore an expenditure of Rs. 731.0 crores (86%) has been incurred.

3.3.4.4 Achievements

Since the programme was launched during March, 2006, it is too early to mention any physical achievements. However, achievements of the scheme as reported are follows:

- Installation of drip system in around 57,000 ha area
- Installation of sprinkler system in around 38,000 ha area
- Various extension activities viz. Training and awareness programmes for state officials, farmers, NGOs, entrepreneurs, scientists, service providers; direct mail campaigns, trouble shooting for operational problems in various agro-climatic zones carried out in all States/UTs through the National Committee on Plasticulture Applications in Horticulture (NCPAH), to enhance the productivity and achieve doubling of horticulture production by the end of Eleventh Plan.

3.3.4.5 Constraints

It is too early to mention any constraints.

3.3.4.6 Suggestions/ future thrusts

i) Financial

- Provision of assistance for closed spacing (high density planting) crops, creation of water sources, pumps, tanks, etc., replacement of dippers, pipes, etc, introduction of micro sprinklers.

ii) Policy

- In order to keep the cost of the system affordable, VAT, Octroi etc and import duties on plastic raw material should be abolished. Excise duty on micro irrigation system need to be considerably reduced.
- Keeping in view the available potential and urgent need to promote efficient use of water resources, it is proposed to cover 17.8 lakh hectare under micro/sprinkler irrigation during the Eleventh Plan (10.7 lakh hectare area under drip irrigation and 7.1 lakh hectare area under sprinkler irrigation as well as components like demonstration etc.).
- The Scheme will cover all horticultural crops besides, some non-horticulture crops (like sugarcane, cotton, wheat, pulses and oil seeds including oil palm) with emphasis on potential belts/regions in the different states.

3.3.4.7 Conclusion

The Scheme was launched only during March 2006 and it should continue during XI Plan period.

3.3.5 National Horticulture Board

The National Horticulture Board (NHB), established during 1984, is involved in the development of high quality horticulture farms in identified belts and make such areas vibrant with horticulture activity which in turn will act as hubs for developing commercial horticulture.

3.3.5.1 Objectives

The objectives of National Horticulture Board are as follows:

- Develop high quality horticulture farms in identified belts and make such areas vibrant with horticultural activity which in turn will act as hubs for developing commercial horticulture.
- Develop post-harvest management and cold-chain infrastructure.
- Strengthen Market Information System and horticulture database
- Assist R&D programs to develop products suited for specific varieties with improved methods and horticulture technology.
- Provide training and education to farmers and primary processing industry for improved agronomic practices and new technologies
- Promote consumption of fruits/vegetables in fresh and processed form

3.3.5.2 Programmes

Major Programmes & activities of the National Horticulture Boards are as follows:

- Development of Commercial Horticulture through Production and Post Harvest Management
- Capital Investment Subsidy for Construction/Modernization/ Expansion of Cold Storages and Storages for Horticulture Produce
- Technology Development and Transfer for Promotion of Horticulture
- Market Information Service for Horticultural Crops
- Horticulture Promotion Services
- Strengthening Capabilities of NHB

Details of programmes and cost norms are given in Annexure-3.5.

3.3.5.3 Budgetary allocation

Against an outlay of Rs. 585.0 crores an expenditure of Rs. 381.3 crores (65.2%) has been incurred.

3.3.5.4 Achievements

The achievements under various programmes are given below:

i. Commercial horticulture through production and post harvest management: Assistance was provided to 9,653 (Nos.) units and subsidy amount of Rs 170.82 crores released. In addition, letter of Intent (LOI) were issued to around 1.10 lakh projects, which may mature during the course of time. Year wise details of projects sanctioned are given in Table 3.10.

Table 3.10 Commercial horticulture through production, post harvest management and construction/expansion/modernization of cold storage

Year	No. of projects	Amount of subsidy (Rs. In crores)	No. of projects	Amount of subsidy (Rs. In crores)
2003-2004	940	19.29	353	60.79
2004-2005	979	26.02	308	73.83
2005-2006	4781	72.68	116	32.85
2006-2007 (as on 22.12.2006)	2923	52.83	54	4.11

ii. 831 (Nos.) projects approved for construction/modernization/ expansion of cold storages and storages for Horticulture Produce. Details are given in Table 10.

iii. Assistance provided for technology development and transfer of technology for production of horticulture produce. 937 projects/ events sanctioned involving a subsidy amount of Rs. 10.21 crores.

iv. 36 market centers established for collecting and disseminating information on daily basis in respect of fruits and vegetables. A CD-ROM on horticulture brought out for the benefit of public.

3.3.5.5 Constraints

i.) Administrative

- Inadequate manpower to handle large projects in States. Similarly, in the North Eastern States, NHB has only one office at Guwahati with limited man-power. Whereas because of complexity of the area and the large number of states, there is problem of monitoring of projects.

3.3.5.6 Suggestions and future thrusts

i) Administrative

- There are many components/ Schemes which are being under taken both by National Horticulture Mission/ Technology Mission for North East Region. Therefore there is need to reorient such programmes as to avoid overlapping.
- To meet increasing load of work there is need to strengthen man power in specialized area.
- NHB to confine itself post harvest activities.

ii) Technical

- Promotion of Good Agricultural Practices (GAP)
- Organizing Grower's Associations and Promotion of Producer Groups/ SHGs
- Certification of horticulture nurseries

iii) Financial

- There is need to reassess the pattern of assistance under different Schemes keeping in view increasing costs.
- Under development of Commercial Horticulture Scheme following changes are proposed:

- Back-ended capital investment subsidy @ 20% of the total project cost with a maximum limit of Rs 50.00 lakh per project. However, for the North-Eastern/ Tribal/Hilly Areas, maximum limit of subsidy would be Rs 60.00 lakh per project.
- For the projects pertaining to the floriculture sector, enhanced back-ended capital investment subsidy @ 25% of the project cost with a maximum ceiling of Rs 60.00 lakh per project.
- For the women entrepreneurs who are the sole owners of the land, back-ended capital investment subsidy @ 30% of the project cost with a maximum ceiling of Rs 50.00 lakh per project. However, for the North-Eastern/ Tribal/Hilly Areas, maximum limit of subsidy would be Rs 60.00 lakh per project.
- Under Capital Investment Subsidy Scheme for Construction/ Expansion**/** Modernization of Cold Storages/Storages it is proposed to that:
- For the projects in the North-Eastern States and special category states/UTs subsidy may be provided @ 33.33% of the project cost with a maximum subsidy not exceeding Rs 80.00 lakh. The unit cost in the case of cold storages in these States would be Rs 5,000/- per MT.
- The unit cost for Controlled/Modified Atmosphere (CA/MA) stores would be considered @ Rs 32,000 per MT where the project size is upto 250 MT with a maximum cost ceiling of Rs 80.00 lakh and @ Rs 22,000 per MT, for projects upto 500 metric tonnes capacity with a cost ceiling of Rs 110 lakh. The quantum of subsidy for CA/MA store would be kept at 25% of the project cost as already provided under the scheme subject to the condition that project up to a capacity of one lakh metric tonne only be supported.

3.3.5.7.Conclusions

The National Horticulture Board was launched with the sole objective of promoting post harvest infrastructure of horticultural crops in the country. However, in due course of period the Board's programme some how got diluted resulting in deviation from its identified objectives. It is felt that the National Horticulture Board should confine it self to implementing and only over viewing infrastructure development with regards to post harvest management, marketing, database and market information.

The National Horticulture Board is not recommended to be continued in its present form. In view of launching of Technology Mission for Integrated Development of Horticulture in North East & Himalayan States and National Horticulture Mission its role needs to be critically reviewed. This requires total overview of the structure of the horticulture division and various units.

3.3.6 Coconut Development Board

The Coconut Development Board was established in 1981, after Government of India abolished the erstwhile Directorate of Coconut Development formed during 1966. The Coconut Development Board (CDB) implements programmes for the Integrated Development of Coconut Industry.

3.3.6.1. Objectives

The objectives of the Coconut Development Board are as follows:

- Bringing additional areas under coconut in both traditional as well as non traditional states.
- Creating infrastructure facilities for the production and distribution of quality planting material.
- Demonstration of scientific coconut cultivation in non traditional areas
- Enhancing farm level income by improving the productivity of coconut holdings through promotion of integrated farming practices promoting product diversification, byproduct utilization, value addition and strengthening of market promotion and market intelligence.

In addition to the regular programmes, Board also launched a Technology Mission in January 2002 with a view to bringing about synergy among numerous ongoing programmes and ensuring adequate, appropriate and timely attention to all the links in the production, post harvesting and consumption chains.

3.3.6.2 Programmes

The Board has been implementing various programmes from the 3rd year of the VI Plan (1982-83) for achieving the goals of enhancing production and productivity of coconut in the country and ensuring remunerative price for coconut and coconut products. The programmes being implemented by the Board at present are given below:

i) Production and distribution of planting material: This scheme has 4 components, which are (i) Production and distribution of planting materials (ii) Aid to private coconut nurseries (iii) Production and distribution of Tall and Dwarf hybrid seeds and (iv) Establishment of Regional Coconut Nurseries

- Area Expansion Programme: The Area Expansion Programme which has been under implementation since 1982-83, has been continued in all the subsequent Five Year Plans. Currently Rs.8000/- per ha is being provided as subsidy to farmers who plant at least minimum of 10 seedlings. Subsidy is available up to a maximum extent of 4 ha under this scheme.
- Integrated Farming for Productivity Improvement: This scheme has the following three components which are (i) Management of disease affected palms (ii) Laying out of Demonstration Plots and (iii) Assistance for organic manure units
- Technology Demonstration
- Market Promotion and Statistics
- Information and Information Technology
- Technology Mission on Coconut: The Technology Mission was launched during January 2002 is designed to promote diversification and value addition in the coconut sector. The other programmes envisaged in the Mission are Market promotion and market expansion.

Details of programmes and cost norms are given in Annexure 3.6.

3.3.6.3 Budgetary allocations

Against an outlay of Rs. 175.0 crores to the Coconut Development Board for various Schemes

including Technology Mission on Coconut, an expenditure of Rs. 127.7 crores (86%) has been incurred. An analysis of the expenditure incurred by the Coconut Development Board reveals that maximum expenditure has been on Integrated Farming (56%), followed by Area Expansion Programme (11.%), Technology Mission (8.%), Production and Distribution of planting materials (6%) and Technology Demonstration and Market Promotion (2%).

3.3.6.4 Achievements

Major achievements of the Boards during the plan period are as follows:

- Increased production of coconuts. Production level expected to reach 14,370 as against target of 15,000 million nuts by the end of X Plan.
- Increased productivity of coconuts. Productivity expected to go up from 6,709 (IX Plan) to 7,358 nuts per ha by the end of X Plan.
- Infrastructure created for production of 57 lakh seedlings through public and private partnership
- The Technology Mission on Coconut has succeeded in taking effective action for pest and disease management particularly in the case of Eriophyid mite, root-wilt and leaf eating caterpillar.
- Established a Quality Control Laboratory, which will have NABL accreditation.
- Market promotion led to market expansion to the Gulf region and also non-traditional areas in the domestic markets.
- Consumption of tender nuts increased from 10-15%
- 1758 copra dryers for processing 285 million nuts installed as a quality improvement initiatives.
- 24 integrated processing units promoted with processing capacity of 95 million nuts.
- New value added products such as packed tender nut water, coconut milk powder, coconut vinegar, etc. launched in the market.
- Value addition resulted in increase and stabilization of farm gate price of coconut.

3.3.6.5 Constraints

Major constraints that are contributing to slow growth of the sector are as follows:

i) Technical

- Decreasing size of operational holdings and the lack of economies of scale.
- High incidence of senile and unproductive palms.
- Practice of traditional monoculture under rain-fed conditions.
- Sudden and unforeseen investment for combating biotic and a-biotic stresses.

ii) Infrastructure

- Slow pace of value addition and by-product utilization.
- Lack of farm mechanization particularly in the post harvest management stage.

3.3.6.6 Suggestions

i) Technical

- Production of quality seedling of the recommended varieties by establishing seed gardens in different coconut areas including imparting training on scientific method of quality seedling production.
- Productivity improvement through farmers/ community participation to meet global challenges.
- Replanting and rejuvenation of coconut palms.
- Bridge the gap between demand and supply of quality planting material.
- Reduce dependency of coconut industry on copra and coconut oil and increased focus on tender coconut.
- Special emphasis on dwarf and hybrid varieties.
- Bringing more area under varieties suited for tender nut water.
- Product diversification/ by-products utilization and value addition.
- Promoting farm level processing and marketing.
- Productivity improvement through nutrient management
- Community based initiatives for organic farming, production of bio-fertilizer, bio control, training in harvesting and post harvesting etc.

ii) Infrastructural

- Promotion of Primary Processing and Marketing
- Quality improvement programme

iii) Finance

- Corpus Fund for pest control

iv) Policy

- Tree life insurance and welfare scheme for coconut climbers.
- Welfare scheme for farmers and workers

3.3.6.7Conclusion

The porgrames of the Board need to continue after incorporating the following suggestions:

- On a review of the ongoing programmes of the Board it is recommended to restrict implementation of certain programmes in certain geographical areas and merge some of the schemes in order to remove overlap between regular schemes and Technology Mission on Coconut. The programmes proposed for discontinuance in traditional areas are as follows:
  - Regional Coconut Nursery;
  - Production of hybrid seedlings;
  - Expansion of Area under Coconut
  - Laying of Demonstration Plots – (one of the components of Integrated Farming).
- The discontinuance of schemes of Regional Coconut Nursery and Production of hybrid

seedlings is recommended as adequate support has been provided to the State Governments in traditional areas over the years, matching share is most often not provided by the State Governments. Hence utilization of the funds becomes difficult. Lastly, private sector participation in production of planting material is picking up.

- The discontinuation of schemes titled Expansion of Area under Coconut and Laying of Demonstration Plots is recommended, as there is very little area for further expansion of coconut cultivation in the traditional states.
- Need of traditional states which have old gardens is replanting rather than expansion. Laying of Demonstration Plot will be more useful to the farmers in non-traditional states. However, it is recommended to continue the programmes titled Regional Coconut Nursery; Expansion of Area under Coconut and Laying of Demonstration Plots in the non-traditional areas.
- With the introduction of Technology Mission on Coconut (TMOC) there are overlappings between the following regular programmes of the Board and the components in TMOC. The following schemes are also implemented in one form or the other under TMOC.
    - Market Promotion and Statistics
    - Information and Information Technology
- In order to remove the overlap it is proposed to bring all Market Promotion activities under Technology Mission and under the scheme titled Information and Information Technology so as to cover activities such as publications, media campaigns, production of films, seminars and exhibitions within the country, statistics and training, etc. As a result Information and Information Technology will be part of the regular programme and Market Promotion will be redesignated as a Market Research and shall remain under the Technology Mission.
- Further the scheme Technology Demonstration will be included in the scheme Information and Information Technology, which provides for imparting training and transferring technology.
- The following programmes are proposed to be continued in the XI Plan.
    - D.S.P. Farms
    - Private Nurseries (Big & Small)
    - Organic Manure Units
    - Technology Mission on Coconut
    - Information and Information Technology (Renamed as Extension and Publicity)
    - Infrastructure and Administration

3.3.7 Coffee Board

The Coffee Board of India is an autonomous body, functioning under the Ministry of Commerce and Industry, Government of India. The Board serves as a friend, philosopher and guide of the coffee industry in India. Set up under an Act of the Parliament of India in the year 1942, the Board focuses on research, development, extension, quality upgradation, market information, and the domestic and external promotion of Indian coffee.

3.3.7.1 Objectives: The objectives of the Coffee Board are as follows:

- Increasing production,
- improving productivity and
- Enhancement of quality through capacity building
- Transfer of technology

3.3.7.2 Programmes

During the X Plan period, Coffee Board implemented the following 7 broad programmes, with 21 schemes:

- Production, productivity & quality
- Infrastructure development & capacity building
- Market development
- Support for small grower sector
- Interest subsidy to small growers
- Interest subsidy to large growers
- Transport subsidy to exporters

3.3.7.3 Budgetary allocation

The sanctioned outlay during the X Plan period for the ongoing schemes is Rs.300 crores. Of this, the expenditure incurred during the plan periods was. Rs. 221.22 crores (74%).

3.3.7.4 Achievements

The major achievements of the Boards during the X Plan are:

A. Production, Productivity and Quality

i. Plant improvement and biotechnology

- For plant improvement and supply of improved planting material, germplasm stocks of 315 Arabica and 14 Robusta accessions revitalized and planted in the gene bank plot
- Nine coffee germplasm materials registered with NBPGR and five more slated for registration
- A new coffee genotype Sarchimor (Nandi) being evaluated for commercial use
- Seed plots of Arabica selections in Board's farms being further purified by vegetative means to attain uniformity in seed and clone production
- Six new genotypes of Arabica identified on the basis of yield, resistance to leaf rust, seed grades and cup quality for multi location evaluation
- Arabica mapping populations created to isolate DNA markers linked to rust resistance genes
- 32 MT of Arabica and 1.8 MT of Robusta coffee seeds supplied to the growers
- 95,000 seedlings and 58,000 clones of elite plant material supplied; 19 million seedlings made available through mini SHG groups
- Transformed tissues and somatic embryos and a few plantlets with marker genes

obtained in both Arabica and Robusta genotypes

- Protocols developed for isolating good quality RNA and preparing DNA and cloning these fragments to understand the molecular basis of leaf rust resistance
- Around 9000 plantlets regenerated by somatic embryogenesis and 5,000 plants planted after hardening in the trial plots
- Significant advantages not seen in tissue culture multiplication compared to multiplication through seeds

ii. Crop management

- Light pruning every year found to be better in enhancing the yield
- Phosphate solubilizing agents could bring about reduction in the dose of phosphorous fertilizers
- Coffee based intercropping systems could enhance returns to the farmers during distress
- Micro-sprinkler irrigation found to be a better option to increase production in Robusta than overhead irrigation to conserve water.
- 29,835 soil samples and 1,116 leaf samples tested to make fertilizer recommendations to ensure rational use of this costly input
- 2,118 samples of agrochemicals comprising of organic manures, liming materials, fertilizers and copper sulphate tested to assess the quality of some of the inputs
- DRIS (Diagnosis Recommendations Integrated System) norms developed for both Arabica and Robusta coffee to aid in precise application of plant nutrients.
- A few drought tolerant varieties were identified that could be used in future breeding programmes

iii. Plant protection

- 59 lakh exotic parasitoids (*Sephalonomia stephanoderis) reared* 59 lakh reared and 39 lakh released in the field to control coffee berry borer.
- 2.7 lakh brocatraps indigenously designed traps developed and supplied for mass trapping the berry borer beetles.
- 20,000 pheromone traps supplied to growers for monitoring and managing white stem borer.
- 6.5 lakh exotic parasitoids (*Leptomastix dactylopii)* reared and supplied to the growers to control mealy bug infestation.
- Some leads obtained in Bio-control of white stem borer using indigenous parasitoids, use of entomopathogenic nematodes against coffee pests and development of an effective formulation of *Beauveria bassiana* against coffee berry borer and shot hole borer
- Information collected on bio-ecology of white stem borer particularly its field activity studied for developing better management practices
- For effective disease management, good sources of leaf rust resistance like sarchimor, cavimor and catimor identified

- Leaf rust race banks established at Central Coffee Research Institute (CCRI) and Regional Stations at Chettalli and Thandigudi with abundant number of rust races for screening of new coffee varieties
- A fungicide namely Contaf (propiconazole) identified as a substitute for Bayleton resulting in better control of the rust pathogen
- Preliminary studies conducted towards developing bio-control tools against major and minor diseases
- *Trichoderma sp.*, an antagonistic fungus, found useful to manage root disease problems was popularized

iv. Standardization of post harvest technology, mycotoxin and pesticide residues in Coffee

- Pulped beans treated with graded doses of powdered lime, enhanced the quality in addition to assistance in storing and drying of semi-washed parchment
- Drying trials suggested that cement, tarpaulin and polyethylene surfaces were good for drying
- Coffee wet processing machines in use evaluated for their efficiency and some of the imported pulping machines like Penagos and Pinhalense found to be good
- Mechanical drying of coffee found to be a cost additive venture
- A few effluent treatment units developed by NEERI, Nagpur and ASTRA, Bangalore evaluated; treated wastewater did not conform to standards being prescribed by the Karnataka State Pollution Control Board
- The Board sponsored multi-centric projects involving Tamil Nadu Agricultural University, Coimbatore, University of Agricultural Sciences, Bangalore and Mangalore University, Madikeri to develop suitable eco-friendly management practices for coffee pulp and waste water
- A multi-country ICO-CFC-FAO project on ‘Enhancement of coffee quality through prevention of mould formation” launched.
- The occurrence of Ochratoxin-A (OTA) producing moulds found primarily dependent on estate practices, especially at harvest and post harvest stages
- Beans obtained from tree dried fruits, insect damaged fruits and gleanings (fallen cherries) found to be more susceptible to contamination with Ochratoxin-A producing moulds
- The critical stages of mould contamination in coffee throughout the production chain identified and prevention strategies standardized for estate level implementation
- An Analytical Laboratory established and method of analysis of OTA in green and roasted coffee beans standardized.
- A survey of more than 90% of trade coffee samples showed OTA levels within the MRL prescribed by many coffee importing countries
- Training courses on Principles of Food Hygiene and Hazard Analysis and Critical Control Point (HACCP)” and awareness campaigns on GAP and GMP for mould prevention in Coffee conducted in all major coffee zones

v. Setting up of quality evaluation-testing centres, training, certification systems and on and off-farm quality up gradation

- Quality evaluation centres functioned at the Bangalore office and Coffee Centre, Chikmagalur
- 5,256 coffee samples tested as on 31.03.2006 for quality against a target of 6,750 for the Plan period
- Thirteen one-day training programmes conducted for 232 roasters and brewers meeting the target set for the Plan period
- 1,262 coffee samples evaluated as a part of the Flavour of India - Fine Cup Award cupping competition
- Thirty-nine 'Kaapi Shastra" training programmes conducted benefiting 506 participants
- Twenty-nine students completed postgraduate diploma course on Coffee Quality Management
- Eleven cupping sessions organized during the four-year period
- Fifty-three curing works inspected for issue and or renewal of license
- Five quality awareness programmes conducted in different regions
- Four private coffee quality laboratories inspected and accreditation accorded

B. Coffee development in northeast region and non-traditional areas

i. North-East Region: The main activities under the Special Area programme (SAP) for coffee development during the IX and X Plan periods are:

- Extending financial support in the form of subsidy to the tribal growers of NE Region under coffee expansion and consolidation programmes.
- Providing Market support assistance to meet the cost of collection, curing, transportation and disposal of coffee produced in the NE Region.
- Supply of seed material for taking up coffee expansion/consolidation programmes.
- Providing training on cultivation aspects/ technological inputs to the growers for production and quality related aspects.
- Establishment of SHGs as part of community approach

ii. Non Traditional Area (NTA) – Andhra Pradesh and Orissa: Under the Coffee Development programme for Non Traditional Area namely Andhra Pradesh and Orissa, the Board implemented (i) scheme on coffee consolidation in A.P. to improve the productivity of coffee areas expanded during IX plan (ii) Scheme on Coffee expansion in Orissa to bring more area under Coffee and (iii) scheme on coffee quality up-gradation to encourage tribal growers to prepare washed coffees for better returns. The achievements during X plan under the coffee Development Programme for NTA are listed in Table 3.11.

- The Integrated Tribal Development Agency (ITDA), Paderu expanded coffee in an area of 13,016.8 hectares (till 2005-06) against a target of 24,000 hectares with the technical support of Coffee Board.
- About 23 metric tonnes of seed coffee distributed during the four-year period

- 3,364 tribal coffee growers trained on scientific coffee cultivation methods at CDF, Minimuluru and RCRS, R.V. Nagar
- 2,152 growers trained during the one-day on-farm training programme conducted at the village level
- 640 Resource persons of I.T.D.A trained on technical aspects of coffee cultivation
- 106 quality awareness campaigns conducted benefiting 5,753 growers

Table 3.11 Achievements for X Plan under the coffee development programme for NTA

Scheme	X plan Target (ha)	X plan achievement up to 2005-06 (ha)
Coffee Consolidation A.P.	3,000	2,367
Coffee Expansion in Orissa	1,000	9,23
Quality Up-gradation	Units	Units
a) Baby pulpers	1,000	402
b) Community pulpers	40	8
c) Community Godown	50	21
d) Mini Curing works	2	1

C. Promotion of organic coffee

- Area under certified organic coffee increased from 600 hectares during 2002-03 to 1,800 hectares during 2005-06 and production from 360 to 1,130 MT
- Export of organic coffee increased from 17.5MT during 2001 to 224 MT during 2005 with export earnings rising from Rs. 16 lakh to Rs. 250 lakh
- The cost of production of organic coffee higher than conventional coffee, mainly due to the high cost of inputs
- Demonstration blocks established at the Board's farms at Chundale in Kerala, Chettalli in Karnataka, Bodinayakanur and Perumparai in Tamil Nadu and Kattapana in Kerala for the purpose of demonstrating organic coffee production
- The Board extended financial incentives in the form of subsidy towards cost of certification of organic coffee estate benefiting 2,200 growers
- Five training programmes conducted for extension personnel and nine seminars/workshops conducted for organic coffee growers covering all aspects of organic coffee production
- Two booklets and two extension folders published on specific aspects of organic farming.

D. Infrastructure development, capacity building and transfer of technology

i. Transfer of technology through extension centers

- Various extension methods and tools viz., visits to coffee holdings, field demonstrations, group meetings, issue of advisory letters, seminars, mass contact programmes and mass communication programmes conducted to improve the knowledge and skill of coffee growers
- Approximately, one lakh visits to coffee holdings in all the zones made for various purposes by the Extension Personnel
- Over 20,600 field demonstrations covering different practices conducted
- About 11,100 advisory letters issued to the growers regarding cultivation aspects and quality improvement
- 207 seminars and workshops conducted on contact cum assessment campaigns (CAC) and mass contact programmes (MCP) conducted to reach out groups of growers
- 109 Mass Media Campaign through Newspapers, Radio and Television

ii. Maintenance of research and extension farms and infrastructure development

- Maintenance and infrastructure development on four Research Farms and ten Technology Evaluation Centres (TEC) continued
- Replanting and rejuvenation of around thirty hectares and new plantation in about fifteen hectares completed
- The productivity of Research Farms and TECs increased from 520 Kg/ha at the beginning of the Plan period to around 800 Kg/ha by the end of 2005-06
- Planting of about 30,000 pepper cuttings, 2,000 arecanut saplings and 1,500 vanilla plants apart from orange and medicinal plants taken up in different Farms as part of diversification
- Around 15 MT of seed coffee produced at the Farms during the period from 2002-03 to 2005-06
- 2200 growers, supervisors and mistries trained at Research Farms and TECs of the Board during the four year period
- Infrastructure for water augmentation for improving production and processing for quality improvement created in a few Farms

iii. Promotion of self-help groups

- This scheme, which started during the IX Plan was strengthened in the X plan and 107 new SHGs formed and 121.6 lakh Arabica seedlings distributed through 1245 mini SHGs

iv. Capacity building among various segments of the industry including board's personnel

- Refresher Courses for periodical up-gradation of the knowledge and skills of Extension personnel conducted

- Training programmes to upgrade the knowledge on the cultivation and management of estates organized for the benefit of Growers, Supervisors / Mistries at various Coffee Research Stations and TECs
- The Krishi Vigyan Kendras (KVKs) of State Agricultural Universities/IIHR were involved in providing training to the plantation workers including women on subsidiary vocations/farming that could augment their income
- The Indian Institute of Plantation Management (IIPM), Bangalore conducted Management Courses viz., Short Term Executive Programme on Financial Management of Coffee Estates and Executive Course on Leadership/ Empowerment and Institution Building for the Extension Officers and selected Coffee Growers

v. Labour welfare measures in the coffee sector

- Grant of donations for medical aid and equipments to hospitals/primary health centers in coffee growing regions
- Extended financial assistance to improve infrastructure in educational institutions in coffee growing regions
- Grant of educational stipends to meritorious students i.e. children/dependents of coffee plantation/processing workers

E. Market development

i. Export promotion of Indian coffee

The Board had projected an annual average growth rate of 5% in exports keeping in view the high production projections originally envisaged. However, due to shortfall in production in the first three years of the X Plan, revised export targets had to be set based on production on a year-to-year basis. The target and achievements in exports during X Plan period are given in Table 3.12.

Table 3.12. Export targets and achievements

Year	Original Projection (MT)	Target (MT)	Achievement (MT)
2002-03	2,64,000	2,10,000	2,07,333
2003-04	2,79,000	2,15,000	2,32,250
2004-05	2,95,000	2,25,000	2,11,765
2005-06	3,13,000	2,00,000	2,01,517*
2006-07	3,30,000	2,05,000*	

***** Provisional

The actual exports fell short of the revised target in 2002-03 while in 2003-04 it exceeded the target.

ii. Coffee promotion initiatives: To improve awareness of Indian coffee in key markets, the Board took up targeted communication initiatives. The entire communication effort was conceptualized on a basic strategy to create a unique image for Indian coffee. To achieve this, the following actions were taken.

- Developed a brand identity package for Indian Coffee
- Developed three films of international quality to facilitate an emotional connect between international coffee buyer and the Indian coffee grower
- Customized strategies for key markets such as Japan, Italy and USA
- Participated in key events by holding cupping sessions and giving vivid presentations on Indian coffee
- An India International Coffee Festival held in 2002

iii. Promotion of domestic coffee consumption: Due to supply constraints and increased demand for coffee in the overseas markets, there was stagnation in the domestic coffee consumption, which was placed at 50 to 55,000 MT per annum. Domestic consumption began to show growth signs at the beginning of X Plan and the trend appeared to be mainly due to the spurt in "out of home" consumption, thanks to the opening up of large number of café outlets by the private sector. Based on the Market research survey carried out in 2003, the domestic coffee consumption was estimated to have reached a level of around 70,000 MT. The year-wise details of domestic consumption of coffee are given in Table 3.13.

Table 3.13 Domestic coffee consumption targets and achievements (MT)

Year	Original Target	Revised Target	Achievement
2002-03	61,000	65,000	68,000
2003-04	67,000	65,000	70,000
2004-05	74,000	70,000	75'000
2005-06	82,000	75,000	80,000
2006-07	90,000	80,000	

iv. Market intelligence unit: Market Intelligence Unit provided on line information of market situation, price movement trends to various segments of the industry and also to Ministry of Commerce. Data Base and Market Intelligence reports were also published on regular basis. The Unit also carried out crop estimation forecasts, and coordinated the domestic coffee consumption audit once in two years

v. Support for small grower sector: The Board formulated a scheme namely Support for Small Grower Sector which provides financial assistance (subsidy) for taking up activities like:

- Re-planting – to convert old and uneconomical Arabica areas with that of high yielding varieties as also convert Robusta into Arabica in suitable areas
- Establishment of water augmentation infrastructure and irrigation facilities especially in Robusta areas whose yields respond very well to irrigation.
- Setting up of quality upgradation infrastructure like pulpers, washers, drying yards and store houses in farms
- Establishment of pollution abatement infrastructure on the basis of recommended technologies to combat pollution arising out of coffee effluents.

3.3.7.5. Constraints

i) Administrative

- Shortage of technical manpower coupled with restrictions on recruitment
- Scattered approach, inadequate manpower & lack of support from State
- State Governments failed to promote suitable coffee development programmes in NER
- With increasing development programmes aimed at large number of small growers, extension staff, their tools & methods are inadequate
- The approach to organise the small grower SHGs was not found sustainable
- No census work carried out for the last 30 years to strengthen database

ii) Technical

- Desired breakthroughs could not be achieved in evolving superior plant materials through breeding efforts
- Permanent solutions could not be evolved to control major pests/diseases (Ex:WSB/leaf rust)
- Weakness in PHT engineering area

iii) Financial

- Inadequate level of incentives (20%) did not attract growers to avail the scheme for re-planting, quality up-gradation & pollution abatement
- Scheme was restricted to only small growers (<10 ha)

3.3.7.6. Suggestions

i) Administrative

- Bring synergy among various institutions on bio-tech to develop superior plant materials for pest/disease control
- Consolidate Coffee development efforts in most suitable areas of NER
- Need to change the strategy and approach of extension dept.

ii) Technical

- Generation of GIS based database on coffee industry
- Reopen the credit lines from financial institutions
- Involve competent institutions to augment breeding/bio-tech/pest & disease control approaches
- Outsourcing PHT engineering efforts
- Consolidation of coffee in most suitable locations in NER only with active involvement of State Governments
- Extension by community approach involving grower bodies
- Encourage small grower collectives for market strength
- Outsource technology development to improve labour productivity
- Promote intercropping/diversification to augment farm income

iii) Policy

- Put in place risk management tools to growers.
- Develop a viable and large scale replanting support programme
- Export promotion to focus on key markets with differentiation
- Massive thrust to develop domestic coffee market in collaboration with industry

3.3.7.7 Future thrust during XI Plan

The areas that are relevant to Coffee sector for the XI Plan are as under.

i. Administrative

- **Promoting coffee cultivation in non-tribal area & NE Region:** The focus in the non-traditional areas like Andhra Pradesh and Orissa and also North Eastern states would be to motivate the tribal population to wean them away from practicing shifting cultivation (Jhum or Podu) and take up coffee cultivation as a better economic activity, besides, improving the soil tilts, organic matter and overall ecology of these regions which are presently denuded forests.

ii Technical

- **Generation of GIS based database of resources in Plantation areas:** There is a need to update the database Coffee in the country with regard to area under cultivation, water resources and scope for water augmentation, land utilization and other relevant details that could be of use for the development of the plantation sector in the country. This will be achieved in collaboration with Department of Space by using appropriate GIS based technology.
- **Increasing labour productivity:** Work force is the most important segment in the plantation sector. More than 5 million workers' livelihood is dependent on plantation sector. 60 to 70% of the total input across the three plantation crops accounts for labour input. Labour scarcity and ever increasing labour costs are making the plantations unsustainable. Therefore one of the main thrust areas for XI Plan will be to develop appropriate tools and implements to improve the labour productivity. This would not only improve the worker earnings but also make the plantations sustainable. This will be attempted by out sourcing work to other reputed institutions like IITs.
- **Promotion of Intercropping and on farm diversification:** Both from the point of providing protection against extreme volatility in international coffee prices and also from the point of protecting the soil quality and environment, it is proposed to encourage intercropping and diversification in the plantation crops.
- **Promotion of small and tiny grower collectives:** In the post liberalization era, the small grower sector lacks enough capacity to take advantage of free market for want of economy of scale and often loses out in realizing the actual remuneration for their produce. There is also a productivity gap between the small and large growers owing to technology gap, lack of resources etc, Therefore in the XI Plan it is proposed to organize the very small coffee growers into Societies on the lines of RPSs and use them as the channels for technology transfer as well as to improve their marketing capabilities.

iii. Infrastructure

- **Plant material improvement:** Focused efforts are required for evolving superior plant materials which are tolerant to pests and diseases without compromising on yield and quality of the product. In this regard Bio-technological approaches are critical to obtain the desired results. Presently, the Bio-tech research is being carried out by the Commodity Boards and several other scientific institutions on various crops in isolation. The schemes of XI plan will bring about synergy amongst various institutions with biotech research capabilities with a view to obtain faster results.

iv. Financial

- To replace the aged and unproductive plantations, an attractive re-plantation support scheme to be developed in consultation with all stakeholders.

v. Policy

- **Risk Management tools to growers: Impacts of vagaries of weather on** production, price volatility are constant threats to growers particularly the small growers. Therefore it is critical to evolve a viable risk management tools to provide protection, especially to the small and very small growers from the weather and price related risks.
- **Export promotion to focus on key markets with differentiation:** The export of coffee will be promoted only in the identified key markets where we have advantages for brand building. The elements of MDA and MAI will be appropriately built into the export promotion schemes of the Coffee for XI plan. Focus will also be maintained in positioning our differentiated coffees.

3.3.7.8 Conclusions

The programmes of Coffee Board to continue after incorporating the following suggestions:

I.) Programmes to be discontinued during XI Plan: A few of the Schemes which has served limited purpose by providing some comfort to growers & exporters during the time of coffee crisis and are recommended to be discontinued in the XI Plan. These are:

- Interest subsidy to small growers
- Interest subsidy to large growers
- Transport subsidy to exporters

II.) Programmes to continue with modifications: Programmes that need to be modified during XI Plan period to make these more effective are as follows:

i) R&D for Sustainable Coffee Production (Research)

- R&D for farmer centric sustainable coffee production
- Transfer of Technology (ToT)
- Infrastructure development at Research stations and Technology Evaluation Centres(TECs)

ii.) Development Support (Field Activities)

- Development support to growers (Focus: Replanting)
- Promotion of Small Grower Collectives
- Consolidation of Coffee areas in NTA and NER
- Capacity building among all stake holders

- Labour Welfare

III.) Programmes that needs to be strengthened during XI:

i.) Market Development

- Development of domestic coffee market
- Export promotion (Focus on value added and differentiated
- Coffee)
- Market Intelligence/Research

IV.) New programmes that are recommended during XI Plan:

i.) Risk Management to Growers

ii.) Weather Insurance

iii.) **Price** Insurance (on pilot basis)

3.3.8 Rubber Board

The Rubber Board is a statutory body constituted by the Government of India, under the Rubber Act 1947, for the overall development of the rubber industry in the country. The Rubber Board is mandated with integrated development of rubber in the country.

3.3.8.1. Objectives

The major objectives of the Rubber Board are as follows:

- Increasing competitiveness of Indian rubber through quality & cost in global competitiveness,
- product diversification,
- socio-economic development through rubber planting
- market development of rubber and rubber wood.

3.3.8.2. Programmes

Schemes being implemented in the X plan period are the following.

- Rubber Plantation Development
- Research
- Processing, Quality Upgradation and Product Development
- Export Promotion of NR
- Market Development
- Human Resource Development
- Rubber Development in NE region

3.3.8.3 Budgetary allocation

The sanctioned outlay during the X Plan period for the ongoing schemes is Rs.415 crores. Of this, the expenditure incurred during the plan periods was. Rs. 447.70 crores (107.9 %).

3.3.8.4 Achievements

- 48,831 ha. replanted / newly planted
- Around 44 million mandays of direct employment generated in the immature phase; In the mature phase permanent employment @ 75 persons per 100 ha. generated.
- National average productivity increased by 254 Kg/ha in 5 yrs.
- Major research achievement – release of RRII 414 & 430 clones
- 53 RPSs newly formed and 147 Nos. activated.
- 300 SHGs also formed
- Strengthened community processing & marketing.
- Around 1,700 tribal families supported to earn permanent income through rubber planting.
- Around 19,000 plantation workers in the unorganised sector supported every year

3.3.8.5 Constraints

The major constraints for rubber development in India are the following:

i) Administrative

- Land available for expansion of rubber area is only in the Northeast. Northeastern region is not in the ideally suitable agroclimatic zone and the communication / infrastructure development is also poor. Ethnic issues and other disturbances in the region are also posing problems to developmental activities.
- Volatility in price of natural rubber
- Consuming centres are away from producing centres resulting in increased cost on transportation.
- Shortage of staff is a serious constraint for proper extension / research work and follow up activities which are essential for development.

ii) Technical

- Large number of small / marginal holdings.
- Due to small holding size, many growers are compelled to take up other occupation, and they turn to be part time farmers.

3.3.8.6.Suggestions

i) Administrative

- Tribal settlement through rubber planting in collaboration with State Governments
- RPS can manage tiny holdings as a single unit by collectively undertaking cultural operations like planting, manuring, spraying processing etc. This will reduce cost of individual member growers and increase productivity.
- Resource poor growers and their family members are grouped into SHGs under RPS. They can form labour bank for plantation work, tapping, processing etc.

ii) Technical

- Replanting and new planting
- Plantation input supply at a price concession of around 20% through RPS

- Planting material generation and distribution
- Addressing environmental issues mainly by protecting soil and harvesting water
- Education and training programmes in farmers' fields
- Focusing attention on modernization of tiny small holdings and socioeconomic development of the resource poor growers, projects are proposed for strengthening RPS and SHGs
- Women SHGs will be supported technically and financially for raising rubber nurseries, bee keeping in rubber plantations etc.
- Tapping ancillary income sources from plantations
- Rubber Agro-management units for problem solving and demonstration through participatory approach

iii) Infrastructure

- Testing facilities for rubber and rubber wood products for quality assurance.
- Find out new markets for rubber and rubber wood products internally and internationally
- Assist RPSs to acquire godown facilities
- Assist the stakeholders in market promotion activities like advertising, participation in trade fairs, exhibitions, etc. for rubber and rubber wood
- Promotion of group processing to attain consistency in quality and minimizing cost
- Assistance for setting up of latex collection centres at RPS level and effluent treatment plants at group processing centres
- Modernization of rubber and rubber wood processing factories and effluent treatment plants.
- IT enabled common service centres are proposed to be set up in RPS/ SHG.

3.3.8.7. Conclusion

- Objectives of X Plan could not be achieved in full because approval of the major scheme was received in May 2005 only and many programmes could not be implemented in time. Therefore all ongoing schemes except for Export Promotion are recommended to be continued.
- Support for rubber export is not found essential. Increased emphasis needs to be given for participatory extension approach in productivity enhancement
- There is urgency to support and strengthen RPS & SHG. Besides, focussed attention needs to be paid to environment conservation by soil protection and water harvesting in plantations.
- It is also targeted to bring socio economic development in tribal areas through rubber plantations.

To address the above, following programmes are recommended during XI Plan period:

- Rubber Plantation Development Scheme
- Strengthening RPS and SHG

- Research
- Processing, Quality Upgradation and Product Development
- Market Promotion
- Human Resource Development
- Rubber Development in NE region

3.3.9. Tea Board

The Tea Board India is a statutory organisation established under the Tea Act, 1953 by the Government of India. Tea Board was established as an apex body concerned with integrated development of the tea industry in India by providing necessary assistance.

3.3.9.1. Objectives

The objectives of the Tea Board are as follows:

- To extend necessary assistance to the tea research institutes for undertaking focused research on tea in the spheres of tea husbandry, biotechnology, pesticide residues, integrated pest and disease management, electronics in tea, product diversification and development of value added items;
- Strengthening of extension services of the Research institutes for narrowing the gap between the lab to land and for ensuring that the growers are able to get technical assistance at their doorsteps.
- Formulation and implementation of development plan programmes aimed at improving productivity, & quality upgradation.
- Carryout export promotion activities like participation in overseas trade fairs, organising Buyer-Seller meets, visit of trade delegations to India and other PR activities;
- To take up generic promotion efforts involving tea councils abroad and producers associations within the country so as to increase the domestic consumption of tea and to cause a substantial growth in the volume and value of exports;
- To create durable public assets for the benefit of plantation labour and provide educational assistance to the wards of workers for pursuing higher studies;
- Establish and develop database on all aspects of tea industry;
- Dissemination of market information on a regular basis to various segments of the industry;
- To give policy formulation advice to Government and Self regulated industry.

3.3.9.2. Programmes

The major programmes taken by Tea Board are as follows:

- Plantation Development Scheme
- Quality up gradation and product diversification Scheme
- Market promotion Scheme
- Human Resource Development Scheme
- Plantation labour welfare measures

- Training programme.
- Research and Development Scheme

Details of programme and cost norms are given in Annexure 3.10.

3.3.9.3 Budgetary allocation

The sanctioned outlay during X Plan period (2002-07) for the ongoing schemes is Rs.463 crores. Of this, the expenditure incurred during the plan periods was. Rs. 462.98 crores (99.9%).

3.3.9.4 Achievements

- 12,381 ha area replanted as against the target of 5,000 ha
- New Plantation taken up in 6,726 ha in 4 years against the target of 2,700 ha
- 480 units were modernized in 3 years against the target of 650 units for 5 years

3.3.9.5 Constraints

The major constraints are as follows:

i) Administrative

- Limited technical man power when compared with Rubber and Coffee Boards. As against the strength of only 37 posts in Tea Board, the corresponding strength of Rubber Board and Coffee Board are 280 and 384.
- Inadequate assistance in the form of subsidy.

3.3.9.6. Suggestions/ future thrust

i) Administrative

- Setting up of full fledged extension wing for effective dissemination of technology to the small tea growers and make it available within their easy reach.
- Besides productivity, improvement of manufacturing standards being an imperative, there is a need for manpower with adequate technical expertise in manufacturing techniques for extending advisory service to the bought leaf factories.
- Identification of the location of small holdings, bought leaf factories and establishing a linkage between them and the Tea Board, and the agencies connected with providing technical and marketing support.
- Monitoring of the physical progress made by the tea gardens with the financial assistance from Tea Board especially under the proposed Special Purpose Tea Fund.

ii) Technical

- Carry out performance audit of the existing processing machinery and suggest ways and means of making them energy efficient so that cost of manufacturing could be reduced considerably.
- To come out with new processing techniques for different types of tea orthodox , CTC, green tea, and design state of the art machinery for making good quality tea
- To come out with simple mechanical aids for reducing the drudgery and improving the productivity of workers
- To look at possible derivatives from the green leaf so that the poor quality leaf coming

from the small grower segment could be used as raw material for making several niche products which are capable of fetching a higher price and thereby create a win –win situation for both the small growers and the manufacturers.

- Using Geographic Information Systems (GIS) in collaboration with ISRO for creating a geo-data base of the tea industry which would throw up:
  i. actual extent of area under tea within the total area of each tea garden,
  ii. the extent of area available for alternative crops
- Profile of resident population in the estates,
- Infrastructure facilities available with the gardens and the deficits if any for taking up suitable measures for bridging the gap
- Water sources available within the gardens for creating irrigation facilities for combating the drought.
- Mapping the drains and their natural outlets for safe conducting the excess water for avoiding the water logging during monsoon months.
- To assess the extent of attack by the pests and diseases for taking timely remedial measures.
- With the digitalizing the GIS map management information system could be developed with regard to development needs of each and every section of the fields within the estate.
- Establishing linkage between Tea Board, Tea Research Institutes and the corporate head quarters of the tea companies for timely communication of the production data to tea board, and obtaining advice from research institutes and management decisions from the corporate houses to the tea gardens.

iii) Infrastructural

- Need to establish strong institutional framework which is presently lacking in India.

iv) Financial

- Need to review present level of subsidy for tea development

3.3.9.7 Conclusions

Programmes of Tea Board be continued during XI Plan after incorporating suggestions in the chapter and following recommendations:

I. Programmes of X Plan that are required to be continued in the present form

i. Plantation Development Scheme

ii. Research and Development

The research schemes that have been initiated during the X Plan period are under various stages of completion and some of the schemes are to be continued for one or two years of the XI plan period for their completion.

II. Programmes of to be continued during XI Plan after modification

The proposed modifications to the ongoing X Plan Schemes for their continuation during the XI Plan are given in Table 3.14.

III. New Programmes to be taken during XI Plan

- Development, Production & Trade of Organic Tea
- Research & Development Schemes

1. Soils: Sustaining soil productivity-some strategies
2. Product Diversification: Extraction of food grade secondary metabolites from Tea and upscaling the methods for commercial Utility.
3. Tea Processing: Biochemical and molecular analysis of stress during processing of tea.
4. Quality Testing: Upgradation of quality tasting laboratories at regional centers of Tocklai.
5. Biotechnology and Breeding: Biotic and abiotic stress analysis for development of stable quality genotypes.
6. Plant Protection: Development of biocontrol packages and their integration for helopeltis and blister blight management to reduce the load of toxic chemicals
7. Services: Studies on heavy metals-phase II (chromium and arsenic)

- Focus on Technological and industrial Research
- Using Geographic Information Systems (GIS) in collaboration with ISRO

Table 3.14. Programmes of tea board to be continued after modification
i. Plantation development scheme

S.No	Activity	Existing mode of support	Proposed Modification
1	Replanting and Rejuvenation	Back end subsidy@25% of the approved unit cost	Upfront loan @50% from the Special Purpose Tea Fund set up for the purpose and back end subsidy@25% of the approved unit cost.
2	Extension Planting	Back end subsidy@25% of the approved unit cost limited to only small holdings in NE Region and in the state of Uttranchal	Subsidy to be made applicable to all the hilly areas where there is less scope for replanting regardless of the size of the holdings
3	Irrigation	Back end subsidy@25% of the actual cost subject to a ceiling limit of Rs.10000 per ha	Back end subsidy@25% of the actual cost- the ceiling limit to be removed
4	Drainage	Nil	Back end subsidy@25% of the actual cost.
5	Green leaf Transport vehicles–Trucks, trailers etc	Nil	Back end subsidy@25% of the actual cost

6	Self Help Groups	i)Transport Vehicle – 50% of actual cost (1 vehicle for every 1000 kgs of green leaf per day) ii)Leaf Collection sheds – 100% of cost or Rs. 30,000 per shed (lower of the two). 1 leaf shed for every 2000 kgs of green leaf per day. iii)Plastic Crates / Bags / Weighing Machines – Actual cost recommended by field offices iv)Pruning: Machines – 25% of the cost (max Rs. 7,500 per machine) per grower. For SHGs 1 machine per 10.12 ha of holdings.	Inputs: In addition to continuing with the existing benefits, it is proposed to provide one time revolving grant towards inputs required for one season and 100% grant for fertilizer storage sheds, office room and purchase sprayers etc . Creation of facilitators:It is proposed to train @ 2 members drawn from each SHG for a period of six months at Tea Research Stations. 100% grant is proposed towards the course fee and the boarding and lodging charges for the training period.
II	**Quality Upgradation and Product Diversification**		
1	Processing Machinery	25% of the actual cost of the machinery	50% subsidy for 1. othrodox machinery in 100% CTC factories; 2 for bought leaf factories for switching over to non-RC CTC processing, 3.for Green tea and other specialty tea machinery 4. setting up micro mini factories by the individual small growers or SHGroups 5.factories opting for 100% HACCP compliance
2	Value addition-colour sorters, cleaning, blending, packaging etc	25% of the actual cost of the machinery	50% subsidy for 1. units going in for 100% value addition within the primary processing factories. 2.Blending and packaging units opting for 100% HACCP compliance 3. Setting up of quality Testing laboratories within ea producing units.
3	Certification for HACCP/ISO/Organic	50% of the one time certification fee subject to a ceiling of Rs.75,000 per certificate.	50% of the certification fee subject to a ceiling of Rs.1,00,000 per certificated including renewals. The subsidy to be extended to all related certifications required for confirming with food safety standards.
4	Setting up of mini hydro power units; Setting up of Bio-gasification units and for opting for installations using non conventional energy sources	Nil	25% of the actual cost subject to non availability of subsidy from any other sources.
5	Incentive for production of Orthodox teas	NIL	Under the subcomponent - Product diversification- it is proposed to provide subsidy for production of orthodox tea which has good demand in the

		international markets. During the X Plan period, commencing from January 2005 an incentive scheme was launched with funding from Special Fund created out of the proceeds of Additional Excise Duty[AED] collected during 2002-04.. This scheme which was approved only for three years(2005-07) has been well received by the industry and production during the first year [ie. 2005] registered an increment of 6.17 million kgs. As there is a good response for this scheme, it is proposed to continue the scheme till the end of the XI Plan period. The fund required for the first year of the XI plan would be met from residual portion of the original allocation under AED fund. For the remaining four years the estimated requirement of the funds would be in the region of Rs.100 crores. Under the scheme the production incentive is being given @Rs. 3 per kg of actual production of leaf grade teas, and Rs.2 per kg of dust grade teas and an additional incentive @Rs.2 per kg of the incremental volume of tea produced over the corresponding period of previous year.
III	**Human Resource Development Scheme**	In order to augment the training programmes for the personnel engaged in plantations it is proposed support the initiative of Indian Institute of Plantation Management, Bangalore, to establish Extension Education Centre at Jorhat and planters productivity councils in each of the plantation districts

3.3.10. Central Institute of Horticulture, Medziphema, Nagaland

Recognizing the importance for institutional support for development of horticulture in NE Region, the Government of India has sanctioned a Central Sector Scheme for setting up of Central Institute of Horticulture in Nagaland during January, 2006. The main objective of the Institute is to support horticulture development in the N.E. region through:

3.3.10.1. Objectives

Major objectives of the Central Institute of Horticulture are as follows:

- Capacity building by training of trainers, extension officers, farmers, entrepreneurs, processors and exporters,
- Demonstration of improved technologies such as use of improved varieties / hybrids, adoption of INM / IPM practices, Hi-tech farming, precision farming, protected cultivation, post harvest technology, etc, and follow-on extension support in the field of horticulture.
- Promotion of organic cultivation of horticultural crops.
- Establishing convergence and synergy among programmes in the field of horticultural research and development.
- Monitoring of Centrally sponsored programmes in the area of horticulture.

3.3.10.2 Budgetary allocation

Against an outlay of Rs. 5.60 crores an expenditure of Rs. 1.3 crores (23.21%) has been incurred.

3.3.10.3 Achievement

The foundation of the Institute was laid on March 27, 2006. it is too early to mention any physical achievements. Few of the achievements are given below:

- Construction of Boundary wall and Barbed wire fencing
- Construction of internal roads and demarcation of blocks including levelling of land construction of Ground level water tanks and digging of well including installation of pump sets and construction of pump sets
- Engagement of chief consultant for 3 months.
- Engagement of consultant on Hi-Tech hort. project for 2 years.
- Engagement of 2 Nos. technical consultants for undertaking various activities of the institute- in Progress.
- A Brochure highlighting the activities of the Institute has also been brought out.
- The master plan for the institute has been prepared and also identified suitable varieties of selected crops for establishment of mother blocks at the institute and technologies for large scale demonstration in the farmer's field.
- The institute has organized Master's training programme on advanced technologies on horticultural development on 26th to 28th May 2006 at National Research Centre for Mithun, Jharnapani.
- A Regional workshop on Cashew was also organized in collaboration with Directorate of Cashew & Cocoa Development, Cochin to discuss various issues related to development of Cashew in NE States.

3.3.10.4 Constraints

It is too early to mention any constraints.

3.3.10.5 Future thrusts during XI Plan

The thrusts areas for the Institute in the XI Plan are as follows:

- Refinement /demonstration of identified technologies specific for the region,
- Production and supply of quality seed and planting material of improved/high yielding varieties
- Training of state department officials and field functionaries in selected aspects of horticulture development including post harvest management, processing and value addition.

3.3.10.6 Conclusion

The Scheme was launched only during January 2006 and it should continue during XI Plan period after incorporating the suggestion to make it more effective and result oriented.

CHAPTER IV
PLANTING MATERIAL

4.1 IMPORTANCE

Planting material, its type and quality are of paramount importance in any horticultural activity. In other words, it is the single most important factor around which the entire gamut of other horticultural activities revolves. It is of special significance especially in perennial horticultural crops which have a long juvenile/ gestation phase and any mistake committed by the grower in the initial stage will result in enormous loss in the later stages. Hence, genuineness, quality and health of plant material are the major requirements of multiplication, sale and adoption of any plant material.

Inadequate availability of plant material is one of the important deterring factors in development of a sound horticulture industry in the country. Massive area expansion under improved varieties, replanting, planting in marginal and arid areas, etc. require a huge demand for quality planting material and a sound supporting infrastructure. At present, hardly 30 to 40% of the demand for planting material in different horticultural crops is being met by the existing infrastructure in public domain. Much of the dependence is on the private sources of which the majority of the units are not regulated or monitored in most of the states. Hence, farmers do not have access genuine diseased free and elite to certified planting material in different crops and as a result suffer with respect to production, productivity and quality of the produce. Most of the old existing nurseries lack modern infrastructure such as greenhouses, mist propagation unit, cold storage, mist irrigation systems, efficient nursery tools, implements and machineries and even facilities for soil sterilization, etc. Ignorance of the farmers, acute shortage of mother plants of improved varieties, and absence of quality testing and monitoring mechanisms make the situation complex. As regards vegetables, the situation is comparatively better with the private sector taking a major share of the production and supply of seeds of hybrids/improved varieties, and enforcement of the provision of Seed Act by the government agencies. However, the gap between the demand and supply of genuine quality material is too large to be met out of the present efforts.

Therefore, during XI Plan it is envisaged that a massive programme on planting material be initiated so that a sound basis for further growth and development of this sector can take place.

4.2 PROPAGATION METHODS IN HORTICULTURAL CROPS

Horticultural plants are propagated both by sexual or asexual means. Asexual propagations involve multiplication of plants from some vegetative plant parts and ensure that plants being propagated have the same characteristics as the parent/stock plant. While sexual/seed propagation this is mainly followed in most perennial fruit and plantation crops. Several other horticultural crops particularly the annual crops are propagated by sexual methods i.e. by seeds. Many annual. These plants produce abundance of seed per plant; therefore, a large number of seedlings can be produced from a single mature plant. The progeny raised through this method produces plants which possess uniform and similar character type to the original variety. A number of vegetables like tomato, brinjal, pepper, cucurbits, cole crops, onions, etc., flowering annuals such as petunia, marigold, poppy, hollyhock, etc. and fruit crops like papaya, coconut and oil palm are propagated through seeds. Propagation by seeds in highly cross-pollinated species results in seedling variability and is not desirable. However, F_1 hybrids comprise the first generation population of a specific cross expressing hybrid vigour and are exploited for commercial cultivation owing to their high production, productivity, quality and uniformity in maturity.

4.3 EXISTING INFRASTRUCTURE

Multiplication of planting material and seed is being done both in public and private sectors. There are different agencies, which do multiply plants however; there is a major concern about the authenticity and quality of plant material supplied under private sector.

4.3.1 State Govt. Nurseries

Most of the nurseries have been established by the respective State Governments according to the type of crops being commercially cultivated there. At present, there are over 100 such nurseries/units in operation in about 15 states. These nurseries mainly multiply horticultural and social forestry plants.

4.3.2 ICAR Institutes

Planting material for different horticultural crops is also being produced by several ICAR institutes like Indian Institute of Horticultural Research, Bangalore; Central Institute for Arid Horticulture, Bikaner; Central Institute for Sub-Tropical Horticulture, Lucknow; Central Institute for Temperate Horticulture, Srinagar; NRC on Banana, Trichy; NRC on Litchi, Muzaffarpur; NRC on Pomegranate, Sholapur; NRC on Grapes, Pune and NRC on Citrus, Nagpur. Some of these nurseries are operating as Revolving Fund Schemes. Their first priority is to produce varieties if any released from their institutes.

4.3.3 SAUs

Almost all the universities have their own nurseries for supply of fruit and plantation crops, vegetable and flower seedlings, ornamental and foliage plants, etc. Some large nurseries exist at PAU, Ludhiana, GBPUA&T, Pantnagar, MPKVV, Rahuri, KKV at Vengurla, NRC, Nagpur, UAS, Dharwad, TNAU, Coimbatore and Periakulum, etc. These universities through their nurseries at KVKs also arrange for multiplication of released/recommended varieties in horticultural crops through Revolving Find Scheme of the ICAR. However, the gap in demand and supply in certain crops or recently released varieties is enormous.

4.3.4 Private Nurseries

At present there are over 6,000 registered small and medium scale nurseries. Large nurseries are about 100 in the country. These have the capacity of producing over five lakh saplings per year.

4.3.5 Hi-tech Nurseries

Most of the Hi-tech nurseries have been established in the private domain. However, under public sector all such facilities exist at TERI, Gurgaon; NCL, Pune; RPRC, Bhubaneshwar, TERI, NE unit, Jorhat, etc. In the private sector one of the most modern and large units particularly for ornamental plants has been established by M/s Indo-American Hybrid Seeds at Bangalore.

4.3.6 Cashew and Cocoa Seed Nurseries

The implementation of the programme “Establishment of Regional Nursery” in cashew with the financial assistance of Government of India was a big success. Inspired over this, such a programme was also implemented in cocoa also during the IX Plan A total of 28 nurseries have been established this Programme in states of Kerala, Karnataka, Goa, Maharashtra, Tamil Nadu and Andhra Pradesh

4.3.7 Vegetable Seed Production Units

There are about 19 NSP centres under National Seeds project which are engaged in quality seed production in vegetables. About 120 varieties are being produced under this scheme by various institutions involved in development of such varieties.

4.3.8 F_1 Hybrid Seed Production

Seeds of about 30 vegetable hybrids are being produced under NSP at 19 centres covering both ICAR institutes and SAUs. In addition a large number of seed companies are engaged in marketing their own F_1hybrids in vegetables.

4.3.9 Multiplication of Medicinal and Aromatic Plants (MAPs)

At present very few centres are in position to supply plant material in different MAP namely CIMAP, Lucknow, TERI, Gurgaon, IHBT, Palampur etc. Still a large proportion of planting material is being supplied by unorganized private nurseries and few NGOs.

4.3.10 Micropropagation

Commercial exploitation of micro-propagation has become vital for making available plant material in a required quantity and of desired quality. Presently, about 48 out of 120 tissue culture laboratories established originally are in operation and producing about 1.5 million plants every year per unit. The consumption of tissue culture plants during 2002-03 has been estimated at approximately 44 million plants with banana constituting 41% share followed by sugarcane at 31 %, ornamentals at 14%, spices at 6% and medicinal plants at 4%. The domestic consumption of TCP will be 44 million plants valued approximately at Rs. 385 million by the end of 2012.

4.4. STATUS OF NURSERIES IN THE COUNTRY

At present there are about 6,300 nurseries under public and private sectors. In addition to this, 1,345 nurseries are proposed to be developed during 2006-07 under Central Govt. Sponsored Schemes like NHM and TMNE. The state-wise details of nurseries are given in Table 4.1.

Table 4.1 Number of nurseries in the different states

S. No.	State	Number of nurseries			
		Public Sector	SAUs/ ICAR Institutes	Private sector	Total
1	Andhra Pradesh	57	-	913	970
2	Arunachal Pradesh	20	-	37	57
3	Assam	4	-	82	86
4	Bihar	127	27	126	280
5	Chhattisgarh	106	1	-	107
6	Goa	-	-	-	-
7	Gujarat	23	14	335	372
8	Haryana	25	1	36	62
9	Himachal Pradesh	78	-	648	726
10	Jammu & Kashmir	77	-	348	425
11	Jharkhand	157	2	-	159
12	Karnataka	28	-	15	43
13	Kerala	64	26	30	120
14	Maharashtra	136	42	1,300	1470
15	Madhya Pradesh	270	-	-	270
16	Manipur	12	-	41	53
17	Meghalaya	31	-	-	31
18	Mizoram	9	-	8	17
19	Nagaland	2	-	15	17
20	Orissa	92	-	62	154
21	Punjab	24	7	39	70
22	Rajasthan	27	6	22	55
23	Sikkim	-	-	-	-
24	Tamil Nadu	76		285	361
25	Tripura	41	-	9	50
26	Uttar Pradesh	79	-	-	79
27	Uttrakhand	23	12	176	211
28	West Bengal	6	-	80	86
	Total	**159**	**138**	**4,607**	**6,330**

Very few states such as Maharashtra, Andhra Pradesh, Uttar Pradesh and Punjab are self-sufficient in production and distribution of planting material. The rest of the States out-source the planting material from other States either to public sector or private sector nurseries.

4.5 SEED ACT AND NURSERIES REGISTRATION ACT

The Seeds Act, 1966 has been under implementation since December, 1966. At present, there are 21 State Seed Certification Agencies in the country. They have different units namely Central Seed Committee, Central Seed Laboratory and State Seed Laboratories which deal with overall seed production, quality management and sale of seeds including horticulture seeds in the country. Subsequently, a Seeds (Amendment) Act, 1972 and Seeds (Control) Order, 1983 were also adopted. The Plants, Fruits and Seeds (Regulation of Import into India) Order, 1989 under Destructive Insects and Pests Act, 1914 (2 of 1914) was adopted for import of seeds. Later, National Seeds Policy, 2001 provided a framework for ensuring the growth of the seed sector in a liberalized economic environment. It seeks to provide the Indian farmers with a wide range of superior seed varieties, and planting materials in adequate quantity.

The Union Govt. has introduced a Seeds Bill, 2004 in Rajya Sabha in which for the first time Clause Nos. 23 & 24 has been made for the registration of nurseries in India as detailed below.

4.5.1 Horticulture Nursery to be registered

No person shall conduct or carry on the business of horticulture nursery unless such nursery is registered with the State Government. Every application for registration under sub-section shall be made in such form and contain such particulars and shall be accompanied by such fee as may be prescribed.

4.5.2 Duties of Registration Holders of Horticulture Nursery

Every person who is a holder of a registration of a horticulture nursery under section 23 shall:

- Keep a complete record of the origin or source of every planting material and performance record of mother trees in the nursery.
- Keep a layout plan showing the position of the root-stocks and scions used in raising the horticulture plants.
- Keep a performance record of the mother trees in the nursery.
- Keep the nursery plants as well as the parent trees used for the production or propagation of horticulture plants free from infectious or contagious insects, pests or diseases affecting plants.
- Furnish such information to the State Government on the production, stocks, sales and prices of planting material in the nursery as may be prescribed.

At present the Nursery Registration Act is in force only in few states. Most of the states have yet to formulate or devise a system for implementing it partially or fully or evolve a new system. The present status of adoption of Nursery Act by different states is given in Table 4.2.

Table 4.2 Status of adoption of nursery act in different states

Sl. No.	Particulars	States
1.	States where there is no Nursery Act at present.	Arunachal Pradesh, Chhattisgarh, Goa, Jharkhand, Madhya Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Rajasthan, Sikkim, Tripura, West Bengal (13 Nos.).
2.	States where some system of registering / monitoring exists for nurseries or process has been initiated.	1. Andhra Pradesh: Horticulture Development Agency (H.D.A) in 1990. 2. Assam: Certification through Zonal Joint Director and committee of scientists from AAU, Jorhat. 3. Bihar: Process initiated. 4. Goa: Certification Committee exists. 5. Gujarat: Deptt. of Horticulture issues certificates for nurseries. 6. Haryana: Issue of license for three years. 7. Karnataka: Deputy Director of Horticulture, a Scientist from UAS-Bangalore / Dharwad and a representative from Nurserymen Association / Farmers Association are members of registration committee. 8. Kerala: District Collector, Co-chaired by Principal Agriculture Officer, Deputy Director (Incharge of Farms) and a scientist from Kerala Agricultural University examine the plant material before certification by any agency. 9. Tamil Nadu: Seed Certification under Seed Control Order 1983 which was enforced in 1994.
3.	States where some Nursery Registration Act exists	1. Punjab: *Punjab Fruit Nurseries Act, 1961.* 2. Maharashtra: *Maharashtra Fruit Nurseries (Regulation) Act, 1969*. 3. Himachal Pradesh: *The Himachal Pradesh Fruit Nurseries Registration Act, 1973.* 4. Uttar Pradesh: *Fruit Nursery Act 1976.* *5.* Uttrakhand: *Fruit Nursery Act 1976.* *6.* Jammu & Kashmir: *Fruit Plant Nursery Registration Act 1987.* 7. Orissa: *Orissa Fruits Nursery's Act (OFNA), 2001.* 8. Tamil Nadu: *Tamil Nadu Horticulture Nurseries (Regulation) Act 2006* needs approval.

4.6 MAJOR INITIATIVE BY STATES

Andhra Pradesh has formed an agency called Horticulture Development Agency (H.D.A) in 1990 for production of pedigree plant material in horticultural crops. This is the most comprehensive step taken by any state towards systematic production and making available plant material to the farmers in the state. Presently, there are 40 farms in all the districts except Medak and Nalgonda. In these farms horticulture plant materials, *viz.,* mango, cashew, guava, pomegranate, coconut, *aonla*, custard apple, jack fruit, papaya, etc. are being produced. In the commercial nursery at Hyderabad, ornamental plants and vegetable seedlings are being produced for meeting the urban demand. Different Horticultural Farms in the state have produced 2,01,57,692 plants of various fruit crops during the last 12 years (1992-93 to 2005-2006). Most of the plant material produced is being distributed from the year 2002-03 onwards mainly to the special package programme for Dry-land Horticulture being implemented in Ananthapur District and rest to the farmers in respective districts under various schemes implemented by government of A.P. from 2005-06, the plant material

required under the programme of area expansion under National Horticulture Mission is also being supplied from these Horticulture Farms registered with H.D.A. The availability, cost of plants, and demands are available on the internet for the benefit of the farming community. The present action plan of the HAD is to produce 29, 26,500 plants of different fruit and plantation crops. This initiative under PPP mode is a positive step and needs to be replicated by other states to have sound nursery programme.

4.7 X PLAN PROGRAMMES

The seed production is being undertaken by different seed production agencies like NSC, SFCI and 13 State Seed Corporations in different states of the country in addition to ICAR institutes, SAUs and the private seed companies. There is a Central Seed Testing Laboratory at New Delhi (recently shifted to NSRTC, Varanasi) and around 80 Seed Testing Laboratories all over the country, which undertake testing of vegetable seeds besides field and fodder crops. A network of 19 Seed Certification Agencies all over the country is available for monitoring the quality of seeds. A number of seed processing units are operative under State Seed Corporations and NSC etc. At present, State Seeds Corporations, National Seeds Corporation, State Farm Corporation of India, State Departments of Agriculture, Private Companies, Cooperatives and individual farmers are producing certified seed. Export/import of seeds is governed by EXIM Policy of 2002-07 issued by Ministry of Commerce. Under EXIM Policy, provision is made to import which is governed by the New Policy on Seed Development, 1988 read with Plant Quarantine Order, 2003 and their amendments.

4.7.1 ICAR, SAUs & State Dept. of Horticulture/Agriculture

Through its network of research institutes and national centres have laid emphasis on seed production of different horticultural crops. There are 9 Research Institutes and 11 National Research Centres and a Network project on Hybrid Seed Production. ICAR's main emphasis is on the standardization of techniques for rapid propagation of planting materials in different horticultural crops. Mass multiplication is accomplished in different crops through implementation of Revolving Fund Schemes under different horticulture and multi-crops institutes/universities. Presently, about 70,000 seed nuts and 5,000 hybrid seedlings of coconut, 2 lakh seed nuts/seedlings of areca nut, 50,000 grafts and 25,000 seeds/seedlings of cocoa are being produced annually at CPCRI, Kasaragod. Besides, about 60 lakhs cashew grafts are being produced annually in the country by cashew nurseries both under government and private sectors. CPRI, Shimla produces nearly 3,000 tonnes of breeder seed every year and supplies about 2,500 tonnes of this seed every year to the state seed producing agencies for multiplication and distribution to the farmers as certified seed.

Besides above, SAUs and State Dept. of Horticulture/Agriculture also have network nurseries and KVKs and Regional Centres for maintenance of mother stocks and production of quality planting materials, but the present infrastructure is old and often not quality oriented.

4.7.2 National Seeds Corporation Ltd. (NSC)

The National Seeds Corporation Ltd., a Public Sector Undertaking under the administrative control of the Department of Agriculture and Cooperation, was established in the year 1963 under the Companies Act, 1956 with the objective of producing and distributing seeds of high quality to the farmers. The Corporation undertakes the production of seeds through Contract Growers. At present NSC is dealing with about 560 varieties in 79 crops including horticultural crops, i.e. vegetables and papaya. Similarly, State Farm Corporation of India (SFCI), Government of India Undertaking operates Central State Farms in different states. The SFCI was set up in 1969 under Companies Act for quality seed production in Central State Farms. At present only 6 farms are with SFCI and the rest are with different State

Governments. Besides seeds it also arranges for large scale multiplication and distribution of vegetatively propagated plant material in different horticultural crops.

4.7.3 Coconut Development Board

Some of the schemes available for funding are; (i) Establishment of hybrid coconut garden for tender coconuts, (ii) Production and distribution of tall and hybrid coconut seedlings; and (iii) Establishment of Hi-tech nurseries in different crop clusters.

4.7.4 Spice Board

Operates scheme for production of planting materials of spices for crops like black pepper (cuttings), clove (seedlings), nutmeg (grafts), cinnamon (seedlings), ginger and turmeric (rhizomes). This scheme is fairing well.

4.7.5 Technology Mission for Integrated Development of Horticulture in NE States (TMNE)

Under this scheme, 302 new nurseries have been established in hill states during 2001 to 2004. The target is for over 500 nurseries.

4.7.6 National Horticulture Mission (NHM)

Under this scheme about 2,830 new nurseries are to be established by the end XI Plan. There is also provision for strengthening the existing nurseries under private and public sector and Tissue culture units.

4.7.7 PPV & FR Authority, DAC

This authority has been established under PPV&FR Act 2001 vide No. 52 of 2001 dated 30th October, 2001 in the Gazette of India. It has prepared DUS test guidelines for 35 different crops including tomato, brinjal, okra, cauliflower, cabbage, potato, onion, garlic, rose and chrysanthemum. The formulation of National test guidelines for DUS testing has been entrusted to ICAR and is in operation. The extent of flouting of plant breeders rights is considerable in the sector owing to non existence of such protection mechanism in the country. With the result some of the nurseries produce the patented exotic varieties and sell them by colour rather than by name. The reasons for such flouting are some times lack of knowledge about the implications of the plant variety protection mechanism. However, with the advent of the Protection of Plant Varieties and Farmers' Rights Authority of government of India and the likelihood of protection system being put in place in the near future such practices would diminish.

4.7.8 Nationalized Banks

Some nationalized banks in the country like NABRAD, SBI, PNB, also have funded schemes for establishing nurseries in rural and peri-urban areas under *Gramin Swarojgar Yojana* of the Central Government. Under this scheme, nursery projects worth Rs. 1.50 to 8.0 lakhs have been sanctioned in different states.

4.7.9 Private Nurseries

There are several private nurseries operating in the country. These have also played an important role in multiplication of planting material of fruit and plantation crops. However, several of these are still following the traditional methods and also lack sufficient infrastructure. At present, around 1,300 nurseries have been registered under the Indian Nurserymen Association, Kaithal, Haryana established in 1987. Besides these another 1,000 nurseries are existing in the country. For vegetable and flowers seeds there are different registered associations like All India Seed Growers, Merchants & Nurserymen Association established in 1988 at Chennai with over 200 members. Seed Association of India, New Delhi has 120 private seed producers as members in the country. New nurseries are also

being set under joint ventures with buy back arrangement with foreign collaborators. There are also several private nurseries selling plant material of unknown pedigree at exaggerated price resulting in fleecing the buyers. It is now felt that a National Authority in this sector needs to be established at the Ministerial level so that the entire nursery related activities in the country are regulated and monitored through certification mechanism.

4.8 CERTIFICATION MECHANISM FOR PLANT MATERIAL

At present, there is no legislation to regulate production and sale of vegetatively propagated planting material by nurseries in most horticulture crops. A mechanism to ensure the quality of planting material needs to be developed through registration and quality control. This could be achieved by establishing an Apex Body for the purpose. The State-wise details are given in Table 4.3.

Table 4.3 Status of certification mechanism for planting material in different states

Sl. No.	State	Certification mechanism
1	Andhra Pradesh	No mechanism exists for compulsory certification of mother blocks in private nurseries in the state. Mother blocks in government owned Horticulture Farms under H.D.A were got inspected by the scientist of RARS/DAT centers of ANGRAU to ensure that the mother plants are disease / virus-free.
2	Arunachal Pradesh	No mechanism exists for certification of mother blocks in public/ private nurseries in Arunachal Pradesh. However, experts/ scientists and consultants are regularly invited to inspect the mother blocks in government owned nurseries.
3	Assam	Government of Assam has authorized Joint Director of Horticulture to issue provisional recognition certificate on receipt of recommendation from Zonal Joint Director/ District Agricultural officer concerned regarding source and variety of mother plants authenticated by the scientists of Assam Agricultural University.
4	Bihar	Registration of nursery under seed act is done by district Agriculture Officer after verification.
5	Chhattisgarh	There is no mechanism for certification and registration of planting material. The In-charge of the Public Sector Nurseries under State Department of Horticulture certifies the nurseries considering the following criteria: (i) Availability of mother plant blocks, (ii) Age of mother plants, (iii) General appearance and age of planting materials in the nursery, (iv) Availability of irrigation facilities, (v) The Department officials examine the nurseries against these parameters. Similar is the case with nurseries maintained by SAU and Private Sector Farms.
6	Goa	The state has in built mechanism for certification of planting material. A committee headed by Director (Agri.) and comprising members from ICAR & State Directorate of Horticulture certifies the planting material. The nursery act is not in existence in the State.

7	Gujarat	The Department of Horticulture certifies mother plants and grafts in nurseries after physical verification. Farmers select the plants of their choice. The BAGAYATDAR assures for true type of production material to avoid any mixing and check poor variety planting material. The genetic purity, age and health of the mother plant are the basic criteria for certifying the mother plants, which is normally done for 5 years. The grafts are certified on the basis of good health and appropriate height of the graft and certification of mother plant. Nurseries men have to submit specific application for getting their mother plants and grafts certified by the Department which is done on payment of fee.
8	Haryana	The Department of Horticulture issues license for a period of three years which can be revalidated/renewed on request. The fee charged is Rs. 2,000 for new license and Rs.1500 for its renewal for a further period of 3 years. The competent Authority can forfeit the license in case the conditions mandatory under the license are contravened. The license is granted on physical inspection of the nursery on the basis of progeny garden, control of pest and diseases, suitability of soil, competence of nurserymen etc. A separate application has to be submitted in case the nurserymen desire to add new types of fruit plants for propagation. The competent Authority can impound or destroy any planting material if found to be of unknown pedigree or affected by any infection. The erstwhile Punjab Fruit Nurseries Act, 1961 is prevalent with minor modifications for registration, certification and regulation of fruit nurseries.
9	Himachal Pradesh	Under "The Himachal Pradesh Fruit Nurseries Registration Act, 1973" periodic inspection of registered nurseries is undertaken to ensure disease free and true-to-type planting material. The Nursery which has appropriate number of progeny trees from which further propagation material is to be taken, is registered under the Himachal Pradesh Fruit Nurseries Registration Act, 1973. A district level Committee comprising of District Horticulture Officer, Subject Matter Specialist and Horticulture Development Officer (Plant Protection) for each district inspects the registered nurseries well before the plantation season of rainy season fruits plants which is from mid June to mid September and winter season fruit plants which is from 1st week of December to the end of February, every year and the said nurseries can undertake the sale of planting material only after obtaining approval of the above mentioned committees.
10	Jammu & Kashmir	To monitor and regulate the quality of fruits plants in the nurseries, Department of Horticulture has Fruit Plant Registration Wing headed by Nursery Registration Officer. Fruit Plant Nursery Registration Act 1987 is in place in J & K but it is not under implementation because of non-formulation of rules thereof. The State Government has indicated that the formulation of rules under the Act has been initiated.
11	Jharkhand	No specific certification procedure has been adopted. At present, the Nursery Act is not in existence in the state but State Government is formulating a nursery act similar to the States where nursery act has been adopted.

12	Karnataka	The State does not have an Act for regulation of nurseries but inbuilt mechanism is there for the certification of plant material, wherein a district level committee headed by Deputy Director of Horticulture, a Scientist from UAS- Bangalore / Dharwad and a representative from Nurserymen Association / Farmers Association are members.
13	Kerala	The State does not have an Act for regulation of nurseries but inbuilt mechanism is there for the certification of plant material, wherein a district level committee headed by District Collector, Co-chaired by Principal Agriculture Officer, Deputy Director (In charge of Farms) and a Scientist from Kerala Agricultural University examine the plant material before certification.
14	Maharashtra	State Department of Horticulture grants registration and certifies nurseries for production of planting material under Maharashtra Fruit Nurseries (Regulation) Act, 1969. The mother stock is utilized and traceable in perfect condition and budding and grafting is done as per the standard procedure in the public sector nurseries/SAUs. The State Department of Horticulture produces the planting material in the nurseries through contract basis by engaging unemployed graduate and payment is made on saleable basis. The hardening chambers, green houses, shade nets etc are properly maintained at the nursery sites. All the planting materials are being lifted based on the slips issued by the Department. The excess of the planting materials are supplied to other States. The virus indexing system are placed only the nurseries maintained by SAUs.
15	Madhya Pradesh	No legislative mechanism in the form of 'Nursery Act' to regulate the nurseries and for enforcing quality standards of planting material. However, work has been initiated to enact Nursery Act for MP.
16	Manipur	There is no mechanism of certification for planting materials produced in the State.
17	Meghalaya	There is no formal certification mechanism in the state. At present, the Nursery Act is not in existence but Nursery Act of the state is under process.
18	Mizoram	No specific mechanism of certification of planting materials is done at present.
19	Nagaland	There is no mechanism for certification. However, the department notify and specify some criteria for the nurseries.
20	Orissa	Under the Orissa Fruits Nursery's Act (OFNA), 2001, there is a mechanism to certify the planting material of fruits plants including cashew by a team comprising of experts from State Agricultural University, ICAR & State Department of Horticulture. However, the planting materials for crops like spices, medicinal, aromatic and ornamental and floriculture plant materials are not covered under the Act.

21	Punjab	Punjab State has Punjab Fruit Nurseries Act, 1961 for registration, certification and regulation of fruit nurseries in Punjab. Under the Fruits Nurseries Rules 1961 of the Department of Agriculture, license is issued for three years which can be revalidated/renewed on request. The competent Authority can forfeit the license in case the conditions mandatory under the license are contravened. The license is granted on physical inspection of the nursery on the basis of progeny garden, control of pest and diseases, suitability of soil, competence of nurserymen etc. A separate application has to be submitted in case the nurserymen desire to add new types of fruit plants for propagation. The competent Authority can impound or destroy any planting material if found to be of unknown pedigree or affected by any infection.
22	Rajasthan	There is no regulation Act for registration and certification of nurseries in Rajasthan. However, the Department of Horticulture certifies the nurseries considering following criteria: i) Availability of mother plant blocks, ii) Age of mother plants, iii) Pest resistance and system for pest control and iv) Availability of irrigation facilities The department officials examine the nurseries against these parameters and certification is done if these are found satisfactory.
23	Sikkim	The State Department of Horticulture does not have any mechanism to check and certify the quality of planting material being supplied to the farmers.
24	Tamil Nadu	The Nurseries are required to get license from Department of Seed Certification under Seed Control Order 1983 which was enforced in 1994. A draft bill named 'Tamil Nadu Horticulture Nurseries (Regulation) Act 2006' is under consideration of Tamil Nadu Government and it is going to be introduced in the legislature.
25	Tripura	No mechanism is adopted for certification of planting material. The State does not have any Nursery Act.
26	Uttar Pradesh	The State Department of Horticulture does not have any mechanism to check and certify the quality of planting material being supplied to the farmers. Although a Fruit Nursery Act is in existence in the State since 1976, no serious efforts seem to have been made in implementing the provisions of the Act in letter and spirit. Tendering system is being adopted for procuring planting maternal from the private nurseries for taking up planting in the NHM districts.
27	Uttaranchal	Director, Horticulture is the competent authority for registration of nurseries and certification of planting material. State level nursery certification committee has been formed. Uttar Pradesh Fruit Nursery Act, of 1976 has been adopted by the Uttaranchal Govt. as such.
28	West Bengal	The State Government of West Bengal does not have any mechanism to register the nurseries nor for quality control. There are about 2,000 private nurseries functioning in the state, but only 88 of them are registered with the Indian Nurserymen's Association. Most of these nurseries have come up on their own and are functioning as a house hold industry.

4.9 CONSTRAINTS IN DEVELOPMENT OF PLANTING MATERIAL

4.9.1 Operational

- Lack of unawareness, inadequate facilities and lack of proper maintenance of the stock plants and nursery activities.
- In some states, State Seed Farms are having a buy back arrangement with different progressive farmers for certified seeds/plant material in different horticultural crops. However, there are several issues to be plugged as inferior quality seeds are being procured from influential individuals on farms with no proper training in scientific seed production.
- No tariff and freight rebates in movement of seed material from one state to other exist.
- Proper mechanism for storage of surplus seeds is not available.

4.9.2 Technical

- Lack of availability of standardized rootstocks in several fruit crops like mango, litchi, walnut, etc. No provision for maintenance of recommended rootstocks. Still random seedlings are used by the nurseryman. Rootstocks for different abiotic stresses like salinity and drought tolerance not in vogue.
- Non- maintenance of healthy stock or blocks of elite varieties at different centres.
- Careless multiplication of breeders seed by state agencies as in potato
- Old inefficient propagation techniques followed in several crops like air-layering and approach grafting in mango, air-layering in guava and *litchi.* Use of over-sized seedlings for grafting. Even no standardized age for grafting being followed.
- Inadequate and slow supply of mother plants of improved varieties from different research institutions causing delay in spread of these varieties at the desired rate.
- Techniques like soil solarization and fumigation not followed by many nurseries leading to of avoidable casualties in nurseries.
- Improved tools for different nursery operation not available. Mechanized grafting machines not available for different fruit crops.
- Non-availability of standardized tying and packaging material for propagation.
- Use of plastics in not very common.
- No-provision for disease and pest management in commercial nurseries.
- Non existence of virus-indexing or norms in vulnerable crops like banana, citrus etc. leading to spread of such pathogens to newer regions.
- Very limited availability of quality seeds in papaya.
- In coconut, open market seeds of unknown pedigree being used for seed production.
- Inadequate production F_1 (TXD) hybrid in seed coconut.
- Use of diseased scion buds and sticks in propagation.
- Quarantine norms not in operation in movement of plant materials within the country causing spread of new disease strains like banana, citrus, potato, ginger, etc.
- Procurement of plants through public quotations and in some states leading to cheap but poor quality material in crops like potato, etc.

- Labeling of plant material, i.e. varieties, age of plants, etc. are not followed by many nurseries.
- Non existence of data regarding availability of plant material in advance.

4.10 PROJECTIONS FOR XI PLAN

According to the estimates of the Ministry of Agriculture, the total requirement of planting material of fruits, coconut, cashew, black pepper, tree spices, areca nut, etc. was around 1,400 million by 2002, which has been projected as 2,000 million by 2012. This will encourage mushrooming of new nurseries, rural entrepreneurships and joint ventures. Renewed efforts for production of quality seeds were initiated under the National Seeds Project during the VII Plan. As a result, seed production technologies for over 120 open-pollinated high yielding varieties of different vegetables have been well established in the country. The annual seed requirement for vegetable crops is expected to be more than 185 MT of Breeders' Seed, 2,600 MT of Foundation Seed and 60,388 MT of Certified Seed. Approximately 41MT breeders' seed is being produced annually under NSP-vegetables. In vegetables, F_1 hybrids are fast spreading, with bulk of the demand being met by private companies. Therefore, these units are required to be brought under regulation through proper certification and also there should be some mechanism to bring down the cost of hybrid seed, which is very high at present. At present only CPRI is producing breeder seed to meet the requirement of potato seed for the entire country.

A new technology for raising commercial crop of potato using 'True Potato Seed' (TPS) has been developed and standardized as supplementary technology to the traditional tuber grown crop. Three TPS populations, TPS-C-3, 92-PT-27 and HPS-I/13 have been developed and recommended for commercial production in Bihar, Gujarat, Tripura and West Bengal. Some efforts on certified multiplication of seed in plains have also been made by the CPRI Regional Centres at Modipuram (UP), Jalandhar, Patna, etc. Micropropagation protocols have been developed in potato, banana, strawberry, pineapple, oil palm, black pepper, ginger, etc. Seed gardens of Tall (T) x Dwarf (D) and D x T hybrids have been established for production of coconut hybrids and seed gardens established for producing oil palm seeds and seedlings.

Near Self sufficiency in cashew plant multiplication by adopting soft-wood grafting has been achieved.

There is a great diversity in floriculture products consequently production and sale of both asexually and sexually grown plant material has emerged as the most important and powerful business world over. Cultivation of flowering annuals for seed production requires constant attention, in-depth knowledge, skill and specialization. In Europe, the climatic conditions during winters are unfavorable for seed production, resulting in higher cost. Therefore, many seed companies from USA, UK, Holland, Germany and France have started their seed production in India which in turn, is getting seeds produced on contract basis from farmers in different regions having favourable climate conditions. Mostly open-pollinated cultivars have been adopted by the growers. In India, about 600–800 ha area is under seed production. Of the total production, Punjab alone contributes 45–50% area, Sangrur, Ludhiana and Patiala being major seed-producing centres. The rest is being contributed by Karnataka (Bangalore and Ranebennur), West Bengal (Kalimpong and tarai areas), Bihar (Ranchi), Maharashtra (Pune), Haryana (Panipat and Sirsa), Himachal Pradesh (Kulu Valley) and Jammu and Kashmir (Srinagar Valley). The NHRDF under NAFED deals with production and supply of planting material of onion and garlic.There is a need to improve the quality of seeds and bulbs produced in India. The value of flower seeds and bulbs traded in international market is about Rs. 1.5 crores annually.

Despite these successes there are still several gaps in availability of plant material in different horticultural crops. Hence, this sector needs total transformation to develop a network of sale points of improved varieties/hybrids/rootstocks produced both by the public

and private sectors at a reasonable cost and of assured quality.

4.10.1 Fruit Crops

Although India is the second largest producer of fruits in the world, production and productivity of different fruits is low. However, the demand of fresh fruits has consistently increased in the domestic as well as international markets. Therefore, efforts need to be made to produce more quantity of better quality fruits so as to capture the emerging national and international markets. India's farmers suffer from an aversion to fruit growing as this requires high initial investment and long gestation period. Poor quality planting material available affects the yield of fruits and thereby returns to the farmers. In the absence of Nursery Act and nursery standards, there is little control on the quality of the planting material produced. Moreover, there is an ever increasing demand for the planting materials and the existing nurseries in the public and private sector fail to meet the requirements. The success rate is also low in the absence of certified packaging standards and storage. Most of the planting material is produced on seedling stocks which gives variable performance under field conditions. The clonal stocks are not commercially produced and are also not available. All these aspects require consideration so that true to type planting material on certified rootstocks is produced in sufficient quantity. The crop-wise requirement of planting material for fruits as estimated by a modest expansion rate of 4% per annum is given in Table 4.4.

Table 4.4 Projected demand of planting material (in 000') in fruit crops during XI Plan period

Crop	2007-08	2008-09	2009-10	2010-11	2011-12
Apple	4,990	5,188	5,395	5,610	5,834
Banana	14,83,450	15,42,788	16,04,500	16,68,680	17,35,428
Citrus	33,894	35,251	36,660	38,127	39,652
Grapes	3,900	4,056	4,218	4,388	4,563
Guava	1,403	1,459	1,517	1,578	1,641
Litchi	521	542	563	586	609
Mango	1,35,758	1,41,189	1,46,830	1,52,710	1,58,819
Papaya	20,160	20,966	21,805	22,675	23,584
Pineapple	54,54,600	56,72,760	58,99,680	61,35,660	63,81,120
Pomegranate	4,867	5,062	5,264	5,475	5,694
Sapota	2,298	2,390	2,486	2,585	2,688
Total	**7,145,841**	**7,431,651**	**7,728,918**	**8,038,074**	**8,359,632**

4.10.1.1 Establishing National Horticulture Nurseries

These will be the dedicated centers responsible for large-scale production and distribution of genuine quality seeds and planting material for the entire country. These nurseries will work in the not work mode as resource base for plant material. This initiative would help in meeting the requirement of planting material for bringing additional areas under improved varieties of different horticultural crops.

Infra-structure suggested to be developed at the national nurseries would include the following:

- Establishment of scion banks of genuine improved varieties/hybrids. These are to be maintained under extreme hygienic conditions with proper fencing, poly cover/ shade nets to protect the stock plants from adverse weather conditions and recommended agro-techniques. These centres would also maintain block of recommended rootstocks.
- Big size field beds for raising rootstock seedlings under net-house/ poly-house conditions.
- Grafting/budding/stooling blocks for large-scale vegetative propagation, packing and shade nets for hardening (500 m^2). Developing vector proof net-houses for

maintenance of plants. Facilities like fogging and sprinkler irrigation systems for improving success in propagation and plant survival.

- Hardening units (2,000 m^2) with 50% shade net with fogging / sprinkler systems.
- Pump house and *pucca* channels to supply irrigation water along with high volume storage tank.
- Facilities like soil preparation machines, power driven tillers, soil sterilization system, soil mixing pits.
- (vii)These centres will multiply the main crop assigned to these along with other crops (70 % + 30% basis).

i.) Mango

These centres would be responsible for large scale production of genuine and healthy quality plant material of the released/recommended varieties in sufficient numbers. Following will be the activities of these centres:

- Maintenance of mother blocks of specific varieties for collection of scion sticks.
- Maintenance of blocks of recommended rootstocks like Muvandan, Vellaikolumban, etc. in southern states, use of H-13-1 and Kurukkan for in central and northern India.
- Large scale net house facilities for maintenance of rootstocks and grafted plants.

Table 4.5 Centers identified for establishing National Mango Nurseries are as listed hereunder

Sl. No.	Centers	S.No.	Centers
1.	CISH, Lucknow	6.	IIHR, Bangalore
2.	GBPUA&T, Pantnagar	7.	APAU, Sangareddy/Kodur (AP)
3.	IARI, Regional Station, Karnal	8.	RAU, Samastipur
4.	BSKKV, Dapoli/ Vengurla	9.	BCKVV, Halda
5.	GAU, Paria		

ii.) Grape

Most of the varieties are so far being propagated from rooted cuttings on their own roots. In recent years grafted plants on rootstocks have become popular in Karnataka and Maharashtra states. Facilities for production of grafted plants on specified root stocks need to be strengthened at NRC, Grape, Pune and IIHR, Bangalore. The different centre identified for propagation of material are listed hereunder.

Table 4.6 Centers identified for establishing national grape nurseries are as listed hereunder

Sl. No.	Centers
1.	a. NRC on Grapes, Pune
2.	c. IIHR, Bangalore
3.	d. APAU, Hyderabad

iii.) Banana

Wide scale adoption of tissue culture plants, high density plantings, use of micro-irrigation and fertigation have shown significant improvements in banana yields wherever followed. However, with use of traditional planting material, i.e. suckers there have been cases of spread of infected material causing *Fusarium* wilt. Following centres are identified for large-scale multiplication of superior banana genotypes through both traditional and tissue culture methods and provided with tissue culture laboratories along with hardening facilities.

Table 4.7 Centers identified for establishing national banana nurseries

Sl. No.	Centers	Sl. No.	Centers
1.	NRC on Banana, Trichy	3.	UAS, Bangalore
2.	MPKVV, Rahuri	4.	RPRC, Bhubaneswar

iv.) Pomegranate

It is also fast emerging as a potential crop in several states. As a result, quality pomegranate is also being exported to different countries. Hence, keeping in view the potential expansion of area under this crop there is a need to establish at least two national nurseries in the country.

Table 4.8 Centers identified for establishing national pomegranate nurseries

Sl. No.	Centres
1.	MPKVV, Rahuri
2.	UAS, Bangalore

v.) Litchi

Following centers can be identified for undertaking large scale production of air-layers and grafts of recommended varieties.

Table 4.9 Centers identified for establishing national litchi nurseries

Sl. No.	Centers
1.	RAU, Samastipur
2.	GBPUA&T, Pantnagar
3.	HARP, Ranchi

vi.) Guava

Following centers are proposed for large scale production of quality guava plants.

Table 4.10 Centers identified for establishing national guava nurseries

Sl. No.	Centers
1.	RAU, Samastipur
2.	MPKVV, Rahuri
3.	CISH, Lucknow

vii.) Walnut

This is one of the most potential crops for growing in higher hills of Jammu and Kashmir, Himachal Pradesh, Uttrakhand, Arunachal Pradesh and parts of Sikkim. The following two locations are suggested for rational nursery.

Table 4.11 Centers identified for establishing national walnut nurseries

Sl. No.	Centers
1.	SKUAS&T, Srinagar
2.	YSP UH&F, Solan (H.P.) or any other place

viii.) Apple

Different delicious group cultivars are very popular in India but there is a dearth of standardized rootstocks for different intended use, i.e. establishment of HDP, Wooly aphid resistance, drought tolerance etc. Hence, it is felt that different rootstocks which are recommended should be made available in large numbers and grafted with improved varieties and then supplied to the growers of the region. Therefore, the focus during the XI plan would be to support centres in temperate region creating facilities for large-scale multiplication of different recommended clonal rootstocks and grafting. Following centres can

be supported during the plan period.

Table 4.12 Centres identified for establishing national apple nurseries

Sl. No.	Centres
1.	SKUAS&T, Srinagar
2.	YSP UH&F, Solan (H.P.)
3.	HETC, Chaubattia (Uttrakhand)

ix.) Papaya

At present, it is the most popular fruit among the health conscious urban populace. However, due to paucity of pure seeds, spurious seeds, random varieties mostly of poor quality are dominating the markets. In recent years some varieties from abroad are gaining popularity. Many private seed producers are in the market, which do not follow proper isolation norms or the proper seed production systems by sib mating or selfing in dioecious and gynodioecious varieties. Even the seed produced under the public institutions like NSC, ICAR institutes, SAUs etc. are inadequate. Hence, it is proposed that high quality seeds after proper certification be imported from Taiwan to meet the demand for seed and seedlings. For quality seed production and multiphase of indigenous varieties can continue at various centers of their developed following centres be entrusted.

Table 4.13 Centres identified for establishing national papaya nurseries

Sl. No.	Centres	Sl. No.	Centres
1.	IARI, RS Pusa, Samastipur	3.	TNAU, Coimabatore
2.	CHES, Chettali	4.	BAU, Ranchi

x.) Passion fruit

It has emerged as a highly remunerative crops for the NE states and is fast gaining popularity. Many farmers are using seedlings which should be discouraged and vegetative propagation should be employed for making available the planting material. ICAR Complex for NE Region, Meghalaya can be engaged in multiplication of plant material in large number with a proper budgetery support.

xi.) Kiwifruit

There is an increasing demand for plant material in Kiwi fruit in Mid and Lower hills of the Himalayan states. Hence, YSP University of Horticulture and Forestry, Solan may be entrusted to establish the national nursery in Kiwifruit. Necessary financial support for this may be provided during the XI plan.

xii.) Ber

Genuine planting material of *ber* is mainly supplied by private nurseries in Rajasthan and Haryana but still there is dearth. There is no proper source to obtain material of high yielding genotypes. Following centres are therefore recommended for propagation of *ber* genotypes in large numbers.

Table 4.14 Centres identified for establishing national b*er n*urseries

Sl. No.	Centres
1.	CAZRI, Jodhpur, Rajasthan
2.	HAU, Hisar, Haryana

4.10.1.2 Establishing Regional Fruit Nurseries

The regional nurseries are proposed to be set at other SAUs centres, which would be on the pattern of the above National Nurseries. These nurseries should act as Model nurseries with

an area of 4 ha and would cost Rs.18.00 lakhs per unit. The Model nurseries which would be established under the Public sector will be eligible for 100 % assistance to a maximum of Rs.18.00 lakhs per unit. The Model nurseries would produce minimum of two lakh plants per year. It would be the responsibility of the nurseries to ensure quality of planting material. The initial allocation for these nurseries is proposed to be Rs. 25.0 Lakhs.

Table 4.15 List of regional fruit nurseries to be established during XI plan

Sl. No.	Particulars	Sl. No.	Particulars
a.	**Regional Horticultural Nurseries at ICAR, SAUs, CSIR Institutes**		
1.	FRS, Rewa	16	HAU, Hisar
2	BHU, Varanasi	17	HARP, Ranchi
3	PAU, RS, Gangian	18	SKUAS&T, Srinagar
4	OUAT, Bhubaneswar	19	CIMAP, Lucknow
5	CAU, Imphal	20	IHBT, Palampur
6	AAU, Jorhat	21	RRL, Jorhat
7	BAU, Ranchi	22	HAU, Hisar
8	CIPHET, Abohar	23	College of Agriculture, Pune
9	IGAU, Raipur	24	College of Horticulture, Mandsaur (MP)
10	CIAH, Bikaner	25	BCKV, Nadia (WB)
11	RAU, Udaipur	26	UAS, Dharwad
12	GAU, Anand	27	KAU, Vellanikkara
13	IARI Regional Station, Shimla	28	PDKV, Dapoli
14	NDUA&T, Faizabad	29	APAU, Hydearbad
15	CPCRI, Kasaragod	30	IARI, RS , Indore
b.	**Commodity Boards Seed Farms**		
	Coconut (5 Nos.)	Coffee (2 Nos.)	
	Spices (3 Nos.)	Rubber (5 Nos.)	
	Tea (5 Nos.)		

4.10.1.3 National Centers for Production of Disease Free Citrus Plants

A successful programme is currently in operation to produce virus free material in citrus at NRC, Citrus and PAU, Ludhiana. It is proposed that this programme may be replicated in other citrus growing regions of the country.

These centers would under take the following activities like identification high yielding virus free plants of scion / stock varieties through meristem culture followed by Shoot Tip Grafting (STG), facilities for virus detection, i.e. serological tests for pathological viruses, containment facilities for maintenance of virus-free stocks and healthy rootstocks in insect proof net-houses, etc. These centres would also maintain a garden for production of seeds of the recommended rootstocks, large net-houses with containment facilities for maintaining the budded plantlets until sale.

Table 4.16 Proposed centers for production of virus-free citrus plants

Sl. No.	Particulars	Crops/varieties
1.	NRC on Citrus, Nagpur	Sweet orange (Mosambi), Nagpur
2.	PAU, Ludhiana/Abohar	Sweet orange, Kinnow mandarin
3.	APAU, Tirupati Campus	Kagzi lime, Sathgudi orange
4.	AAU, Jorhat	Khasi orange and Assam lemon
5.	IIHR, Bangalore/ CHES, Chethalli	Coorg orange, Kagzi Lime

4.10.2 Vegetable Seeds

The annual seed requirement for vegetable crops is expected to be more than 185 MT of Breeders' Seed, 2,600 MT of Foundation Seed and 60,388 MT of Certified Seed. Approximately 41 MT breeders' seed is being produced annually under NSP-Vegetables. Though, there is a big gap between the requirement and production of breeders' seed, only about 21 MT of breeders' seed is indented by The Deputy Commissioner (Seeds) and not many efforts are being made to increase indenting of newly released improved varieties. No data is available regarding the production of foundation and certified seeds. This indicates that private sector is playing a major role in production and distribution of vegetable seeds, but farmers being highly charged and quality of seed not being ensured in many cases. Therefore, active participation and synergy between government and private sectors is required to achieve the targeted seed production of quality seed so as to make India the vegetable seed capital of the world.

4.10.2.1 Infrastructure in vegetable seed production

Adequate infrastructure has been developed for vegetable breeder seed production at almost all the breeder seed production centers under the ICAR and SAUs. There are following 14 cooperating centers under the National Seed Project (NSP-Vegetables).

Table 4.17 Centers of National Seed Project of the ICAR

1.	IIVR, Varanasi	8.	YSPUH&F, Solan
2.	IARI, Karnal	9.	TNAU, Coimbatore
3.	IARI, Kattrain	10.	JNKVV, Jabalpur
4.	IIHR, Hessaraghatta	11.	APAU, Lam
5.	PAU, Ludhiana	12.	GBPUA&T, Pantnagar
6.	CSAUA&T, Kalyanpur(Kanpur)	13.	OUAT, Bhubaneshwar
7.	MPKV, Rahuri	14.	IGAU, Raipur

The future seed requirements in different vegetables crops are as listed in Table 4.18.

Table 4.18 Tentative seed requirement (MT) of vegetable crops during XI plan period

Crops	2007-08	2008-09	2009-10	2010-11	2011-12
Brinjal	297.3	309.2	321.5	334.4	347.8
Cabbage	2018.0	2098.7	2182.7	2270.0	2360.8
Cauliflower	160.7	167.2	173.8	180.8	188.0
Okra	6018.6	6259.4	6509.7	6770.1	7040.9
Peas	36895.8	38371.7	39906.5	41502.8	43162.9
Onion	7981.5	8300.7	8632.8	8978.1	9337.2
Tomato	220.4	229.2	238.4	247.9	257.8
Total	**53,592.3**	**55,736.1**	**57,965.4**	**60,284.1**	**62,695.4**

4.10.2.2 Constraints in vegetable seed production

- The vegetable seed production in our country is taken up mainly under the open sky, which makes it vulnerable to vagaries of weather. Many times the production and its quality are affected by inclement weather.
- At present the requirement of vegetable seeds in the country is based mostly on estimates, which do not reflect the actual requirements.
- Since in our system there is no restriction for planting any particular vegetable crops in any particular area, it often becomes difficult to maintain the recommended isolation distance for producing quality seed of certain crops.
- Most of the indenting agencies are ignorant about the newly developed improved varieties of different vegetables and they keep on indenting seeds of old and obsolete varieties time and again.
- Sometimes the nucleus seeds available at source centres are not adequate to meet the requirements for breeders' seeds because concerned breeders cannot produce and supply adequate quantity of nucleus seed. This results in mismatch between demand and actual production of seeds.
- Though indents are placed, many a times the indenting agencies do not turn up to lift the seeds produced against their indents. This situation adversely affects the seed production in the succeeding year.

4.10.2.3 Programmes suggested for XI Plan

- Meeting the breeder seed production targets as per demand in OP varieties and F_1 hybrids.
- Conducting research on important issues related to vegetable seeds like standardization of seed production technology in different vegetable crops and hybrids, varietal characterization through electrophoresis, DNA fingerprinting, maintenance and use of self-incompatibility, cytoplasmic male sterility, male sterile lines/ gynoecious lines, cropping system research for vegetable seed production, isolation requirements for vegetable seed production, disease-free vegetable seed production and seed storage studies.
- Seed production of only hybrids and varieties identified by AICRP (VC) should be taken up in appropriate areas. Popular cultivars of each vegetable crop along with the appropriate areas for their seed production are given separately.
- The target of seed production of different varieties and hybrids popular in the respective regions should be assigned to the Directorate of Horticulture/Agriculture, as the case may be, of the state in consultation with National Seed Corporation and State Seed Corporations. The farmers of these areas should be given some incentives exclusively for the production of quality planting materials under the supervision of the State departments and N.S.C. The minimum area of the particular variety/hybrid to be covered by a particular state after the release of funds for that state. This should be done under the Area expansion programme of the state govt. The N. S. C. and S.S.C. will procure the seeds of the varieties for further distribution as per the demand of the state.
- The projects for production of disease free seed and hybrid seedlings by public as well as private agencies under National Horticulture Mission should be continued, but quality monitoring needs to be strengthened. Keeping in view an average inflation rate of 5% per annum, suitable correction in financial assistance may be made. Production of hybrid seeds of vegetables developed by private agencies should be undertaken only after multiplication as per Seed Act.

- The mega seed project under NSP for quality seed production of vegetable crops should be continued. However, recently released varieties should be targeted for seed production. There should be an option for mid-course correction of the targeted varieties and production. The participating SAUs and ICAR institutes should finalize the targeted crops and seed requirements after discussion with respective State Department of Horticulture/Agriculture. For this, there should be a co-ordination committee between the above three public agencies. Public-private partnership should be encouraged for quality seed production and distribution. In this regard, public institutes may provide necessary technologies while multiplication and private entrepreneurs may do distribution/marketing of planting material.

It is proposed that the ongoing seed production by the different agencies like NSC, SSC, SFCI, etc. will be continued with proper monitoring mechanism to be under **National Authority on Regulation of Planting Material in Horticulture**. The budget provision to be made for quality seed production in vegetables will be Rs. 50.00 crores.

4.10.3 Potato & other Tuber Crops

Potato and other tropical tuber crops are usually vegetatively propagated and are often infected by several viruses, which are transmitted through planting material. In order to ensure that the planting material is free from diseases, a seed certification programme is a must. Quality plant multiplication in potato and other tuber crops are always in dearth. It is mainly due to very few seed. For this, the initial planting materials are indexed for the virus infection through ELISA, PCR and using nucleic acid probes. After indexing, virus free materials are multiplied under strict quality control. At every stage of multiplication, the plants are subjected to virus testing to ensure that they are virus free and no secondary infection occurred during field multiplication.

The total requirement of potato breeders' seed in the country is about 3,000 MT. Currently, CPRI is producing 2,600 MT of potato Breeders seed out of which approx. 2,100 MT is distributed to various State agencies for further multiplication at their level. Apparently, there is a shortfall of 900 MT of breeders' seed. However, in reality this is not the case. Reason being that breeders' seed produced by CPRI goes into seed multiplication channel only in 45-50% of the total potato area in the country. There is no seed multiplication and supply channel available in the remaining 50-55% area comprising the states of West Bengal, Karnataka, Maharashtra, Orissa, NEH Region, Gujarat and Bihar. Consequently, there is no demand for breeders' seed barring few hundred quintals in most of these States. In the remaining part of the country where seed multiplication channels exist, normally seed is multiplied only once up to the stage of Foundaion-1 and the same is allotted to the farmers without any further monitoring and checks. Because of several reasons including shortage of finances and infrastructural support the state agencies are not able to take up seed multiplication up to certified level. As a result there is a gap in supply and demand of quality seed which otherwise would not have been there had the seed multiplication been taken up to the certified level.

Area under principal root & tuber crops of different states during 2004-05 and the extrapolated area during next 5 years of the XI Plan calculated at a modest area expansion of 4% per annum are given below. The seed requirement at the end of XI Plan is also calculated on the basis of recommended seed rate for the crop.

Table 4.19 Tentative seed requirement (000' kg and million setts) during XI Plan period

Crops	2007-08	2008-09	2009-10	2010-11	2011-12
Potato	49,43,683.1	51,41,436.6	53,47,094.1	55,60,977.9	57,83,417.0
Sweet Potato	16,827.9	17,501.0	18,201.1	18,929.1	19,686.3
Tapioca	5,667.7	5,894.4	6,130.2	6,375.4	6,630.4

4.10.3.1 Infrastructure for production of planting materials

The breeders' seed of potato is produced by CPRI, from its 5 regional research stations located at Kufri-Fagu (HP), Modipuram (UP), Jalandhar (Punjab), Gwalior (MP), and Patna (Bihar). Besides, there are a number of private farms like Chambal Agritech, Sangha Farm, etc. which also produces breeders' seed potato on a limited scale. The foundation and certified seed potato is mainly produced by the potato farms of the State Dept. of Agriculture/Horticulture and NSC. The seed crop is essentially grown in primary seed areas in northern hills of Himachal Pradesh and North-western Indo-Gangatic plains of Punjab, Haryana, Uttar Pradesh, Madhya Pradesh, Bihar and secondary areas of North-eastern hills of Sikkim, Manipur, Arunachal Pradesh, Mizoram & Nagaland, which are free from destructive diseases like wart and pests like cyst forming nematodes. The breeders' seed of other tuber crops like sweet potato and tapioca etc. is produced by CTCRI, Thiruvananthapuram.

4.10.3.2 Measures to ensure quality and adequacy on large scale

To bring improvement in the quality of seed potato, a well organized scientific system of breeders'/basic seed production was envisaged in 1962-63 through clonal selection, tuber indexing and phased field multiplication of healthy indexed tubers in subsequent four generations to get sizeable quantity of basic seed for further multiplication in foundation I and II and certified seeds by State/Central seed producing agencies. The quality of foundation and certified seed potato, which is produced by the State Dept. of Agriculture/Horticulture, is being ensured by the State Seed Certification Agency by adopting the minimum seed certification standards. In India, there are 19 seed certification agencies in different states certifying the seed of different crops. The states in which potato seed certification is in operation are Himachal Pradesh, J&K, Punjab, Haryana, UP, Bihar, West Bengal, Assam, MP, Gujarat, Orissa, Karnadaka and Tamil Nadu.

The projected demand of certified seed can be met by involving private sector, growers' cooperatives, SAUs, KVKs etc. Currently, no seed agency is multiplying Breeders seed beyond Foundation-I level. Therefore, above mentioned agencies have to be involved for producing Foundation-II and certified seed. For this purpose, 50% of the Breeders seed may be allotted to State/Central Govt. agencies whereas remaining 50% may be made available to the private sector/growers cooperatives/ NGOs/SAUs/ KVKs. It should be made mandatory on the part of the stake holders listed above to multiply allotted Breeders seed up to certified level. As for the States where no seed supply channel exists there is need to create an altogether new potato seed multiplication and supply chain involving private sector and State Govt. agencies. The *Seed Village Scheme* proposed by the National Commission on Farmers will also serve the purpose in this direction.

4.10.4 Floriculture Crops

India is the second largest grower of flowers after China. The floriculture industry in India is characterized by growing traditional flowers (loose flowers) and cut flowers under open field and protected environmental conditions, respectively. However, the export share of India is very low. One of the major concerns in expanding this industry is the inadequate availability of planting material both quality seeds and plants. The planting material requirements of the sector are mostly met through the nurseries in both organized and unorganized sector. The major constraint in the planting material is the non-availability of named varieties. While, the Hi-tech nurseries in the organized sector supply the named/ patented varieties are costly. Several Joint ventures are in operation which also sell plants at higher price. The named varieties produced by the R&D organizations in the public sector are limited in number and are not sufficient to meet the growing requirements of the industry. The cut flower industry imports the latest varieties from the international breeders after paying the prescribed

royalty. Due to expanding requirements of the planting material some of the global breeders have established their production bases in India to supply the latest varieties. In spite of the presence of number of nurseries there is gross shortage of quality planting material.

Hence in the XI Plan, it is proposed that priority be given to the top 10 cut flowers traded in the world namely rose, spray chrysanthemum, tulip, lily, gerbera, cymbidium, freesia, standard chrysanthemum, anthurium and alstroemaria. Besides cut flowers, there is a growing market for potted plants and accordingly it is important that these plants be given priority. Some of potted plants are traded in the world include Ivy, kalanchoe, ficus, African violet, potted chrysanthemum, spathiphyllum, hyacinth, dracaena, potted rose and primrose. Therefore, these crops should be given much attention.

It is imperative that quality seed and planting production be initiated under a network project at the major ICAR institutes (IARI, New Delhi and IIHR, Bangalore), CSIR organizations (NBRI, Lucknow; IHBT, Palmapur; CIMAP, Lucknow; RRL, Jammu; RRL, Jorhat) and some of the State Agricultural Universities like PAU, Ludhiana, YSPUH&F, Solan, UAS, Dharwad; TNAU, Coimbatore; BCKV, Mohanpur; KAU, Vellanikkara. The proposed budget for production of seed and plant material in floricultural crops would be Rs. 15 crores.

The planting material requirement of this sector is also met partly by nurseries and partly by tissue culture units established across the country in the public and private sector. Nearly 50% of the planting material generated by the tissue culture labs comprise of ornamental crops. Some of the export oriented tissue culture labs export nearly 70% of the production (mostly ornamentals in ex agar state) to the breeders in the developed countries. The product mix often comprises of gerbera, limonium, orchids, carnation, anthuriums, cala lily, syngoniums, ficus, dracaena, kalenchoe, gypsophila, etc.

Micropropagation has an edge over traditional propagation in case of vegetatively propagated floricultural plants. Micro-propagation has become order of the day for rapid multiplication of disease-free, clean plants in millions in a very short time. Difficult-to-propagate plants can now be propagated in any numbers through this technology. The new Seed Act of 1988 which facilitated import of seeds and planting materials of international varieties and the liberalization of industrial and trade policies in 1991 paved way for the development of export-oriented units with strong back up from NHB and APEDA. A number of units came up with the foreign collaboration. About 122 tissue culture labs with an aggregate capacity of 245 million plants/ annum have been set up in country. The concentration of labs around Pune and Bangalore is due to climatic advantage and availability of good infrastructural facilities.

The single most important investment on any floriculture enterprise is in planting material. Few floriculture companies backed by the established rose breeders have their propagation units in Bangalore and Pune. These companies have the advantage of introducing new varieties of roses and carnations which are necessary for the growers to remain in business. Future demand for the high performing planting materials is going to increase many fold in the coming decade.

Considering that the area under floriculture would increase by 5,000 ha during the XI plan period the demand for planting material during the period would be around 19,681 lakhs which requires approximately 2,232 ha of nursery area (Table 4.20).

Propagation units will have high-tech system for the indexing and maintenance of mother stocks. It will require about 150 million plants of evergreens under shade-nets for the domestic markets. Important greens are now-a-days propagated through tissue culture.

Table 4.20 Projected requirement of planting material in floriculture sector

Flower	Area in production (ha)	Projected planting material requirement (lakhs)	Projected Nursery area required (ha)
Anthurium	250	100	10
Carnation	750	2,100	20
Chrysanthemum	250	1,089	7
Cymbidium	100	40	5
Freesia	50	218	10
Gerbera	500	300	20
Gladiolus	500	1,452	250
Lilies	500	1,452	400
Rose	1,750	12,250	1,500
Other	350	680	10
Total	**5,000**	**19,681**	**2,232**

The major constraint in the planting material is the non availability of named varieties and a majority of the nurseries in the unorganized sector sell the planting material mostly on colour basis and not by name. While the hi-tech nurseries in the organized sector supply the named varieties. The named varieties produced by the R&D organizations are limited in number and are not sufficient to meet the growing requirements of the industry.

4.10.4.1 Thrust areas in floriculture crops

- Strengthening model floriculture centers established by State Dept. of Hort./Agril.
- Apart from utilizing the agency of certified growers for multiplication of new plant varieties, tissue culture procedures should also be employed wherever feasible.
- Import of new seeds and planting materials to meet the requirements for international trade.
- Protocols already available for micro-propagation of flower plants may be refined and tried on mass scale.
- Initiate work on developing protocols for difficult to propagate flower plants and also for new and exotic materials.
- Create state-of-the-art infrastructure facilities like tissue culture lab., polyhouses, mist chambers, net-houses, micro-irrigation, fertigation, hardening facilities etc.
- Refine the nursery propagation techniques for raising the mother plants and also the secondary materials.
- Standardize appropriate media and containers for micro-propagated flower and foliage plants.
- Develop/fabricate indigenous machinery and equipment required for seed processing.
- Develop male sterile lines in annual flower crops for producing F1 hybrids and also standardize hybrid seed production technology for various annual flower crops.
- Develop appropriate handling storage practices for various plant materials and annual seeds.
- Identify seed villages and nursery villages for various flower plants and create common facilities to encourage small and marginal farmers.

- Establish mother gardens for various flower plants.

Organize awareness programmes among nurserymen, tissue culture units and seed production centres on the quality standards for seed and planting materials.

4.10.5 Plantation Crops

Presently, about 70,000 seed nuts and 5,000 hybrid seedlings of coconut, 2 lakh seed nuts/seedlings of areca nut, 50,000 grafts and 25,000 seeds/seedlings of cocoa are being produced annually by CPCRI, Kasaragod. Besides, about 60 lakh cashew grafts are being produced annually in the country by cashew nurseries both under government and private sectors. Nearly 20,000 ha area has have been newly developed in the country under cashew plantations during the period by new planting and replanting.

In case of cocoa, attempt is being made by the nurseries established by the private entrepreneurs for the production of planting materials as the scion banks are in its their primitive stage of production. Establishment of mega and small nurseries under cocoa, the multiplication and distribution of cocoa planting material of recommended varieties etc. are directly done through development departments in association with Cadbury India Ltd., in which this multi-national company has established large nurseries in Kerala, Karnataka, Andhra Pradesh and Tamilnadu. The Central Plantation Crop Research Institute, Vittal, Karnataka and Kerala Agricultural University, Trichur, Kerala are also producing nucleus planting material and commercial planting material in large quantity for meeting the requirement for traditional cocoa growing states. The State Farm, Aralam is also engaged in coco nursery production to a limited extent.

4.10.5.1 Infrastructure for production of seeds and planting material

The Central Plantation Crop Research Institute (CPCRI) has 3,500 mother palms identified for seed production of coconut, which can yield about 1 lakh seed nuts and 15,000 hybrid seedlings. The institute has established seed gardens at Kidu and Kasaragod for commercial production of coconut hybrids and varieties. A seed garden has been established at Kayamkulam for commercial production of root wilt tolerant planting material. Three high yielding hybrids, 2 high yielding varieties and 1 tender nut variety of coconut have been released by the institute for commercial cultivation. Similarly about 10,000 areca palms of released varieties have been established in five compact blocks for production of elite planting materials.

In order to make adequate availability of grafts and to achieve significant boost in the raw nut production a component “Establishment of Regional Nursery” was incorporated and implemented by the Directorate of Cashew nut and Cocoa Development in the VIII Five Year Plan and continued till 2003-04 with the financial assistance of Government of India. Now 90 such nurseries are available in the country, which have the multiplication capacity of 90 lakhs graft for area coverage of 45,000 ha per annum. Besides, a number of satellite nurseries are also available in the major cashew growing states some of which have been recognized/registered by this Directorate for the multiplication of elite clones of high yielding varieties.

In cocoa, four promising high yielding hybrids and five clones have been identified for production of planting materials. One polyclonal and six bi-clonal orchards comprising of 1,600 trees have been established at Kidu and two scion banks of promising clones/hybrids have been developed at Vittal. These clonal orchards and scion banks will be utilized for production of hybrid pods and provide scion for preparation of grafts. The implementation of the programme “Establishment of Regional Nursery” in cashew with the financial assistance of Government of India was a big success. Inspired on this, it was planned to implement such a programme in Cocoa also during the IX Plan and started in 2000-01. A total number of 28 nurseries have been established under the regional nursery programme in the states of Kerala, Karnataka, Goa, Maharashtra, Tamil Nadu and Andhra Pradesh.

Area under principal plantation crops of different states during 2004-05 and the extrapolated area during next 5 years of the XI Plan calculated at a modest area expansion of 4% per annum are given below. The plant requirement at the end of XI Plan is also calculated on the basis of recommended seed rate for the crops.

Table 4.21 Tentative requirement of planting materials during XI Plan period

States	2007-08	2008-09	2009-10	2010-11	2011-12
Cashew nut	65,93,600	68,57,344	71,31,638	74,16,903	77,13,579
Areca nut	2,18,38,600	2,27,12,144	2,36,20,630	2,45,65,455	2,55,48,073
Cocoa	6,15,000	6,39,600	6,65,184	6,91,791	7,19,463
Coconut	1,44,10,375	1,49,86,790	1,55,86,262	1,62,09,712	1,68,58,101
Total	**43,457,575**	**45,195,878**	**47,003,714**	**48,883,861**	**50,839,216**

4.10.5.2 Measures to ensure quality and adequacy for large scale production

For coconut, certified nurseries of elite planting material will have to be established with the help of NGOs/progressive farmers. Planting material will be produced from the high yielding mother palms growing in local farmer's plots or from seed nuts supplied by Govt. agencies. These nurseries should be certified by scientists/officials from CPCRI/CDB/SAUs. Only selected mother palms should be used for seed production. Strict vigilance should be observed at different stages of planting material production like seed nut selection, seedling selection and nursery management. In case of areca nut, the mother palms selected on the basis of health status and potential yield should only be used for seed production. For cocoa, hybrid pods from promising bi-clonal and polyclonal orchards should be used. Scions from established scion banks should be used for grafting. The use of F_1 hybrid seedlings for plantation development may be used since cocoa grafts may not be available for large area coverage.

Quality of cashew grafts for sale is prescribed according to the norms of National Research Centre for Cashew. Registration for planting material production is being done on the basis of site inspection. To ensure adequacy of planting materials for the development programmes of cashew the Directorate of Cashew nut and Cocoa Development co-coordinates the supply of the grafts from different regional nurseries established under various Cashew Research Institutes, Public Sector Undertakings and Private Entrepreneurs on demand. On the commencement of National Horticulture Mission to promote the growth of horticulture sector in all the states, the task of establishment of nurseries has been vested with the State Development Departments / State Horticulture Mission Societies. The role of Directorate of Cashew nut and Cocoa Development has confined to the extent of taking inventory for existing nurseries set up during the macro-management period and advice the State Horticulture Mission Societies to establish new nurseries in areas where they are not at all existing and registering the nurseries. Therefore, in order to ensure quality aspect of the planting material to be generated in XI Plan, the following aspects can be considered for adoption.

- Formulation of strict guidelines for the production and distribution of quality planting materials. It is under process by the Directorate of Cashew nut and Cocoa Development.
- Use of quality planting materials of recommended varieties mainly multiplied from the research organization should be used for replanting of senile areas.
- Like, the use of seedlings for the development of cashew plantations was banned by the Government of India, the quotations/ tender system should also be banned for procuring the planting materials.

4.10.6 Spices

Quality planting materials of improved varieties are produced and distributed by Indian Institute of Spices Research (IISR), Calicut. Financial assistance for production of planting material is made available under ICAR Mega Seed Project, Revolving Fund Project of ICAR, National Horticulture Mission, KVKs and ATIC programmes. Besides, SAUs, Govt. Seed Farms, NGOs, and private entrepreneurs are also involved in the development and distribution of planting material. Besides, Spices Board is also supporting some seed multiplication farms. The plant materials are supplied to developmental agencies and progressive farmers. At present the annual production of planting materials from IISR is given below.

Table 4.22 Production of plant material in different Spice crops by IISR Calicut (2006-07)

Crop	Target production
Black pepper (rooted cuttings)	50,000 Nos.
Cardamom (seedlings)	10,000 Nos.
Cardamom (suckers)	5,000 Nos.
Cardamom (seed capsules)	50.0 Kg.
Ginger	5.0 MT
Turmeric	10.0 MT
Nutmeg (grafts)	5,000 Nos.
Clove	2,000 Nos.
Cinnamon	1,000 Nos.
Cassia	1,000 Nos.

4.10.6.1 Infrastructure for production of seed and planting materials

IISR has facilities to produce quality planting materials' by conventional methods and also tissue culture. There are 15 semi-permanent nursery sheds and well equipped tissue culture lab for large scale multiplication of the improved varieties in major spices. Established mother blocks of black pepper, cardamom and tree spices are available. Ginger and turmeric seed rhizomes are also produced in large scale and facilities are available for storage and supply. However, production of materials under protected and controlled conditions are necessary for large scale production of disease-free materials.

For seed spices, NRC on Seed Spices has been established at Ajmer in the year 2,000 to produce quality seed of coriander, cumin, fennel and fenugreek. With the growing demand for seed, it is important that the seed production at this place is strengthened.

Area under principal spices crops of different states during 2004-05 and the extrapolated area during next 5 years of the XI Plan calculated at a modest area expansion of 4% per annum. The tentative area and seed requirement during the XI Plan is given in the following Table 4.23.

Programme for large scale-multiplication of traditional spices will be initiated at the IISR, Calicut, Spice Board funded farms and SAUs.

For seed spices, NRC for Seed Spices will be given the necessary funds for making available commercial seed production of different spices likes *dhania* and *jeera*.

Multiplication at of Black pepper, will be the responsibility of clove, cardamom IISR, Calicut and KAU, Trissur with a budget allocation of Rs. Twenty five lakhs each.

Table 4.23 Tentative seed requirement of different spices during XI Plan period

Crops	2007-08	2008-09	2009-10	2010-11	2011-12
Seed propagated crops (million tonnes)					
Chilli	1.4	1.5	1.5	1.6	1.6
Coriander	4.8	5.0	5.2	5.4	5.6
Cumin	8.8	9.1	9.5	9.9	10.3
Fenugreek	1.4	1.5	1.5	1.6	1.7
Fennel	0.3	0.3	0.3	0.3	0.4
Sub-total	**16.7**	**17.4**	**18.0**	**18.8**	**19.6**
Vegetatively propagated crops (million Nos.)					
Black pepper	276.1	287.1	298.6	310.5	322.9
Garlic	60.2	62.6	65.2	67.8	70.5
Ginger	143.6	149.3	155.3	161.5	168.0
Tamarind	7.0	7.3	7.6	7.9	8.2
Turmeric	420.1	436.9	454.4	472.6	491.5
Sub-total					

4.10.7 Medicinal and Aromatic Plants (MAPs)

At present different MAP species are under cultivation in the country out of which about 32 are listed in the priority list of the Medicinal Plants Board, Ministry of Health for commercial cultivation and processing in the country. However, unorganized collection from forest area has been banned in many states; the trade in this important sector is far from being organized and is also under private hands leading to distress sale by the growers and causing loss making ventures for new growers. Hence, in this sector it is important that only need based cultivation of the any Medicinal and Aromatic crops is taken up with assured buy back arrangements. Furthermore, in some CSIR institutes the plants are available but the costs are higher and not affordable to the growers. There is dearth of planting material in many key species and limited improved varieties are available. Hence different institution under public domain are required to multiply plants for supply to the growers. The centres to be entrusted with this task are NRC on MAP, Anand, CIMAP, Lucknow), AICRP Centres of the network projects; Madhya Pradesh, West Bengal, Orissa, Jharkhand, Chhattisgarh, etc. The projected demand for plant material in top five MAPs is listed in table 4.24.

Table 4.24 Area and production and requirement of planting materials for major medicinal plants in India by end of XI Plan (2011-12)

Crop	Total Area (000'ha)	Production (000' MT)	Targeted requirement of planting materials (2011-12)
Isabgol	156	95	79 MT
Aloe	NA	NA	44,741 suckers
Aswagandha	4	2	132 MT
Senna	25	10	658 MT
Safed musli	20	160	26,000 MT
Total	**201**	**267**	**26,869 MT + 44741 suckers**

Table 4.25 Budget allocation for the planting material production

Sl. No.	Particulars	Budget during XI Plan in crores (Rs.)	Total (Rs. in crores)
1.	NRC on MAP, Anand		
2.	CIMAP, Lucknow		
3.	IHBT, Palampur		
	Total	**0.5 x 3**	**1.5**

4.10.8 Establishment of Planting Material Authority

The ongoing programmes under different commodity board need to be continued keeping in view the replanting and area expansion under different crops during the plan period.

Paucity of genuine and quality planting material is said to be the major hindrance in area expansion and replanting fruit crops. At present a large chunk of planting material is supplied by private and many a times un-registered nurseries spread all across the country. Many of these nurseries are known to sell spurious materials. Hence, during the XI Plan period it is proposed that a Planting Material Authority be established under the *aegies* of Ministry of Agriculture. The authority would be responsible for formulating norms for quality in planting material, quarantine facilities, promotion of rootstocks, trade norms for domestic and international consignments, etc. For this initiative a provision for Rs. 100 crores be made for establishing the Authority.

The main objectives of the Planting Material Authority will be:

- To facilitate and monitor quality of planting material being produced and traded in the entire horticulture sector in the country.
- To facilitate availability of genuine and quality planting material in different horticultural crops by accrediting nurseries and seed farms.
- To create guidelines for all plant propagation related activities in horticulture in the country.
- To create awareness amongst people for adopt of improved varieties.
- To develop and facilitate linkages between planting material production systems in public and private sector and joint ventures.
- To accredit, register and monitor all activity related to production of plants and seed of horticultural commodities.

4.11 BUDGET ALLOCATION OF CREATING FACILITIES UNDER PLANTING MATERIAL DURING XI PLAN

Budgetary requirement for establishing planting material authority is Rs 1,000 crores.

CHAPTER V
HORTICULTURE BIOTECHNOLOGY

5.1. INTRODUCTION

The last two decades or so of the twentieth century have witnessed unprecedented technological advances in biological sciences. The techniques of plant tissue culture, recombinant DNA technology and DNA based markers have provided hitherto unthinkable approaches for harnessing genes of interest from across the biological systems even from those separated by sexual incompatibilities, for developing superior genotypes of different crops. Rapid multiplication of elite genotypes through micropropagation and refining as well as shortening the breeding process using marker-aided selection are the important technologies, which are already positively contributing to crop improvement programmes world over. The application of frontier technological approaches offer unique advantages in bringing novelty, precision and speed in our goals of development including higher production, nutritious food and efficient and economical designer crops of choice. Some of the tools and the techniques of biotechnology presently being used for improvement of horticultural crops include

- Micropropagation of elite genotypes and rootstocks.
- Molecular, primarily DNA based diagnostics of plant pathogens and developing pathogen-free planting material.
- Ovule and embryo rescue for distant hybridization.
- Development of cyto-plasmic male sterility system for hybrid seed production especially in vegetable and flower crops.
- Molecular breeding based on marker assisted selection for both qualitatively and quantitatively inherited traits especially for yield and abiotic stress tolerance, search for novel alleles.
- Genetic engineering for enhanced shelf-life in fruits, vegetables and flowers, improvement of nutritional quality including efficient bio-fertilizers and tolerance to biotic and abiotic stresses.

The technological advances in biotechnology in horticulture are many and are gaining strength each day. It is now possible to isolate gene(s) from plants, study their function at molecular level, and modify the gene(s) as per need and to reintroduce them into either plants or other organisms. These tools have revolutionized the genetic approach to the improvement of crops and at the basic level, information about the way in which individual gene(s), singly and in concert with other genes, control the expression of specific plant characters. Several genetically modified (GM) vegetables and few fruits have reached the market which is a testimony to the viability of this technology. In years to come, several GM varieties in horticultural crops like apple, peach, strawberry, papaya, cucumber, melons, tomato, capsicum, potato etc. are expected to be generated. There are several researchable issues in horticultural biotechnology. However, some of the developmental issues and their present status are dealt in this chapter.

5.2 MICROPROPAGATION INDUSTRY IN INDIA

While the first tissue culture Laboratory in India was established at Delhi University in the 1950s the major benefits derived from tissue culture are: Control of organogenesis, elimination of breeding barriers, micropropagation, disease detection and eradication, somatic embryogenesis, use of protoplasts, somatic hybridization, somaclonal variation, detection of genetic variability *in vitro* and production of transgenics. Undeniably the most

useful outcome of tissue culture has been in the micropropagation of ornamentals, fruits and plantation crops, MAP and forest trees. Laboratory research on micropropagation of plants of economic importance (*Citrus, Eucalyptus*, bamboo, teak, poplar, banana, sugarcane, turmeric and cardamom) has been scaled up to near commercial level. Tissue culture has been effectively used for multiplying and storing economically important, endangered (e.g. *Nepenthes khasiana*), threatened (Himalayan orchids) and biologically incompletely understood plants (Podostemaceae) and medicinal plants (*Dioscorea, Coptis teeta, Valeriana wallichi, Podophyllum hexandrum, Picrorhiza kurroa*) at the North-Eastern Hill University (NEHU), DU, NBRI, NCL, BARC, CIMAP and Institute of Himalayan Bio-resources and Technology (IHBT), Palampur. The DBT has established six centres in India to provide hardening facilities for laboratory-raised plants and Micropropagation Technology Parks at TERI and NCL. The National Facility for Plant Tissue Culture Repository (also started by DBT) is located at the NBPGR, New Delhi. Collection, evaluation, introduction, exchange and conservation of germplasm, storage of elite plants, rare hybrids, and germplasm of vegetatively propagated plants and of plants bearing recalcitrant seeds in the form of tissues or embryonic axes in cryo-banks are being practiced at NBPGR, New Delhi.

In ICAR system, different plant-based institutions are conducting research on different horticultural crops. Indian Agricultural Research Institute, New Delhi was a pioneer in initiating tissue culture research on horticultural crops in 1972. It has standardized protocols for micropropagation of papaya, grape, guava, rose, chrysanthemum, etc. At IIHR, Bangalore, tissue culture technique for mass multiplication of grape rootstock Dogridge has been standardized. Tissue culture raised banana plantlets are now commercially adopted. At present, virus-free clones of cardamom and micro-tubers of potato, obtained through meristem culture, are a reality. IIHR, Bangalore, has developed protocols for micropropagation of plants like banana, papaya, strawberry, triploid watermelon, orchids and anthuriums, which have been commercially adopted. A PCR-based technique for indexing micro-propagated banana for the Banana Bunchy Top Virus (BBTV) has been developed. Micropropagation protocols have also been standardized for apple, grape, pineapple, papaya, strawberry; potato, pepper, cardamom, orchids, etc. are available in the country. Shoot-tip grafting technique in citrus has been considerably advanced and is fast becoming a suitable alternative for multiplying healthy plants. Success has been achieved at NRC Citrus, Nagpur in case of Nagpur mandarin. Micropropagation of bulbs/tubers of crops like gladiolus, lilliums, tulips, liatrice is also picking up fast. Tissue culture protocols for micropropagation of large number of flowering and ornamental plants have been developed. In addition to rose, bougainvillea, carnation, chrysanthemum, gladiolus, amaryllis, petunia, orchids. anthuriums, foliage plants like *Ficus elastica*, *Monstera deliciosa*, *Cordyline terminalis*, *Begonia rex*, *Peperomia obtusiflia* and *Philodendron* has also been reported to be successfully propagated through tissue culture.

There are a large number of government and private nurseries engaged in multiplication of planting material of deciduous fruit crops. In addition, the State Agricultural Universities and the Research Institutions are also multiplying planting material of improved cultivars for sale and distribution to the farming communities. The Government of India had supported establishment of a large number of fruit nurseries, both in public and private sectors. During the 8th Five Year Plan (1992-97), over 55 million nursery plants of different perennial crops, including temperate fruits are estimated, have been produced and distributed under this scheme. There was a target for the establishment of 85 big nurseries, 587 small nurseries, and 37 tissue culture units (20 by the private sector and 17 by the Government) on different fruit crops. Exact number of these nurseries engaged in production of pome and stone fruits is not known. However, the existing nurseries (more than 600), covering both public and private Institutions, are sufficient to meet the requirement of planting material of deciduous fruit crops. Micropropagation through tissue culture technique has not yet been commercialized for temperate fruits, although tissue culture protocols have been developed at research Institutes/Universities.

5.2.1 Micropropagation Trade in India

Commercial exploitation through micropropagation has become vital for improved crop production. The consumption of tissue culture plants for 2002-03 has been approximately 44 million plants with banana constituting 41% share followed by sugarcane at 31 %, ornamentals at 14%, spices at 6% and medicinal plants at 4%. The demand for tissue culture banana is expected to increase by about 25 to 30 percent estimated to the extent of about 5.0 million every year by 2010. The domestic consumption of TCP will be of the tune of 44 million plants valued at approximately Rs. 385 million by the end of 2012.

The present global biotech business is estimated at around 150 billion US dollars. Around 50-60% of this constitutes agri-business. The annual demand of tissue-cultured products constitutes nearly 10% of the total, amounting to 15 million US dollars. The estimated annual growth rate is about 15%. Among the developing nations, however, India is positioned advantageously to exploit this market due to availability of cheap skilled labour, low input cost and low energy cost when compared to the developed nations. The Govt. of India identified micropropagation of plants as an industrial activity and several subsidies and incentives were offered. Many state governments, prominent among them the state of Karnataka, have given the Plant Tissue Culture ventures as Thrust Sector Industry.

The Indian micropropagation industry is just two decades old. The constitution of the Department of Biotechnology (DBT) and the subsequent 'Hi-Tech Industry' status given to Plant Tissue Culture encouraged several corporate houses to venture into this area on commercial scale. However, many of these ventures are actually export-oriented, having a buy-back arrangement with the foreign companies that the Indian counterparts were tied-up with. Most of the Indian commercial TC units have been set up in foreign collaboration with companies from Holland, UK, Belgium, Australia, Israel and France, etc. A large volume of the export is confined to ornamental foliage plants. The first commercial micropropagation laboratory was set up in 1987. As per a recent study, there are about 130 small, medium and large tissue culture units in India. Their combined installed capacity is around 300 million plantlets per annum. However, not all units are functioning at their fullest potential. Their combined capacity utilization is 25-30% only resulting in technical and marketing problems. Even though this industry is a late starter in India, the infrastructure created today matches with the best in the world. Several constraints like air-freight related problems, inadequate cold storage facilities at airports and delays in clearing the live, perishable cargo have been some of the key causal factors for this downward trend. Besides, the target crops of most of the units are the same, resulting in supply exceeding demand, owing to over-production or non-staggered production. Even though the global market for micropropagated plants is enormous, it is fast changing, highly-competitive and relatively volatile. However, elite planting material in horticultural, plantation and agro-forestry crops like banana, cardamom, sugarcane, vanilla, bamboo, etc., enjoy a good domestic market.

Horizontal technology-transfer should be encouraged by operating viable indigenous commercial units which will help save precious foreign exchange being paid as Technology Fee. Value-addition to the product, from research carried out in the public/private sector laboratories, stands to pay rich dividends e.g., development of a cardamom variety yielding 250 kg/ha, which can be cropped in two years, compared to plants yielding 70 kg/ha and maturity in 3 years, high glucovanillin-producing, early-flowering vanilla plants, etc. Micro-tuber production in potato has been scaled-up using the bioreactor technology at Hindustan Lever Ltd., Mumbai. Unfortunately, tree fruit crops like cashew, mango, guava, litchi and walnut, which would immensely benefit from micropropagation, are still intractable. Some of horticultural crops where micropropagation technology has been perfected are listed below;

Table 5.1 Horticultural crops where tissue culture techniques have been perfected

Sl. No.	Broad group	Crops
1.	Fruit crops	Banana, citrus, grape, pineapple, sapota, strawberry etc.
2.	Vegetables and tuber crops	Potato, asparagus etc.
3.	Ornamentals	Anthurium, carnation, gerbera, lilies, orchids, syngonium rose, chrysanthemum, ficus, vanilla etc.
4.	Spices	Black pepper, large cardamom, small cardamom, ginger, Kalazira, turmeric, vanilla, saffron etc.
5.	Medicinal and aromatic plants	Aloe vera, dioscorea, geranium, neem, Pachouli, Stevia sp. etc.
6.	Plantation crops and social forestry species	Tea, teak, bamboo, eucalyptus, populus etc.

Of all the plants micropropagated globally, ornamentals account for nearly 75%. At present most of the large commercial tissue culture laboratories are operative in states like Maharashtra, Karnataka, Kerala and Andhra Pradesh. Banana is the largest sold micropropagated fruit crop in India and abroad. Strawberry is also catching up in our country too. Among plantation crops, cardamom has been successfully commercialized. The, major ornamentals produced through tissue culture have been the syngonium, chrysanthemums, dieffenbachia, gerberas, anthuriums, roses, orchids, lilies, gladiolus, etc. At present, the states, adopting large-scale planting of TCPs are Andhra Pradesh, Maharashtra, West Bengal, Karnataka, Tamil Nadu, Punjab, etc. Up to 1995, India had the capacity of producing 110 million tissue culture-derived plantlets per annum. A programme on refining tissue culture in coconut was launched in 1986-1987. However, it has not been operational. In 1995-2005, massive-scale production units were to be set up for supplying large numbers of plantlets of high-yielding coconut varieties to replace traditional low-yielding ones.

5.2.2 Micropropagation for Supply of Planting Material

Micropropagation is perhaps the most popular and widely commercialized global application of plant biotechnology. This is evident from the fact that a large number of plants are being cloned and exploited commercially worldwide and newer crops are being added continuously. Novel germplasm existing in horticultural crops and those created using various biotechnological tools need to be multiplied rapidly in large number for quick dissemination. An added advantage is the production of pathogen-free planting material. Propagation of plants through tissue culture, including skillful technique of meristem culture followed by molecular indexing for diseases are of immense use in making available healthy propagules in large numbers. Besides its several uses, micropropagation is also applied advantageously to national and international germplasm conservation and exchange, obviating quarantine-related problems.

5.2.3 Micropropagation in Banana: A Success Story

Traditionally, banana is being propagated using suckers but realizing the advantages of *in vitro* propagation, mass multiplication, through shoot tip culture has been gaining popularity. The advantages of TC plants include freedom from diseases, better establishment in field, uniformity in flowering and harvest; shorter crop and harvesting duration and higher returns with increased yields. Banana is mainly grown by small farmers. To improve productivity per unit area, banana needs major thrust in terms of use of healthy planting material, improved production technology and post harvest management. At present about 45% area in banana is under TC plants. These plants also go well with the other hi-tech interventions like micro-irrigation and fertigation. Such a practice is fast spreading in states like Maharashtra, Karnataka, Andhra Pradesh and Madhya Pradesh etc.

5.2.4 Problems of Commercial Micropropagation in India

Constraints in commercialization of tissue culture plants and different hurdles met during commercial multiplication and hardening of tissue culture plants is as listed below;

- Non-availability of proven and reproducible protocols in many desired crops.
- High production costs and sale price of TCP
- Seasonal nature and heavy peak demand.
- Inadequate quality control of the plants.
- Low acceptability of plants and their growing technology at grass root level.
- Inadequate availability and unorganized market.
- High air-freight in domestic and international trade.
- Proper demonstration and technology validation for exploitation on commercial scale.
- Evaluation of plantlets at field level.
- Ensuring genetic fidelity and freedom from viruses in TCP.

The production cost of tissue culture plant is 5-10 times more except in few crops as compared to conventional planting material like cuttings, budded and grafted plants. A higher costing *in-vitro* raised plantlet would be acceptable if the yield is much higher e.g. banana, cardamom, etc. Product quality of tissue culture is of great importance because of its production of true-to-the-type planting material, which is disease-free, and of high quality. Other important factor is the genetic fidelity. The new bio-technology tools like DNA fingerprinting and molecular markers such as RAPD, RFLP, AFLP, etc. are promising in ascertaining the genetic fidelity of the *in-vitro* developed plants.

5.2.5 Current Market and Future Demand

The demand for TCPs is likely to increase with the promotion of Hi-tech horticulture in the country. The present and the future demand for TCP is summarized hereunder

i). During 2003-2004 the anticipated production was 72 million plants (Banana 30%, Ornamentals 28%, sugarcane 21%, Spices 6%, Medicinal plants 3%, Potatoes 0.008%). However the actual production was 44 million plants.

ii). During 2007-2008 the anticipated production would be 112 million plants. The Horticultural crops for which demand is expected to grow are citrus, pineapple and grape, medicinal and aromatic crops, cut-flowers, etc.

iii). During 2011-2012 the anticipated demand for TCP's would be 219.67 million plants against the installed capacity of 144 million plants.

Table 5.2 Market demand for tissue culture raised horticultural plants

(No. in lakhs; Rs. Lakhs)

Crop group	Crop	2002-2003 (X Plan)		2007-08 (start of XI Plan)		2011-2012 (end of XI Plan)	
Fruits							
		Nos.	Rs.	Nos.	Rs.	Nos.	Rs.
	Banana	180.00	1,620	640.60	5,765	1,200.00	7,946
	Pineapple	2.50	425	67.61	1,014	120.00	2,228
	Grape	0.05	2	11.37	284	40.85	920
							11,094

Vegetables and tuber crops							
	Potato	0.50	2.5	0.83	3.8	1.130	8.9
	Asparagus	-	-	0.01	0.125	0.002	0.21
	Leek	-	-	0.01	0.22	0.0150	0.45
							9.56
Ornamentals							
	Gerbera, carnation, anthurium, orchids, rose	59.95	899	211.72	3,176	484.50	6,925
Spices							
	Large ardamom	10.00	70	20.00	140	45.00	316
	Small cardamom	1.50	10	6.00	54	18.00	1,565
	Turmeric	5.20	36	9.29	65	15.67	1,103
	Ginger	3.00	22	5.86	41	9.84	69
							3,053
Medicinal and aromatic plants							
	Vanilla	5.30	37	11.23	79	17.65	124
	Others	15.50	78	122.75	614	244,12	1,719
		26.27*		11,072		219.67	21,082

* Actual realized.

5.2.6 Requirements During XI Plan

Most of protocols developed are for herbaceous crop species and few for woody species. Hence, it is now felt that micropropagation protocols be refined for different crops like citrus, grape and apple rootstocks, pomegranate, guava, sapota etc. where there is huge requirement of planting material. Commercial micro-prorogation of chip-making potato cultivars, all important ornamental crops and Medicinal and Aromatic Crops continue with strengthening of the existing facilities under public and private sectors.

Table 5.3 Micropropagation initiatives to be undertaken during XI Plan period

Sl. No.	Group	Name of the crop(s)
1.	Fruits and plantation crops	Crops: Banana, papaya, grape, pineapple, strawberry, sapota, apple, citrus, cherry, walnut, almond, pecan nut, fig, cashew, mangosteen, coconut, oil palm, mandarin orange (Nagpur, Kinnow, Khasi), superior clones of tea Rootstocks: Apple, peach, cherry, citrus, grape etc.
2.	Vegetables and tuber crops	Potato, asparagus, leek, CMS lines for F_1 hybrid seed production.
3.	Ornamental crops	Carnation, gerbera, orchids, chrysanthemum, anthurium, lily, syngonium
4.	Spices	Turmeric, ginger, vanilla, large cardamom, small cardamom, black pepper, tree spices
5.	Medicinal and aromatic plants	Aloe vera, Gloriosa superba,, geranium, Aswagandha, Solanum khasianum, Phylanthus niruri, Dioscorea, Safed Musli, Stevia, pathouli, neem, Digitalis, Taxus, Senna, Dioscorea.

The state wise prioritization of crops for taking up micropropagation in the identified Agri Export Zones is summarized in Table 5.3. The identified AEZ's would be taking up large scale cultivation of specific crops identified for the zone. Therefore it is important to establish micropropagation units that specialize in identified crops for overall development of the AEZ's.

Table 5.4 Priority horticultural crops for commercial micropropagation in states regions and their Agri-Export Zones (AEZs)

Sl. No.	States	Priority crop(s)	Additional crops suggested
1.	West Bengal	Pineapple, potato,	Flower and foliage crops, ginger
2.	Orissa	Turmeric, ginger	Banana, MAPs
3.	Sikkim	Orchids, ginger, turmeric	Large cardamom, Temperate fruits
4.	Assam	Ginger	Banana, citrus, tea, pineapple
5.	Andhra Pradesh	Grape	Citrus, oil palm, sapota, grape
6.	Kerala	Banana	Black pepper, cardamom, ginger, vanilla, orchids, tea, coffee,
7.	Tamil Nadu	Rose	Banana, sapota, carnation, turmeric
8.	Karnataka	All flower crops	Banana, MAPs, sapota
9.	Punjab	Potato	Citrus, banana, carnation, gerbera
10.	Uttar Pradesh	Potato	Strawberry, grape, MAPs
11.	Uttranchal	Flowers and MAPs	Tea, strawberry,
12.	Maharashtra	Grape	Citrus, banana, gerbera, carnation,
13.	Jharkahand	None at present	MAPs, ginger, banana
14.	Chhattisgarh	None at present	MAPs, banana, ginger, turmeric
15	Bihar	None at present	Banana, MAPs
16.	Himachal Pradesh	Strawberry, temperate fruits	Rootstocks of temperate fruits, potato, asparagus, carnation, gerbera, MAPs

5.2.7 State Governments' Initiatives

Realizing the need for expanding area under banana using healthy planting material, the Dept. of Horticulture, Govt. of A.P., has established the Bio-Technology Centre that houses Tissue Culture Lab besides a Leaf Analysis Laboratory at Hyderabad during 2001 at a total cost of Rs. 2.8 crores with the following objectives.

(i) To achieve self-sufficiency and self-reliability in planting material,

(ii) To bring awareness of modern day technology within the reach of farmers,

(iii) To supply quality true-to-the-type disease-free plant material to the farmers to mitigate the huge demand,

(iv) To increase the elite plant material production of banana and sugarcane,

(v) To supply quality plant material at a reasonable cost,

(vi) To bring about overall increase in the productivity of banana crop.

With several major advances in biotechnology having taken place in the last few years, it is natural that state governments wish to take advantage of the ongoing biotechnology revolution and benefit from the same. States of Karnataka, Andhra Pradesh, Maharashtra, Uttar Pradesh, Madhya Pradesh, Gujarat, Himachal Pradesh, Kerala and Orissa have shown keen interest in the concept of developing Biotechnology Parks. Karnataka and Himachal Pradesh have set up separate Departments of Biotechnology at the state level. Others have set up Biotechnology Boards/Task Forces, respectively to make detailed plans. Tamil Nadu, Karnataka, Kerala and Andhra Pradesh have already announced their biotechnology

policies. State governments are also setting up biotechnology development funds on their own and earmarking significant amounts to invest in the companies located within their respective boundaries. The activities in the bio-tech park will include exploitation of technologies available from various research institutes and production of plants raised through plant tissue culture, hybrid seed production, bio-drugs, antibiotics, vaccines, organic acids and industrial enzymes.

5.2.8 Micropropagation In Private Sector

In 1984-1985, the A.V. Thomas group (AVT) initiated commercial production of cardamom through tissue culture. On an average, tissue culture-derived plantlets show an increase of 63% in yield, the mean estimated yield being 360 kg/ha. AVT has also applied tissue culture for propagation tea, for it owns 2,000 ha of tea plantations; the company has been successful in increasing tea yield to 2,520 kg/ha, compared with the average South Indian tea yield of 2,060 kg/ha. Unicorn Biotek is a recent example of a tissue culture-based company moving modern biotechnologies from laboratory to marketplace. In addition to a project on the large scale production of virus-free banana plantlets, supported by the Department of Biotechnology, Unicorn Biotek, produced and exported 120,000 *Spatiphyllum* (a foliage ornamental) and 2,000 rose plantlets over 12 months at competitive prices in the world market. In addition to selling to clients in Belgium, The Netherlands, Denmark and USA, the company is also present on the local market: farmers in Andhra Pradesh, Karnataka, and Maharashtra bought 20,000 disease-free strawberry plantlets. More than 40 tissue-culture companies started producing commercially viable products to the market place; and face competition from major Southeast Asian companies. The other companies in the TCP business are the Indo-American Hybrid Seeds, Bangalore; Jain Irrigation, Jalna etc.

5.2.9 Promoting Commercialization

The different initiatives taken by the DBT and other departments in promotion of TC units are as follows;

- Scaling up of indigenous R&D efforts on target crops.
- Production of quality planting material in bulk to meet the domestic demand.
- Certification of tissue culture raised plants for viruses and clonal fidelity.
- Guidelines for assessment of TC Laboratories.
- Guidelines for production of quality planting material.

5.3 OTHER BIOTECHNOLOGY INITIATIVES

Several other initiatives in biotechnology have been taken by the Department of Biotechnology, the apex public body which deals with all biotechnology related programmes in the country, Till date more than 2,500 R&D projects have been launched in 20 identified areas of which tissue culture, genetic transformation, molecular diagnostics, genetic conservation etc. are some of the important components. Recently, National Bio-resource Development Board was set up for bio-prospecting and bio-resource utilization. It has established different gene banks for conservation and inventorisation of bio-resources. It has also signed as partner in the International Consortium on Tomato Genome Sequencing (chromosome 5 of tomato) programmes. Functional genomics of tomato – nutritional quality, shelf life, and disease resistance is also under progress.

DBT also has a strong programme on agricultural biotechnology with the focus on: Improving production and productivity; inducing drought and salinity tolerance; Inherent tolerance to pests and diseases; Enhancement in nutritional qualities in crops like potato and banana. Different strategies employed include transgenics and Marker based molecular breeding: cloning and Characterization of New Genes and Promoters, crop improvement for better nutrition in sweet potato, potato and cassava using AmA1 gene in crops like potato, coffee,

tomato, brinjal, cauliflower, pea, papaya, cabbage, banana, muskmelon, bell-pepper, chilli, watermelon etc.

5.3.1 Transgenes Being Employed for Genetic Transformation

The different foreign/novel transgenes in experimentation are namely *Bt*, herbicide tolerance (CP4 EPSPS, Bar gene), Xa21, ctx-B and tcp of *V. cholera*, fungal tolerance (Chitinase, Glucanase), salinity tolerance and shelf-life enhancement (ACC synthase, Osmotin RIP, Ama-1, OXDC gene, Rabies glycoprotein gene, Fertlity related gene for cms development (Bar, Barnase, Barstar), bacterial tolerance (Protease Inhibitor, Lectin, GNA gene, *Vip*-3 gene, etc. The success achieved so far under the DBT supported projects are as follows;

- 57 *in vitro* regeneration systems documented.
- Commercial scale protocols standardized for 20 plant species.
- Ten TC technologies transferred to industry (Eucalyptus, bamboo, teak, sugarcane, potato, black pepper, coffee, citrus).

  The priority crops and the targeted traits include;
- Tomato, Grape and Banana - Enhanced shelf-life
- Chilli, Pepper, Ginger and Cardamom – Disease resistance
- MAPs: micropropagation and scale up of plantlet production

  The Department of Biotechnology has also taken some major initiatives on some of the above aspects. These are:

5.3.2 Micropropagation Technology Park (MPTs)

These parks have been established to serve as an interface between educational/research institutions and industrial units. In other words, research work undertaken at various institutions would be translated into technologies, which could be applied at the field level. The proven technologies can then be passed on to entrepreneurs/industry for further commercialization. The scope of the production facility was widened and diversified to cover horticultural species, including fruit, ornamental, medicinal, and forestry species. Keeping in view the above, the Department of Biotechnology (DBT), Government of India set up two Tissue Culture Pilot Plants (TCPP) for mass propagation of forest tree species in 1989. In December 1997, these TCPPs were upgraded into a Micropropagation Technology Park (MTP). MTP at TERI, Gual Pahari, Haryana produces large-scale elite planting material of various forest species and horticultural species. These parks have state-of-the-art infrastructural facilities with in annual production capacity to 2 million plants for supply to different state departments, non-governmental organizations, agro-based companies and private growers. These parks also develop protocols for the micropropagation of a variety of species and also refine the procedures for economizing the mass production and conducting multi-location field trials. Clonal homogeneity or the clonal fidelity has been confirmed using RFLP/ RAPD techniques and clonal gardens have been established at NCL, Pune.

5.3.3 Establishing High-Volume Hardening Units for TCP's

There are six Regional Hardening Units functioning to provide quality-planting material according to the regional needs. Here micropropagation protocols have been perfected for the plantation crops, MAPs and arid zone species. A number of user agencies have been identified for field plantation and demonstration.

The West Bengal Council of Science and Technology, Kolkata has successfully completed the first phase of support and two lakh plantlets of important horticultural and medicinal plants were produced for user agencies. The Unit has also been successful in creating awareness amongst industries/state departments and a number of training programmes etc., have been conducted. The WBCOST is now maintaining the unit; support for second phase

has been provided for plantlet production and documentation at the rural level. At TERI North-East Facility in Guwahati, large-scale production of important horticultural crops is being done. Need-based research and protocol refinement is also being carried out. Another regional Hardening Unit has been set up at the Regional Research Laboratory, Jammu for large-scale production of medicinal and aromatic plants and horticultural crops. At Regional Plant Resource Centre, Bhubaneswar, a unit for micropropagation and scaling-up, hardening facilities was set up for bamboo, MAPs and some floricultural species. A Hardening Unit was set up at the G.B. Pant Institute of Himalayan Environment and Development, Almora for establishing and providing planting material of endangered species. At the Haryana Council for S&T, Hisar, the facility is fully operational and the state government has constructed TC laboratories and greenhouses. Large-scale production of sugarcane, eucalyptus and horticultural crops (floriculture crops) has been initiated. Plantlets have been provided to user agencies and state departments. A number of demonstration programmes have been conducted.

5.3.4 Freedom From Diseases In Micropropagated Plants

Micropropagation is being commercially exploited in a large number of crops in India including potato, banana, citrus and other commercial crops. All these crops are hosts of a number of fungal, bacterial, viral and virus-like pathogens, which get perpetuated through micropropagation. For example potato is a host for 25 different viruses or virus-like diseases. For India, only a few viruses like potato leaf roll virus, potato virus x, strains of potato virus Y and viroids are important. Similarly, banana is naturally infected by a large number of viruses but the most important viruses are banana bunchy top, banana bract mosaic, cucumber mosaic and banana streak. Citrus is also infested with a host of viruses but three viruses namely citrus Tristeza (CTV), Indian citrus ring spot virus (CRSV) and citrus yellow mosaic virus (CYMV) are important. In addition a fastidious greening bacterium and two viroids namely Citrus Exocortis and Citrus Hop Stunt are also transmissible in citrus. Some of the viruses and virus-like pathogens which are of concern in micropropagated plants are listed below.

These viruses and pathogens need containment in any commercial TC venture and hence DBT also initiated a programme accordingly: as later below

5.3.5 Establishment of National Facility for Virus Diagnosis and Quality Control of Tissue Culture Raised Plants, Indian Agricultural Research Institute, New Delhi

In India, several plant tissue culture laboratories and commercial facilities have been set up recently, and they have been growing a large number of tissue culture raised plants of commercial crops and forest trees. However, there are no facilities to establish their quality or to increase that the regenerants are virus free. The most deleterious variants in tissue culture raised plants are those that affect yields, quality and carry infection of viruses which are difficult to diagnose. To bridge the gap, the Department of Biotechnology, Government of India has established a multi-Institutional collaborative programme with the goal of ensuring production of virus-free plants of assured quality raised through tissue culture. The main centre is at IARI, New Delhi with five satellite centres at NCL, Pune; TERI, New Delhi; IHBT, Palampur; IIHR, Bangalore and SPIC, Chennai. The objectives of the facilities are;

i. To develop protocols for virus diagnosis and quality testing for clonal fidelity.

ii. To ensure that tissue culture-raised plants are virus-free and of an assured quality.

The above centres are concentrating on virus diagnosis in horticultural (both fruits and ornamentals) and plantation crops, and also spices. The major focus is on isolation and maintenance of authentic cultures of plant viruses, development of diagnostic kits and standardization of diagnostic protocols for virus detection. Tissue culture-raised plants are tested for clonal fidelity using standard molecular marker techniques for DNA fingerprinting

such as RAPD, RFLP, AFLP, SSR etc. These centres work on developing diagnostic kits and standardizing quality testing parameters/markers for the identified plants. Based on the users needs, new crops have also been identified. The certification format has been evolved in consultation with the Ministry of Agriculture and the centres will be notified as testing centres as per existing plant quarantine procedure. Guidelines for assessment of quality are being formulated. Interaction with industry is also continuously being strengthened**.**

A National Certification System for Tissue Culture raised Plants (NCS-TCP) has recently been established through GOI Gazette Notification on 10.03.2006. It has identified DBT as certifying agency for clonal fidelity and freedom from viruses. Furthermore, an accreditation unit has been set up at Biotech Consortium India Ltd. for certification of TC labs in the country after verifying the norms formulated by the agencies, i.e. DBT and BCIL.

5.3.5.1 Techniques for virus diagnosis and elimination

(i). Meristem culture

Meristem tip culture is mainly used in tissue culture for elimination of viruses. However, it also enables isolation of plants free from other pathogens such as phytoplasma, bacteria and fungi. In some cases, virus-free plants are obtained by thermotherapy followed by meristem tip culture. Heat treatment may be conducted either by soaking dormant plant parts (tubers, cuttings, bud wood) in water of approximately 50^0C for a period ranging from several minutes to couple of hours, or by exposing growing plant parts to an air temperature of 35-40 ^{0}C for some weeks. Thermotherapy *in vivo* combined with meristem tip culture has been used for eradication of viruses in potato, yams, citrus and nectarine. Various steps involved in production of pathogen-free plantlets by meristem tip culture are: -

- Testing of parent material for the presence of viruses and similar pathogens (viroids and phytoplasmas).
- Thermotherapy/chemotherapy of parent material if disease-free material is not available.
- Excision of meristem tip under aseptic conditions.
- Culture of apical dome plus one or two leaf primordia on suitable medium to produce plantlets.
- Indexing of plantlets for presence or absence of viruses.
- Plantlets transferred to soil.
- Maintenance of pathogen free nuclear plant stocks.
- Meristem culture is then followed by *in vitro* mass propagation of the virus-free plants thus obtained.

(ii) Biological indexing and use of indicator plants

Biological indexing is the oldest method of examination for determining the presence of viral disease and is achieved by visual inspection of the plants followed by inoculation on to indicator plants, to be identified for each virus. However, biological assays are time, space and labour consuming and are rarely used for testing the micropropagated plants.

a. Electron microscopy: It is the most convenient approach to virus detection in plants. It has been possible to detect most of the viruses within a few minutes in crude plant sap and this can facilitate the selection of healthy planting material to some extent. EM tests should always be supported by other tests like immunosorbent electron microscopy (IEM) and immuno-gold labeling which increase the sensitivity of virus detection many folds. IEM is the most powerful tool for detecting specific virus even in mixed infections in decoration tests.

b. Serological tests: The serological techniques are indirect method of virus detection and are best suited for virus diagnosis in micropropagated plants. Techniques like enzyme-linked immunosorbent assay (ELISA) developed in late 1970's and variants of ELISA are used and these are direct antigen coating (DAC) ELISA, double antibody sandwich (DAS) ELISA and indirect Triple antibody sandwich (TAS) ELISA. DAS ELISA is also used for virus diagnosis. ELISA readers can be used for determining absorbance at 405 nm. Normally, the value of absorbance 3 times more than healthy control is taken as positive.

c. Dot Blot Immuno-binding Assay (DIBA): DIBA is another protein based serological detection method based on immuno-blotting of nitrocellulose membrane. This technique is particularly useful when facilities for serological assay are not available at the site of micropropagation of plants.

d. Immuno-fluorescence: It is used for diagnosis of the pathogens restricted in phloem tissues such as fastidious bacteria and phytoplasmas.

e. Molecular techniques: There are two basic approaches of diagnostics based on nucleic acids of viruses, nucleic acid hybridization and nucleic acid amplification. Nucleic acid amplification was initially demonstrated for DNA by polymerase chain reaction (PCR). PCR can not be applied directly for single stranded RNA viruses and therefore, the RNA is first reverse transcribed into c-DNA using a reverse transcriptase (RT) enzyme. The PCR can be combined to enhance the sensitivity of virus detection level and one such variant is immuno-capture PCR (IC)-PCR in which virus is trapped by antibodies coated on the wall of microfuge tube and then nucleic acid of virus is released for c-DNA synthesis and subsequent PCR. The use of nucleic acid (NA) hybridization is a useful and sensitive tool for virus and viroid diagnostics and has been used in crops like potato and citrus for testing of viruses in micropropagated plants. The introduction of multiplex PCR for simultaneous detection of more than one virus provides a strong tool for rapid detection of mixed infection of viruses.

f. Molecular and Immuno-Diagnostics for Disease Management in Horticulture Crops: Plant health management is the science and practice of understanding and overcoming the succession of biotic and abiotic factors that limit plants from achieving their full genetic potential as crops. Plant health management aims at achieving the genetic yield potential of crops by various approaches. The science of immunology has developed as a multipurpose technology with numerous applications in biological sciences in general Immunoassays have provided reliable and sensitive methods for assessment of levels of resistance of crop cultivars and also wild relatives, which often form the reservoirs of disease-resistance genes. The extent of expression of resistance genes can be evaluated and their products, primarily proteins and enzymes, can be detected and analyzed. The interaction between the products of resistance (*R*) genes of host plants and avirulence (*avr*) genes of microbial pathogens.

Immunoassays have been extensively applied for the detection and quantification of microbial plant pathogens and plant constituents both in healthy plants and also in plants exposed to abiotic and biotic stresses. The usefulness of immunological techniques for effective application of various approaches of plant health management, such as development of resistant cultivars through genetic manipulation, induction of resistance to diseases, and production of disease-free crops, has been vividly demonstrated. Furthermore, immuno-detection of contamination in fresh produce processed foods can be made with this technique. Production of disease-free seeds and plant-propagation materials such as tubers, setts, and corms has been possible because of the reliable and rapid indexing methods based on immunodiagnostic tests.

Many crop diseases are difficult to diagnose, especially at the earliest stages of infection by the pathogen. In particular, many diseases caused by viruses can exhibit similar symptoms and therefore it is difficult to identify the causative virus(es). Knowledge of the nature of the pathogen can be used to develop and apply proper management practices. The development of cheap diagnostic techniques could assist decision-making in relation to pest

and disease management. The development of diagnostic kits, such as enzyme linked immuno-sorbent assay (ELISA), and other molecular assays, can enable the precise identification of viruses, bacteria and other disease-causing agents, and are now an established tool in disease management in many farming systems. Diagnostic assays have also been developed to identify a wide range of other organisms, chemicals (such as undesirable by-products, e.g. afla-toxin), or impurities involved with food quality. DNA diagnostics are also a powerful technique for identification of pathogens and other organisms. Most DNA diagnostics are now based on the use of the polymerase chain reaction (PCR), a common research tool used in most molecular biology laboratories worldwide, which can be used to specifically amplify segments of DNA. The use of Monoclonal Antibody (MAb) technology has further improved diagnosis of viral diseases. MAb based, ELISA has also shown promise in the diagnosis of diseases caused by phytoplasma, bacteria and fungi. Above, all, direct electron microscopy and immuno-electron microscopy are very useful for the diagnosis of viral infection.

At present, the commercial use of ELISA is only in Eastern Europe, where it is used to detect plant viruses (e.g. PLRV, PVX, PVA, PVM, PVY) in crops such as potato, fruits and strawberries. There is hardly any work on developing kits in India except for BBTV in banana at IIHR, Bangalore. A major effort is presently going on at CPRI, Shimla on potato. ELISA kits for the detection of PVX, PVS, PVA, PVM, PVY and PLRV prepared and routinely used in breeder seed production. Immuno electron microscopy for optimal detection of PVX, PVS, PVA, PVM, PVY and PLRV worked out and routinely used for testing of imported stocks, meri-clones, etc. for virus freedom. RT-PCR detection of PVX, PVS, PVA, PVY, PLRV and Potato apical leaf curl virus (PALCV) worked out and used in the post entry quarantine clearance of imported material and of meri-clones for virus freedom. There are few initiatives under public funded labs but they are mostly basic in nature when it comes to development of molecular diagnostic tools. There is ample scope in citrus, potato, grape, cucurbits, cassava, beans, flowers crops, etc. Protocols for various immunological assays are to be developed for different diseases. At present many diseases in horticultural crops like BBTV of banana, Tristeza and other viruses of citrus, greening bacteria etc. need immediate attention of the scientists and planner, since it is directly associated with the plant material and biotic stresses causing crop losses.

The total expenditure made by the DBT during the last Plan period is listed below;

Table 5.5. The Plan expenditure under the DBT in crop biotechnology (Rs. in lakhs)

Scheme	VIII Plan 1992-1997	IX Plan 1997-2002	X Plan 2002 -2007	XI Plan 2007 -2012 proposed
Crop biotechnology	1,916	2,897	7,500	25,000*
Approximate share of Horticultural biotechnology	575	870	2,250	5,500*

* Tentative figures including research, HRD and other activities.

5.4 PROGRAMMES UNDER NATIONAL HORTICULTURE MISSION

The Department of Agriculture and Cooperation has decided not to fund establishment of new Tissue Culture (TC) units under NHM. However, programme exists for strengthening the already existing TC units by providing the financial assistance for rehabilitation/ strengthening. At present, the support is subject to a maximum ceiling of Rs. 8.00 lakhs for the public sector units and 50% of the cost with a ceiling of Rs. 4.00 lakhs in the private sector. Besides NHM, financial support is also provided by different governmental agencies like NHB, NABARD, NCDC, Nationalized banks etc. for setting up/strengthening of the TC units in different regions.

5.5 PROGRAMMES PROPOSED FOR XI PLAN

5.5.1 Establishing National Centers for production of Virus-free Citrus Plants

Most of the citrus growing regions are experiencing decline in the population due to different reasons. This is mainly attributed to the different viruses which are spreading through planting of infected planting material. Viruses like Tristeza, Posorosis and Xyloporosis, and Greening bacterium are causing decline in citrus and the need is felt to revive citrus plantations on sound footing with appropriate biotechnological interventions. Meristem culture and shoot tip grafting have been trend in different citrus varieties and have become an important regulation in different citrus growing countries. This has been adopted as a national policy to trade only in certified disease-free planting material and there exist strict quarantine regulations in movement of germplasm. In India, there has been not much awareness since the decline was evident in infected plantations only after 7- 8 years of planting. Viruses have caused enormous damage in almost all regions of the country. Though a sound research infrastructure exists on citrus virus research, it is imperative that some initiatives are taken during XI plan to make facilities for large scale production of healthy planting material in citrus.

The success achieved at the National Research Centre on Citrus, Nagpur in multiplication of disease-free citrus planting material is commendable and it proposed that the same be replicated at different established laboratories in different citrus growing belts following the common protocol. It is suggested that the desired scion varieties may be first made virus-free using meristem culture, tested for virus detection using different serological techniques followed by shoot tip grafting (STG) to raise healthy specific-virus-tested (SVT) clones. The mother plants regenerated so be then maintained in net-house containment and then multiplied on the desired rootstocks using micro-budding method. It is proposed that the following centres be established/ strengthened at the Central universities and SAU laboratories under public domain to supply healthy plant material of citrus in these reparative regions.

Table 5.6. National Centres for production of certified virus-free citrus plants

Region in India	Citrus scion group	Centres	Budget allocation (Rs. in crores)
North	Sweet orange(Hamlin and Blood Red) , mandarin Kinnow and grape fruit	IARI, New Delhi, and PAU-RS, Abohar	1.0 x 3 = 3.0
East	Mandarin, sweet orange and lemon	AAU, Jorhat ICAR Complex for NEH Region, Shillong	1.0 x 2 = 2.0
Central	Nagpur Mandarin and sweet orange (Mosambi)	National Research Centre on Citrus, Nagpur	1.0 x 1 = 1.0
South	Sweet orange Sathgudi and lime	IIHR, Bangalore/ CHES, Chettali, ANGRAU, Tirupati (AP)	1.0 x 2 = 2.0
Total			**9.00**

These centres will be established to replicate facilities like large net-houses for raising healthy rootstock seedlings. Establishment of containment facilities for maintenance of virus-free scion variety stock plants. Strengthening of the existing tissue culture laboratory and other production facilities.

5.5.2 Setting up of Hardening Structures for TC Plants

The major cost involved in the production of TCP is the expenditure involved in hardening. To make the TCPs available at affordable rate, the need is felt to establish large-scale hardening facilities in different horticultural crop growing clusters to meet the demand and also to minimize price of the plantlets through governmental intervention. It is proposed that six new large scale hardening structures be installed in different regions having demand for near 15-20 million plantlets per annum of different horticultural crops. These structures can be established in some University/Institute having facility for time culture. These centres will exclusively establish big hardening facilities and would work on behalf of the State Horticulture/agriculture department for procuring proliferated/ semi-hardened plantlets and then hardening them and making them available to the farmers at reasonable cost during the planting season. These centres would also monitor the peak demand for each horticultural crop/variety and arrange for the timely supply of the same to the farmers, growers cooperatives, NGOs after getting about fifty per cent advance money at least three months before actual supply of the consignments. These centres would also cater to the need of the entire region/ adjacent states. These centres should also make necessary arrangement for ensuring quality of TC plants by produced/hardened by them from the accredited laboratories.

Table 5.7 7. National Hardening Centres for production of TC plants

Region in India	Centres	Budget allocation (Rs. in crores)
North	IARI, New Delhi, PAU, Ludhiana	0.5 x 2 = 1.0
East	ICAR Complex for NEH Region, Shillong	0.5 x 1 = 0.5
West	MPKVV, Rahuri	0.5 x 1 = 0.5
South	IIHR, Bangalore NRC on Banana, Trichi	0.5 x 2 = 1.0
	Total	**3.0**

5.5.3 Setting up of National Centre for Plant Disease Diagnosis at IIHR, Bangalore

A new Centre is proposed to be established, i.e. IIHR, Bangalore to conduct research on disease management in different Horticultural crops and development of pathogen detection and their diagnostic kits. This centre will serve as a National Facility for the entire country to have provision for sharing facilities on hire for any study related to diagnostics and kit development for specific pathogens or group of plant pathogens causing concern in horticulture. It will be developed with all state-of-the-art facilities**.**

5.5.4 Upgradation of Facility for Horticultural Biotechnology and Ancillary Facilities at SAUs and CUs.

Under this programme the existing commercial TC labs actively involves in production and supply of T-C plants of horticulture crops will be upgraded. This will include the enhancement of facilities, contractual help, consumables and other contingencies, renovation of lab and purchase of equipment. This facility will augment the R & D backup on the priority horticultural crops, i.e. on protocol development, refinement, hardening strategies, facility for assuring clonal fidelity of TCPs etc. The one time catch-up grant will made available to 50 of and centre which would be required to be spent in the next five years. These centres would mainly use the funds in facilities up-gradation, replacement and purchase of equipment, employing contractual man power for making the TC activities of the

commercial scale. These centres will cover ICAR institutes dealing with horticulture crops (Only one each), SAUs, Central and Deemed to be universities. The budgets allocation for this facility would be 50 crores.

5.5.5 Strengthening of centres accredited by DBT under National Facility for Virus Diagnosis and Quality Control of Tissue Culture Raised Plants

Besides the centres accredited by DBT under National Facility for Virus Diagnosis and Quality Control of Tissue Culture Raised Plants will also receive the financial support under DBT ongoing programme. These centres will receive 2.0 crores each for strengthening their facility and also generate resources on it own after the notification of DBT for quality certification on any export consignment pertaining to any TCP trade.

5.5.6 Biotechnological Interventions In Horticulture During XI Plan

Following activities are proposed to be undertaken in different target horticultural crops;

5.5.6.1 Micropropagation of Elite Genotypes and Rootstocks

All horticultural crops which are under commercial micropropagation and those for which there is dearth of planting material need to be taken up to develop improved protocols to meet the demand under area expansion.

Fruits: Pineapple, papaya, guava, cashew, litchi, date palm, oil palm, Kiwifruit, passion fruit, Kokum, pomegranate, walnut, pecan nut, **Rootstocks**: Apple, citrus, grape and mango (polyembryonic);

Vegetables and spices: Asparagus, leek, pepper, clove, cardamom, nutmeg, saffron and tree spices;

Flowers: Cut rose and Damask rose, varieties carnation, gerbera, anthurium, orchids, Asiatic lily, etc.

Plantation crops: Coconut, tea and coffee.

MAPs: All plant species identified by ICAR/ CSIR for commercial exploitation.

5.5.6.2 Molecular Characterization

Crops of indigenous origin and where large number of collections is available be given priority for genetic characterization.

Fruits: Mango, banana, citrus, guava, *aonla*, *jamun*, *ber, mahua*, walnut, *chilgoja*, apple and pear rootstocks.

Vegetables: Brinjal, beans, native cucurbits.

Ornamentals: Roses, gladiolus, chrysanthemum, orchids.

Spices: Black pepper, cardamoms (small and large), turmeric, ginger, tree spices.

Plantation crops: Coconut, cashew nut, tea and coffee;

MAPs: All Indigenous medicinal plants.

5.5.6.3 Marker Technology

Markers for differentiation of nucellar and zygotic seedlings in citrus and mango and sex specific markers in papaya, nutmeg and Kokum.

5.5.6.4 Marker Assisted Breeding

Identification of markers and application in assisting breeding for specific trait with precision. The different characters identified are

i. Mango – malformation & spongy tissue,

ii. Guava – wilt banana – sigatoka, wilt,

iii. Pomegranate – Aril browning and bacterial nodal blight and

iv. Tomato – *Rhizoctonia* and *Fusarium* wilt,

v. Cabbage & cauliflower – *Sclerotium*, powdery mildew, quality cucumber,

vi. Potato - Quality & biotic resistance,

vii. Onion - blight,

viii. Cassava and pea – disease resistance,

ix. Mushrooms – For heterosis. In these crops Molecular breeding based on marker assisted selection for both qualitatively and quantitatively inherited traits especially for yield and abiotic stress tolerance, search for novel alleles, etc.

5.5.6.5 Ovule and Embryo Rescue for Distant Hybridization

Introgression of desirable genes from wild relatives and for assisting crop improvement programmes. Some of the crop, which can be exploited by this technology, are mango, grape, banana, papaya and citrus.

5.5.6.6 Development of Cyto-plasmic Male Sterility System

To make use of leads in synthesizing genotypes for F_1 hybrid varieties in different seed propagated vegetables (Cauliflowers, broccoli, cabbage and tomato, and flower crops.

5. 5.6.7 Development of GMOs

Genetic engineering for: enhanced shelf-life in fruits, vegetables and flowers, improvement of nutritional quality including efficient bio-fertilizers and tolerance resistance to biotic and abiotic stresses. Some of the priority crops are;

Fruit crops: Banana – virus resistance, shelf life; Papaya – virus; Grapes – fungal resistance; Watermelon – virus; Citrus – virus tolerance;

Vegetables: Brinjal – insect resistance; Cabbage and cauliflower – insect and fungal resistance; Onion – fungal resistance; Okra – virus and insect resistance; Potato – virus and late blight; Cassava – virus and starch quality; Chilli – insect and virus resistance; Tomato – virus, slow ripening; Sweet potato – insect resistance; Mushroom (*Agaricus*)– shelf-life;

Flower crops: Chrysanthemum – virus, insect resistance; Carnation - fungal resistance and shelf-life; Rose- fungal resistance; Gladiolus- virus.

5. 5.6.8 Molecular Diagnostics and Disease Management

Development of molecular, primarily DNA based diagnostics of plant pathogens and developing pathogen-free planting material in horticultural crops like citrus, banana, potato, black pepper, cardamom, vanilla, etc.

5. 5.6.9 Structural and Functional Genomics

This programme need to be initiated in two priority crops namely Potato and banana.

5.6 FINANCIAL OUTLAY FOR HORTICULTURAL BIOTECHNOLOGICAL R&D DURING XI PLAN

Financial outlay for different programmes and initiatives under Biotechnology in Horticulture in XI Plan period (2007-2012) envisages a total of Rs. 560 crores.

Table 5.8 Financial projections during XI Plan

Sl. No.	Particulars	No. of units	Fund allocation (Rs. in crores)
1.	National Centres for production of certified virus-free citrus plants	6	9.0
2.	National Hardening Centres for production of TC plants	6	3.0
3	Up-scaling of micropropagation activities in target horticultural crops.	50	150.0
4.	Programmes in Molecular diagnostics		
	a. Production units	10	10.0
	b. National Centre for Plant Disease Diagnosis	1	200.0
5.	Funds for up gradation of facility for Horticultural Biotechnology and ancillary facilities.	50	200.0
		Sub-total	**560.0**

CHAPTER VI
HIGH-TECH INTERVENTIONS

6.1 INTRODUCTION

After attaining independence in 1947, major emphasis by the policy planners was on achieving self-sufficiency in food production. This gradually led to the development of high yielding wheat varieties, intensive production technologies, wide network of canal irrigation projects, paved the way towards higher food production ushering in Green revolution in the sixties. Thereafter about two decades later after achieving food sufficiency the shift was on agricultural diversification to different farm activities including horticulture. It, however, gradually became clear that horticultural crops for which the Indian topography and agro-climates are well suited is an ideal method of achieving sustainability of small holdings, increasing employment, improving environment, providing an enormous export potential and above all achieving nutritional security. As a result, due emphasis on diversification to horticultural crops was given only during the last one and half decade. Diversification to horticulture is the best option as these crops not only meet the above requirements but also have several other advantages. Furthermore, horticulture has the potential for improvement of wastelands and arid and semi-arid areas through planned strategies. Most of the horticultural crops need comparatively less water than several other field crops and provide higher employment opportunities, better nutritional security as well as healthy environment.

The country has recorded significant growth rate in horticultural output among various agricultural products in the last five years. Moreover, globally India is the second largest country in the production of fruit and vegetables next to China. The share of fruit and vegetable production accounts to 7 to 11 per cent respectively in the world output. In spite of all these milestones, there is still lot to be achieved on the productivity front and export share where we are lagging behind in several commodities compared to the global productivity averages. To make horticulture enterprise more productive, efficient, remunerative and sustainable it is imperative that Hi-tech and Biotech interventions are to be emphasized in the XI Plan to make a dent in the overall global horticultural scenario. These interventions are also important in giving impetus to export, processing and value addition activities, mechanization activities.

It refers to “the precise production techniques for efficient use of inputs at appropriate time and quantity for maximization of yield and quality in different horticultural crops”. The term maximization refers to the genetic potential equivalent to highest productivity achieved in other advanced countries. The era of global competitiveness necessitates the use of the above technologies that brings about efficiency in production and improvement in the quality of the produce. Protected cultivation, precision farming, micro irrigation and fertigation etc. gradually being adopted in different parts of the country by progressive farmers and as a result different production clusters have emerged. Inputs are also equally important and are related with the adoption of IPNM, use of bio-fertilizers, IPM, mulching, organic farming, use of bio-pesticides etc. Micropropagation, adoption of GMOs and molecular markers have emerged as powerful tools for accelerating the propagation, process of variety development and improvement in quality of horticultural crops.

The different components of Hi-tech Horticulture are as follows;

- High density plantation (HDP)
- Use of Plastics
- Bio-fertilizers and Integrated Nutrient Management (INM) strategies
- Use of Integrated Pest and Disease management

- Mechanization
- Micro-propagation
- Molecular diagnostics
- Molecular breeding

In the following paragraphs, the status and programmes on different aspects for Hitech intervention in horticultural interventions are dealt;

6.2 HIGH DENSITY PLANTING

High density planting (HDP) is one of the important methods to achieve high productivity per unit area both in short duration and perennial horticultural crops. High density planting in fruit growing was first established in apple in Europe in the early sixties. Presently, the continued decline in the availability of cultivable land, rising energy and land costs together with the mounting demand for horticultural produce, have given thrust to adoption of HDP in horticultural crops. Furthermore, it is of main concern to the growers with small land holdings. High density planting is more efficient since it is precocious, easily manageable, has higher yield potential with better quality fruits and higher returns/unit area. Being an intensive system, it requires more capital to establish and is more productive and profitable, if followed scientifically. High density planting is referred as Semi-intensive system accommodating 500-1,000 trees/ha, Intensive system accommodating 1,000 to 10,000 trees/ha employing specialized training systems and Super-intensive system with 20,000 to 1,00,000 per ha.

Five important components of High Density Planting are (a). Dwarf scion varieties; (b). Dwarfing rootstocks and inter-stocks; (c). Training and pruning, (d). Use of chemicals and (e). Suitable crop management practices. These components are harnessed in HDP which helps in attaining the goals.

High density planting is important for horticultural crops as it permits efficient use of land and resources higher yield and net economic returns per unit area, easy canopy management and is suited for mechanized field operations, efficient weed control, improvement in fruit quality; and easy and efficient harvest.

At present majority of temperate fruit orchards in Europe, America, Australia, New Zealand, Israel and Japan are under intensive systems of fruit production. There are several fruit crops where success on their HDP has been achieved, e.g. apple, peach, plum, sweet cherry, pear among temperate fruits and banana, pineapple, papaya among tropical fruits. In India, HDP technology has been successfully tried in banana, pineapple, papaya and recently in mango guava and citrus.

6.2.1 Present Scenario in HDP in Different Fruit Crops

i) Apple

There are four categories of high density planting based on plant densities used in apple, i.e. low (less than 250 plants/ha), moderate (250 to 500 plants/ha), high (500 to 1,250 plants/ha) and ultra-high (more than 1250 plants/ha) density. Apart from these, super high-density plantings or meadow orcharding (20,000 to 70,000 plants/ha) have been demonstrated in some European countries. The optimum density ranges from over 3,000 trees/ha in the Netherlands to less than 2,000 trees/ ha in USA under single and double row system of planting. Use of pruning, rootstocks and spur type scion varieties is done to establish HDP. Other techniques like training and pruning methods are bending of branches and use of growth retardant.

The most common dwarfing/semi-dwarfing rootstocks for HDP are M9, M26, M4, M7 and MM106, whereas M27 has been used for raising meadow orchards. In Himachal Pradesh, MM106 and MM109 for spur types and M7 and MM111 for non-spur cultivars are being

popularized under Himachal conditions. Of late, MM 106 has been recommended for establishing HDP in Jammu and Kashmir At present, non-availability of clonal rootstocks is the major problem in area expansion. For this purpose, stooling and micropropagation techniques are required to be adopted on a large scale to meet such demand.

The spur-type varieties are genetically dwarf. Some of the promising spur varieties which need popularization are Starkrimson, Red Spur, Gold Spur, Well Spur, Oregon Spur, Silver Spur, Red Chief and Hardispur. Besides, many other varieties such as Bright 'N' Early, Royal Gala and Red Fuji are promising columnar varieties suited for HDP.

Training systems, such as spindle bush, dwarf pyramid, espalier, cordon, palmette and Noored Holland Spindle bush are recommended for intensive orchards. On dwarfing rootstocks, plantings are trained on spindle bush, dwarf pyramid and cordon in Himachal Pradesh.

ii) Peach

Peach bears fruits on one-year-old shoots, which require regular annual pruning to make them suitable for high-density orcharding. High density in peach has been tried with planting varying from 930 to 2,050 trees per hectare yielding 13 to 34 t/ha following different training systems viz. Hedge row, Y shape trellis, spindle, modified free spindle and modified leader. A plant population of 2,000 trees/ha trained on Tatura trellis system gave fruit yield of 31.5 t/ha.

iii) Pear

In pear systems hedge row system gives a plant density of 888 plants/ha and causes significant increment in yields in Bagugosha pear.

iv) Mango

Mango yields worldwide are generally poor, ranging from 4 to 9 t/ha in the major mango producing countries. This is partly attributable to wide tree spacing, which are traditionally based on expected eventual tree size. Canopies of these mango trees often take more than 10 years to fill the allocated space in the orchard row. Little consideration is generally given to canopy size maintenance once the overcrowding eventually occurs. Yields for more closely spaced trees of well-managed orchards in Florida and Puerto Rico, where annual or biennial hedging is employed to maintain canopy size, generally exceed 20t/ha. Most of the commercial varieties of the mango are irregular bearer and generally planted at a distance of 10 to 15 m, accommodating about 70 to 100 plants/ha, while Amrapali variety has been recommended by IARI to be grown at 2.5 x 2.5 m (triangular method) and accommodating 1,600 plants/ha as against 80-100 plants/ha under traditional planting density yielded up to 22 t/ha. The high-density orchard provides several times (8-9) higher yields than the traditional densities. Dashehari mango at 2.5m x 3m (1,333 plants/ha) can also be raised under HDP with pruning and dehorning after the harvesting after 10^{th} year of planting. In countries like Israel, productivity of mango has been doubled by adopting HDP technology (3 x 5 m or 3 x 6 m) using pruning machines mounted on tractor. In Maharashtra, HDP has been achieved with application of paclobutrazol.

Successful HDP (666 plants/ha) plantations of different commercial varieties namely Kesar, Alphonso, Tommy Atkins, Maya, etc. has been demonstrated by the Reliance Agro Ltd. at Jamnagar (Gujarat) under arid agro-climate. A solid plantation of over 80,000 plants has been established using different Hi-tech interventions like fertigation, use of growth regulator (Paclobutrazol), uniform clonal (Polyembryonic rootstock), modern packaging unit, etc. It is exclusively an export-oriented plantation and is likely to revolutionize mango production and productivity in India. This model is proposed to be replicated in different mango belts for hi-tech cultivation of fruit crops.

v) Sapota

Sapota is normally planted at a wide spacing of 8 x 8 m. Results have shown that high plant density of 312 plants per ha (8m x 4m) is possible yielding 15.35 t/ha after 15 year of planting in PKM-1.

vi) Banana

Due to availability of dwarf clones in banana HDP is gaining popularity. There can be good area expansion under banana based on factors like cultivar, soil fertility, climatic conditions, moisture level, planting system, planting material, management level and economic considerations. For the highest possible yields of good quality fruit, an optimum plant density (2.1 m x 2.1 m of 2,267 plants/ha) for poor soils and 1.5 to 2.1 m for Dwarf Cavendish, 2.4 m x 2.4 m for Chakkarakeli and 2.4 to 3.0 m for Bontha (Monthan) has been tried Results revealed that the Dwarf Cavendish and Robusta are fit to be planted under high density planting concept at a planting distance of 1.2m X 1.2m (6,944 plants/ha) in a square system of the planting under a proper nutrient management practice. There is minimum weed growth, effective utilization of the solar radiation and appropriate utilization of the inputs, which are the other major factors, attributed to the success of such planting systems. Yield realization varies from 86 t/ ha in Basarai at 1.5 x 1.5 m to 174 t/ha in Robusta planted at 1.2 m x 1.2 m spacing.

vii) Papaya

With the development of dwarf varieties like Pusa Dwarf, Pusa Nanha and Ranchi Dwarf, it is now possible to grow papaya under the HDP concept. Normally, papaya varieties are planted at a distance of 2.5 m X 3 m or 2.5m X 2.5 m, which accommodates 1,333 to 1,600 plants/ha, while Pusa Nanha may be planted at a distance of 1.25 x 1.25m (6,400 plants/ha). Such orchards may give 3 to 4 times higher yields (60 to 65 tonnes/ha) in comparison to the yield of the traditional orchards (15 to 20 t/ha). Other cultivars like CO-1, CO-2, Pusa Dwarf and Honey Dew-1 are also suitable for high density planting.

viii) Pineapple

Pineapple is grown traditionally at low density (15,000 to 20,000 plants/ha) leading to low productivity and an increased production cost. Kew, Queen and Smooth Cayenne cultivars are found highly suitable for HDP using Double row method of the planting suckers (500 to 600 g) or (slips 350-400gm) spaced at 25 to 30 cm in the rows at a distance of 45 to 60 cm with a spacing of 90 to 105 cm between the beds (63,000 plants/ha). There is ample scope for expanding area under HDP for the benefit of the fruit growers, so that more and more area could be brought under pineapple cultivation. Yield realization varies from 60-70 tonnes /ha with use of high density in Kew pineapple.

xi) Cashew

It is normally planted at 7.5m x 7.5m or 8m x 8 m (100-177 plants/ha). In case of high density planting, 312 - 625 or higher grafts/ha are planted at a closer spacing of 4 m x 4 m or 6m x 6m or 5m x 5m in the initial stage followed by thinning out in the later years thereby maintaining a spacing of 8m x 8m in the 11^{th} year. It gives rise to four-fold increase in yield up to 6 years and about 2.5 fold increases up to 12 years.

x) Guava

By grafting, on dwarfing rootstock Pusa Srijan (Aneuploid No. 82) high density planting can be achieved in guava. A full bearing high-density guava orchard on Aneuploid No. 82 rootstock may yield 18 to 20t/ha compared to 8-10t/ha in low density planting. Planting distance varies from 5.4 to 7.5 m. The trials conducted under All-India Co-ordinated Fruit Improvement Projects at different centres, *viz.* Faizabad, Ranchi and Basti indicated that double-hedge-row system of planting with 800-900 plants/ha is beneficial for achieving high yield per unit area in Allahabad Safeda. At the Central Institute for Subtropical Horticulture,

Lucknow. Planting was tried at four densities e.g. 1.5 x 3.0 m (2,222 plants/ha), 3.0 x 3.0m (1,111 plants/ha), 3.0 x 6.0 m (555 plants/ha) and 6.0 x 6.0 m (277 plants/ha). Average yield of 73, 41, 26 and 13 from pruned trees in comparison to 57, 29, 22 and 10 kg/ plant under unpruned trees from above densities was obtained. Further, results however need to be worked.

xi) Citrus

High density planting has been aimed with the use of dwarfing viral agents, use of interstocks selected from citrus related genera and the use of dwarfing rootstocks. Trifoliate orange rootstock Flying Dragon is capable of reducing growth by 75 per cent as compared to standard rootstocks. Kinnow mandarin has been grown successfully under high density planting using Troyer citrange, *Karna Khatta* and *Sohsarkar* rootstocks at a planting distance of 6' x 6' (2,990 plants/ha), 8' X 8' (1,682 plants/ha) on *Karna Khatta* and 10' x 10' (1,076 plants/ha) on *Soh Sarkar* rootstocks respectively. Similarly, Cleopatra mandarin rootstock was ideal for Mosambi sweet orange. For Khasi mandarin, a spacing of 5m x 5m (400 plants/ha) was found ideal.

xii) *Aonla*

It in generally planted at a distance of 6-7 m. However, by systematic pruning, the grafted trees of high yielding varieties can be maintained under HDP. High yielding varieties such as NA 7, Krishna and Chakia can successfully be grown under HDP concept at a spacing of 3 m by 3 m under hexagonal or triangular systems accommodating over 1,200 plants per ha.

xiii) Arecanut

It is normally planted at a spacing of 2.7m x 2.7m under square, rectangular, triangular and quincunx systems of planting. Growing of several crops in association with arecanut is a common accepted practice by farmers of hill zones of Karnataka to utilize both the vertical and horizontal space in multi-storeyed cropping systems. Several arecanut based mixed cropping systems revealed highest nut yield in arecanut + pepper + cardamom and arecanut + pepper + cocoa cropping systems.

xiv) Cardamom

High density planting particularly for high yielding elite clonal materials is advocated. A planting density of 5,000 plants per ha (2 m x 1m) and a nutrient combination of 150:75:300 kg $N:P_2O_5:K_2O$ per ha were found to be ideal for optimum tillering and yield in cardamom

6.2.2 Constraints in Adoption of HDP Systems

Non-availability of planting material in dwarf varieties in different horticultural crops except banana.

- Non-availability of vegetatively propagated rootstocks in different fruit and plantation crops.
- Avoidance in use of inter- and mixed-cropping system
- Overcrowding trees in mango HDP after 1to 12 years?
- Harmful effects of chemicals like paclobutrazol causing barrenness in crops like mango, grape etc.
- Non-availability of complete package for HDP and use of mechanization

6.2.3 Focus During XI Plan

Following are the key areas to be undertaken during the XI plan period for the promotion of HDP in fruit and plantation crops. In crops in which the complete packages are available there is a need to adopt them in area expansion and also in cases where replanting has to be undertaken.

Promotion of high-density plantings to produce early and sustained production of quality fruits. Area to be expanded in crops like banana, pineapple, mango, cashew nut etc.

To refine successful high density planting systems in different tropical, sub-tropical and temperate fruits. There is a need to develop crop-specific strategies for developing high-density plantings.

Dwarf and compact trees in high-density orchards should be adopted commercially in temperate horticulture particularly in apple.

Adequate emphasis should be laid on the development and evaluation of dwarfing rootstocks apart from mango and citrus where few rootstocks have been identified.

High-density plantings require standardisation of training and pruning techniques in tropical, sub-tropical and temperate fruits. The success achieved in guava and mango need to promoted to different regions.

Alternative to growth retardants like paclobutrazol need to be developed to avoid residual effects. The use of chemicals also needs to be standardized for different fruit crops.

HDP should be promoted along with micro irrigation and fertigation methods need to be standardized for different crops and agro-climatic conditions. The mono-species HDP is cost and technology-intensive, suited for commercial fruit production. For small and marginal farmers with smallholdings multi-species HDP approach should be brought out. This system is effective in plantation crops and multiple cropping systems like coconut and arecanut with pepper; tree spices, tuber crops, banana and pineapple are popular in south India. Similarly, the crops where heavy pruning is required such a practice will be highly remunerative.

6.2.4 Budget Allocation During XI Plan

For wise scale adoption of high density planting in different crop clusters, the target is to double the area in different fruit and plantation crops. Since many of the crops are perennials and has long gestation period, financial allocation would be made for replanting with new varieties on desired dwarfing rootstocks. The financial allocation is for the subsidies to be granted for land preparation, digging of pits, fertilizers, plant protection chemicals and purchase of plant material.

The targeted area expansion /conversion to high density planting has been mentioned in the following table.

Table 6.1 Present area under high density planting and expansion suggested during the XI Plan period (2007-2012)

Crop	Total area ('000 ha)	Area under X Plan ('000 ha)	Area expansion under XI Plan ('000 ha)	Budget allocation suggested for XI Plan (Rs. in crores)
Banana	530	200	300	8.0
Apple	231	50	75	3.0
Citrus	713	100	150	5.0
Guava	162	15	50	2.5
Papaya	73	15	50	2.0
Mango	1962	100	200	10.0
Pomegranate	113	30	60	2.0
Pineapple	81	20	60	2.5
Cashew nut, coconut, arecanut, etc.		100	500	15.0
Total	**3,865**	**630**	**1,445**	**50.0**

6.3 USE OF PLASTICS IN HORTICULTURE

Plastics have various applications in any commercial horticultural activity. These include drip irrigation; plastic film mulches; greenhouse structure; high and low tunnels; post harvest operations; nurseries; roof top gardening, shade nets; off season fruit, vegetable and ornamental crop productions; gardening; hi-value crop applications in horticulture; Plastic bags for nursery samplings and grafting, food processing and packaging, etc. Use of plastics has proved beneficial to promote the judicious utilization of natural resources like soil, water, sunlight and temperature.

Use of plastics in agriculture or '**Plasticulture'** provides several benefits like; improves the economic efficiency of production systems, user friendly maintenance, efficient water and energy management, reduced temperatures and moisture fluctuations, control on pest and disease infestations, precise irrigation and nutrient applications and reduced wastage, reduction in soil erosion, etc.

Present level of use of plastics in horticulture is except for micro irrigation is very low in India *vis-à-vis* its use in several developed countries. Different grades of plastic material like Low Density Polyethylene (LDPE), High Density Polyethylene (HDPE) pipes for drip irrigation system, Ultra Violet Stabilized films for use as cladding material for greenhouses, plastic sheets of different thickness for mulch are now available for use. These are light in weight, durable and cost effective.

6.3.1 Micro Irrigation

One of the major sectors of application of plastics in horticulture is in the area of water management and conservation. Drip/Micro irrigation is a technology for providing irrigation to plants through network of pipes. The term drip/ micro irrigation includes emitting water by drippers, micro-sprinklers, mini-sprinklers, micro-jets, misters, fan jets, micro-sprayers foggers, emitting pipes, micro-tubes and similar other emitting pipes. The use of different components depends upon the requirement, which may vary due to crop type, water requirement, plant spacing, soil type etc. Drip/Micro irrigation Technology can be used both on the surface as well as sub-surface. Technology helps in increasing productivity by 30 to 100 per cent with 50 to 70 percent saving of water. There is enhanced water use efficiency (WUE). Micro irrigation saves the energy as compared to sprinkler and conventional methods.

Sprinkler irrigation enables water to be sprinkled with the help of a network of pipes and sprinklers (nozzles) on the plant foliage. Sprinkler irrigation system has become popular as a method of irrigation especially under undulating topography particularly for light textured soils for a variety of horticultural crops. Sprinkler system is ideally suitable for close spaced crops like vegetables, spices, Medicinal & Aromatic Plants and flowers. It is now popularized in some fruit and plantation crops.

Systematic research on micro irrigation of horticultural crops was conducted at Tamil Nadu Agriculture University, Coimbatore in seventies and thereafter a large number of trails have been conducted for wide varieties of crops under varying agro-climatic conditions by Water Technology Centre, IARI, New Delhi and MPKVV, Rahuri. All the trials have proved that micro irrigation improves productivity and quality of produce, reduces labour cost, salt concentration in the root zone, disease incidence, and economizes on fertilizer if used through drip system. Since, drip irrigation permits frequent application of water without soil moisture stress, enhanced growth is achieved. However, high investment at initial stage and frequent clogging of emitters, have become impediment in wider uses of this system.

The data on research work carried by SAU's, IARI, WALMI's & AICRP were compiled by INCID and reported in Table 6.2.

Table 6.2 Result of studies on micro irrigation under PFDCs funded by NCPAH

Sl. No.	Crop	Yield (q/ha)		Irrigation (cm)		WUE (q/ha/cm)		Advantage of MI (%)	
		Surface	Drip	Surface	Drip	Surface	Drip	Saving	Increase in yield
1	Beet	5.70	8.90	86.00	18.00	0.07	0.50	79.10	56.10
2	Bitter gourd	32.00	43.00	76.00	33.00	0.42	1.30	56.60	34.40
3	Brinjal	91.00	148.00	168.00	64.00	0.55	2.30	61.90	62.60
4	Broccoli	140.00	195.00	70.00	60.00	2.00	3.25	14.30	39.30
5	Cauliflower	171.00	274.00	27.00	18.00	6.3.0	15.20	33.30	60.20
6	Chilly	42.30	60.90	109.00	41.70	0.39	1.50	61.70	44.00
7	Cucumber	155.00	225.00	54.00	24.00	2.90	9.40	55.60	45.20
8	Lady's finger	100.00	113.10	53.50	8.60	1.87	13.20	84.00	13.10
9	Onion	284.00	342.00	52.00	26.00	5.50	13.20	50.00	20.40
10	Potato	172.00	291.00	60.00	27.50	2.90	10.60	54.20	69.20
11	Radish	10.50	11.90	46.00	11.00	0.23	1.10	76.10	13.30
12	Sweet potato	42.40	58.90	63.00	25.00	0.67	2.40	60.30	38.90
13	Tomato	61.80	88.70	49.80	10.70	1.24	8.28	78.50	43.50
14	Banana	575.00	875.00	176.00	97.00	3.27	9.00	45.00	52.20
15	Grapes	264.00	325.00	53.00	28.00	5.00	11.60	47.20	23.10
16	Papaya	130.00	230.00	228.00	73.00	0.60	3.20	67.90	76.90
17	Pomegranate	34.00	67.00	21.00	16.00	1.62	4.20	23.80	97.00
18	Water melon	82.10	504.00	72.00	25.00	5.90	20.20	65.30	513.9

Source: Report of Task Force on Micro- irrigation, GOI (2004)

Fertilizer use efficiency is also enhanced when it is applied through drip irrigation. Increased productivity with saving of 30 to 40 per cent of fertilizer is achieved through fertigation. Thus, drip irrigation is becoming a major component in precision farming. Realizing the usefulness of drip irrigation, several incentives have been provided by Government of India to popularize this system with farmers. Initially, GOI launched a Centrally Sponsored Scheme on Use of Plastics in Agriculture during the VIII Plan, duly earmarking 200 crore (out of Rs. 250 crores) for drip irrigation. The Scheme was continued during IX Plan under the title Development of Horticulture through Plasticulture Applications with an outlay of Rs. 375 crore out of which Rs. 300 crore was for drip irrigation. The scheme was thereafter subsumed under the Centrally Sponsored Scheme on Macro Management in Agriculture during 2000-01.

In July 2003, Government of India constituted a **Task Force on Micro Irrigation** to assess the scope and potential of the technology and to suggest strategies for it's promoted in the country. The Task Force which was headed by the then Chief Minister of Andhra Pradesh gave several recommendations for promoting Micro- irrigation in the country. It is recommended that additional area of 6.65 m ha could be brought under the micro irrigation. The cost for that purpose would be about 1,828 crores. Expert group recommends that banana, grape, be brought under the purview of micro irrigation. Sprinkler irrigation system does not categorized under use of plastics in agriculture. Some of the major recommendations of the Task Force on Micro irrigation are as under.

- A total of 17 million ha need to be covered under Micro Irrigation in the country by the end of XI Plan including three million ha during X Plan.
- Financial Assistance should be available on all crops.
- The rate of financial assistance to the farmers should be 50% of unit cost.
- 40% share should be from GOI and the balance 10 % by the respective state governments.
- The states may raise their share through RIDF loan from NABARD.

- The funds need to be released through NABARD/leading nationalized banks rather than state implementing agencies or macro management scheme; there should be tax concessions to make the system affordable by farmers;
- An Apex Body in the form of National Council for Precision Farming needs to be constituted as a registered society under Societies Registration Act 1860.

In line with the recommendations of the Task Force on MI, the Government of India launched a Centrally Sponsored Scheme on Micro Irrigation during the X Plan, with effect form 2005-06 with outlay of Rs 850.00 crore for the plan period. The scheme envisages covering an area of 6.2 lakh ha under MI (3.8 under drip and 2.4 under sprinkler) during the X Plan. The horticultural crops would share 50% drip irrigation with allotment of 60% share of budget due to closely spaced cash crops.

Through the GOI support, good awareness has been created about the usefulness of Micro Irrigation in different parts of the country. The area currently under drip amd sprinkler irrigation is estimated to be 2.75 lakh hectares. However, the drip irrigation has hardly 30 5 share covering 8.29 lakh ha area. In view of paucity of water availability, drip irrigation has to be given priority. The present area under MI systems is given in Table 6.3.

Table 6.3 Area under micro irrigation in India

(Area as on March, 2006 in '000 ha)

S. No.	State	Drip	Sprinkler	Total
1	Andhra Pradesh	155.441	124.51	279.951
2	Arunachal Pradesh	0.613	0	0.613
3	Assam	0.116	0.129	0.245
4	Chhattisgarh	1.979	3.765	5.744
5	Goa	0.746	0.306	1.052
6	Gujarat	53.707	96.374	150.081
7	Haryana	4.258	503.877	508.135
8	Himachal Pradesh	0.116	0.581	0.697
9	Karnataka	114.433	157.028	271.461
10	Kerala	10.562	1.548	12.11
11	Madhya Pradesh	6.483	100	106.483
12	Maharastra	341.848	153.507	495.355
13	Manipur	0.03	0	0.03
14	Mizoram	0.072	0.106	0.178
15	Nagaland	0	3.962	3.962
16	Orissa	2.036	20.22	22.256
17	Punjab	5.101	10	15.101
18	Rajasthan	10.025	554.708	564.733
19	Sikkim	0.8	10.03	10.83
20	Tamil Nadu	116.665	26.332	142.997
21	Uttar Pradesh	4.609	10	14.609
22	Uttaranchal	0.038	0.006	0.044
23	West Bengal	0.11	150.02	150.13
	Grand Total	**829.788**	**1927.009**	**2,756.797**

The programme, which started as a subsidy scheme is now a demand driven enterprise in several States like Maharashtra, Karnataka, Andhra Pradesh and Tamil Nadu. As a result of all these efforts, India has now emerged as one of the leading countries in using micro irrigation technology.

Among the crops, maximum adoption of drip system has been in fruit crops (35%) followed by plantation crops (18.5%). There is growing awareness for use of drip irrigation even for closely spaced crops especially tomato, capsicum, chillies and potato (Fig. 6.1).

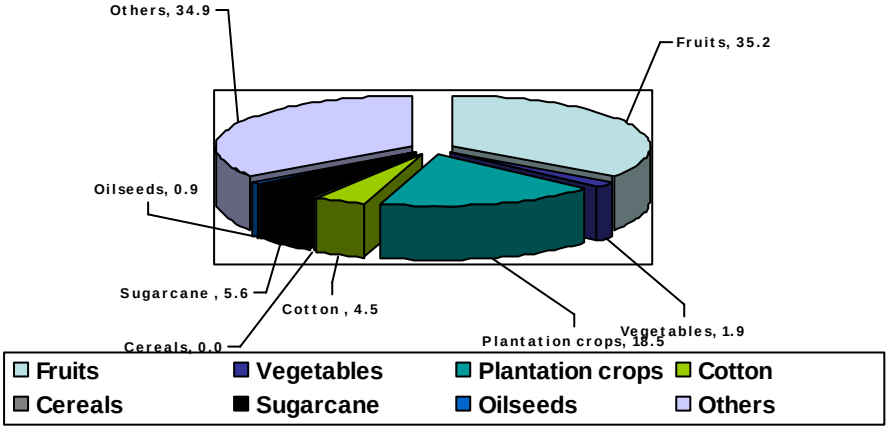


Fig. 6.1 Coverage of area under drip irrigation

Among fruit crops, the maximum coverage is under citrus (24%) followed by grapes (19.1%). Other major fruit crops covered are banana, pomegranate, mango and sapota (Fig. 6.2).

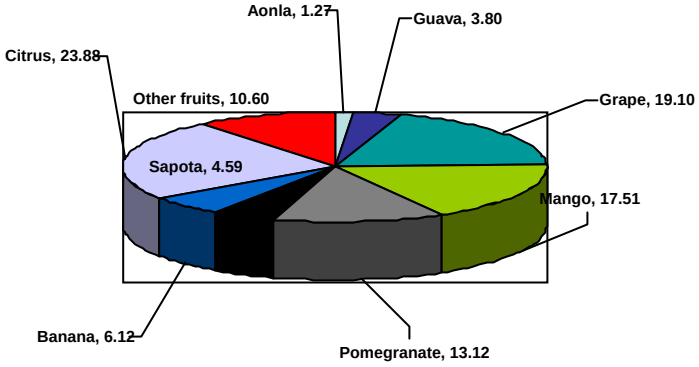


Fig. 6.2 Coverage of MI under Fruit Crops

The major share of sprinkler irrigation is under cereal crops followed by oilseeds & pulses (Fig. 6.3).

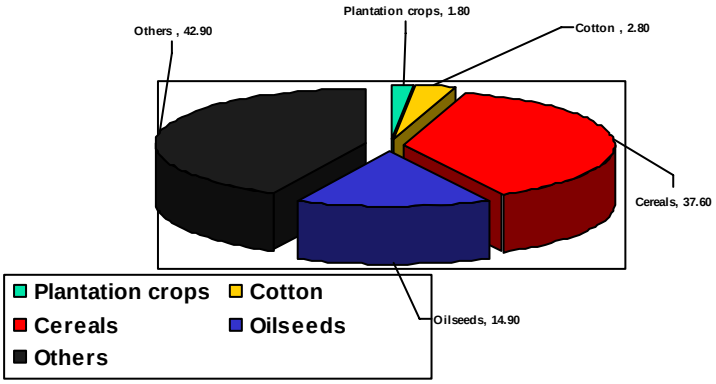


Fig. 6.3 Coverage of area under Sprinkler irrigation

Since the efforts during the X Plan would cover only a fringe of the existing potential there is need to provide further impetus for covering additional area under Micro Irrigation during the XI Plan.

To make the technology more effective it will be necessary to address the methods for predicting the temporal and spatial variation of soil moisture, the minimal and optimal fraction of the soil volume to be wetted, and management system in different horticultural crops under varying weather and soil conditions, application of nutrients, critical stages of growth and development etc.

6.3.1.1 Fertigation

For intensive and economical crop production, the best solution for higher productivity is fertigation, where both water and fertilizers are delivered to growing crops through micro irrigation system. Fertigation provides Nitrogen, Phosphorus, Potash as well as the essential trace elements (Mg. Fe, Zn, Cu, MO, Mn) directly to the active root zone, thus minimising losses of expensive nutrients, which ultimately helps in improving productivity and quality of farm produce.

Fertigation ensures higher and quality yield along with savings in the time and labour, which makes Fertigation economically profitable. Experiments have proved that the system economises use of fertilizer and water ranging from 40-60 per cent. This is being experienced by few progressive farmers of grapes, pomegranate, and banana and still it is beyond the reach of resource poor farmers. Fertigation is ideally suited for hi-tech horticultural production systems since it involves not only the efficient use of the two most precious inputs i.e., water and nutrients but also ensures their simultaneous availability to plants. Though micro irrigation has found widespread use in plantation and horticultural crop production in India, fertigation is confined to few high value crops. Significant yield response coupled with enhanced quality of produce is possible through hi-tech productivity using fertigation.

One of the main reasons for slow adoption of fertigation is the non- availability of totally water soluble fertilizers at affordable cost. Due to the non-availability of good fertigation compatible soluble NPK fertilizers, imported fertilizers are being, used which escalates the cost to Rs.50/- to Rs.60/- per kg cost of nutrient whereas, the average per kg cost of nutrients in India is around Rs.4/- to Rs.6/- per kg. Another important reason for lack of enthusiasm in fertigation is the high investment on machinery tools for injecting the nutrients into the system, and the lack of precise information about fertigation in different crops

- The grape, pomegranate and banana growers in Maharashtra have adopted fertigation to some extent. Based on the studies on fertigation carried out on different horticultural crops using several formulations of water-soluble fertilizers, the advantages of fertigation are summarized below:
- By and large a saving of at least 20-40 percent in fertilizers could be made if fertigation is adopted using water-soluble fertilizers (WSF) due to better fertilizer use efficiency.
- The water soluble fertilizers being completely soluble in water are ideally suited for fertigation as they do not cause any clogging of the system due to the high acidic urea phosphate used in formulating these fertilizers.
- Frequent and split application of fertilizers through fertigation near the root zone of the crops help in reduced leaching and consequently better absorption of nutrients resulting in increased yields by 25 to 35 percent besides improvement in the quality of the produce in almost all the crops.
- Keeping in view the NPK requirement of various horticultural crops and several formulations that are available for evaluating their efficacy, fertilizers in the NPK ratio

of 1:1:1; 2:1:3 and 1:2:0 are found to be more desirable as these could be used for majority of the crops by supplementing either nitrogen (N) or potash (K) nutrients wherever necessary through fertigation.

The studies indicate that fertigation holds ample scope for adoption especially in high value horticultural crops for getting high productivity and quality produce. It would also be cost effective if type, level, split applications and cost of water soluble fertilizers are optimized for various crops/regions.

Keeping in view the promising results of fertigation in improving crop productivity, fertigation has been included as a part of the Micro Irrigation scheme. It will be necessary promote fertigation more aggressively during the XI Plan.

6.3.1.2 Micro irrigation during XI Plan

The Task Force on Micro irrigation had recommend a coverage of 17 million ha under drip and sprinkler irrigation during the X and XI Plan period including 3 million ha area coverage during the X Plan. However, as per budget provisions available during the X Plan, only an area of 6.2 lakh ha would be covered. This would call for intensification of efforts during the XI Plan. Accordingly, it is proposed to cover an area of 10 million ha during the next Plan as per the following breakup (Table 6.4).

Table 6.4 Proposed annual target for micro irrigation

S.No.	Year	Proposed area for adoption, million ha		
		Drip	Sprinkler	Total
1	2007-08	0.6	0.4	1
2	2008-09	1	0.5	1.5
3	2009-10	1.4	0.6	2
4	2010-11	1.8	0.7	2.5
5	2011-12	2	1	3
	Total	**6.8**	**3.2**	**10**

The crop-wise details of area to be covered are given in Table 6.5. Since historically non-horticultural crops are also being covered under the MI Scheme, estimated for these crops have also been included.

Table 6.5 Target for coverage of area under micro irrigation during XI Plan

(area in 000 ha)

Sl. No.	Name of crop	Total area	Area already covered		Target for XI Plan		
			Drip	Spri.	Drip	Spri.	Total
A. Horticulture Crops							
1	Fruits	5,352	291.7	3.6	2000	100	2,100
2	Vegetables	6,733	15.9	10	500	200	700
3	Spices	2,511	2.2	4	500	100	600
4	Flowers	144	1.7	0.59	100	100	200
5	Plantation crops	3,068	151.9	31.1	3000	100	3,100
6	Others	200	100		200		200
	Total	**18,008**	**563.4**	**49.29**	**6300**	**600**	**6,900**
B. Non Horticulture							
1	Cereal & Pulses			725.6		1500	1500
2	Oilseeds		9.3	287.8		950	950
3	Sugarcane		46.2		200		200
4	Cotton		37.2	53	100	100	200
5	Others		172.4	809.4	200	50	250
	Total		**265.1**	**1875.8**	**500**	**2600**	**3,100**
	Grand Total		**828.5**	**1925.09**	**6800**	**3200**	**10,000**

6.3.1.3 Crop specific programmes for promotion of micro irrigation schemes

There has been a substantial increase in area under micro irrigation in different crops. However, during XI Plan some of the crops / crop-groups have been identified for intended area expansion under the already existing schemes like NCPAH, NHM, TMNE states, etc. in a much focused way. The target area expansion is listed hereunder (Table 6.6)

Table 6.6 Present area under micro irrigation and expansion proposed during XI Plan period (2007-2012)

Crop	Total area (000 ha)	Area under micro irrigation in X plan	Area expansion under XI plan	Rate of allocation per ha basis (Rs.)	Budget allocation for XI plan in crores (Rs.)
Banana	530	250	100	40,000	400.0
Apple	231	50	50	20,000	100.0
Citrus	713	100	100	25,000	250.0
Guava	162	15	25	35,000	75.0
Papaya	73	15	20	25,000	50.0
Mango	1962	100	70	20,000	140.0
Pomegranate	113	30	50	25,000	125.0
Pineapple	81	20	10	40,000	40.0
Grape	60	10	50	40,000	200.0
Cashew nut, Coconut, arecanut	3102	100	50	25,000	250.0
Tree spices, nutmeg, cinnamon, black pepper, tea and coffee	-	10	10	30,000	30.0
Flowers crops	116	10	20	40,000	80.0
Maintenance and upgradation of existing areas under MI	-	-	100	25,000	200.0
Total			**555**		**1,940.0**

The cost does not indicate specific make of controlled environment, since it depends upon climatic parameters such as sun light, temperature, relative humidity, etc. Protected cultivation includes hardening structures, tunnels, shade nets, ventilated structures, Class III polyhouses, etc.

With an average unit cost of Rs.45,000/- per ha for drip irrigation, the total investment required for bringing 6.8 million ha under drip irrigation will be Rs.30,600.00 crore. Similarly, with a unit cost of Rs.15,000/- per ha for sprinkler irrigation, the cost for bringing 3.2 million ha under sprinkler irrigation would be Rs. 4800.00 crore. Thus the total investment required for micro irrigation during the XI Plan will be to the tune of Rs.35,400.00, out of which the GOI share would be Rs.14,160.00. The farmer's contribution will be 50%, *viz.* Rs.17,700.00 and the State Government's share will be Rs. 3540.00 (10%).

6.3.2 Protected Cultivation

Optimum growth of plant is governed by the availability and use of natural resources of land, water and sunlight. However, climatic variations often tend to have adverse effect on the yield and production of crops. Efforts have, therefore, been on for harnessing these natural resources through artificial means for increasing crop productivity. One such technology is protected cultivation/green house cultivation.

Green houses are framed or inflated structures covered with plastic material or glass in which crops can be grown under partially controlled environment which is large enough to permit normal cultural operation manually. The size of the green house could vary from about 10 M^2 to few hectares. Green houses of larger size are usually constructed for export oriented projects for floriculture. Green house technology was well adapted in Europe and USA by the end of the nineteenth century. Presently, China and Japan are the leading countries. Other countries where green house technology is being widely used are Netherlands, Israel, Canada, Spain and Egypt besides some Arab countries.

Green houses are suitable for growing a variety of vegetables, fruits and flowers. Year-round cultivation even under extreme climatic conditions is possible through green houses. In addition to temperature control, other benefits of green house cultivation include protection from wind, soil warming and, in some cases, protection against insects, pest and diseases. In general, green house cultivation could be considered as protected cultivation that enhances the maturity of crop, increases yields, improves the quality of produce and in some instances reduces the use of insecticide and pesticide. The total time for preparation of seedlings and cuttings also get reduced significantly by the use of green house technology. Greenhouse is also essential for plant propagation through tissue culture.

Considering the advantages of greenhouse, there is ample scope for encouraging area under protected cultivation of high value flowers and vegetables out of season, both in the temperate and tropical climate. However, profitability in green house cultivation will depend upon the choice of green house structure, selection of crops and varieties and production technologies adopted. While the conventional green houses are simple structures, the hi-tech green houses have facilities for controlling light intensity, temperature, humidity with complete automation of the system.

The constraint in adoption of green house is mainly the high investment required on equipments. Since capital cost is high due to high interest rate and consumers are less attuned to pay higher price for quality green house, cultivation is viable only for one or two crops. However, with growing consciousness for quality, trend of reducing rate of interest on capital and increasing demand for different produce, the viability of this technology is improving. Since the technology has potential of increasing yield by 300 percent coupled with quality, it needs to be encouraged.

With boom in retail sector of horticulture in India, there is a growing demand for high quality, specialty produce and thus protected cultivation will be playing a major role to meet the demand of specific variety or type of flower and vegetables. Globalization of Indian economy and economic reforms initiated in early 90's paved the way for the advent of state-of-the- art protected cultivation technology in India. Indian horticulture, which was hitherto an individual activity, became corporate driven, which could sense the potential and scope the modern protected cultivation technology.

Refinement in protected cultivation technology is being carried out in different organizations under Indian Council of Agricultural Research (ICAR), Council for Scientific and Industrial Research (CSIR) and State Agricultural Universities. Protect net – a comprehensive research programme launched by the ICAR nearly a decade ago to address some of the issues related to protected cultivation. Thereafter it also served as a major thrust area under ICAR's multi-locational and multi-disciplinary research programme under National Agricultural Technology Project (NATP) to develop production modules suitable for protected cultivation in different agro-climatic situations. The DRDO Field Research Laboratory, Leh installed a glasshouse during 1964. Perhaps it is one of the oldest greenhouses in the country. Subsequently, different designs of glasshouse and polyhouses were tried. Besides above-ground green houses, underground green houses were also tried. Polytunnels and poly crop cover has also been tried in Leh. Every structure has been found suitable for one or the other aspects of vegetable production. Besides glass and polythene, Fibre Reinforced Plastics (FRP) was also been tried in greenhouse.

Non availability or inadequate power supply is the main limiting factor in popularization and propagation of greenhouses in Leh but plant protection structures such as soil trenches and low cost polyhouses are quite useful. They are being used for the following on limited scale for raising early vegetables and flower nursery, production of early vegetable crops, extension of growing season, vegetable production during frozen winters, protection of valuable germplasm and cultivation of cucurbits, brinjal, capsicum and certain flowering annuals. There is a gross increase in yield and quality of produce under protected cultivation. Some of the potential yields realized are given in Table 6.7.

Table 6.7 Potential yield realization in protected vegetables (kg/m^2)

Sl. No.	Vegetable	Yield (kg/m^2)
1.	Capsicum	19.6
2.	Cucumber	13.0
3.	Tomato	8.42

6.3.2.1 Greenhouse designs

India has varied climatic conditions in different regions, so the greenhouse and the supporting facilities have to be developed accordingly. The southern plateau will have mild climate and coastal regions need only naturally ventilated polyhouses. The northern plains with extreme hot and cold climate need the cooling and heating facilities. The local climatic conditions play a major role in design of the greenhouse structures and cladding materials. Under mild and hot climates, single film cladding of 200 micron thick UV stabilized LDPE film will be sufficient, while for cold climates inflated double layer of UV stabilized LDPE film is required.

The initial cost of the greenhouse generally depends upon the cost of structure, cladding and temperature control mechanism. The fan and pad greenhouses are cooling type and are suitable for high temperature and low humidity (for northern plains). Bur the operating costs are high due to continuous running of exhaust fans and water circulating pumps for cooling pads. The centrally heated glasshouses are suitable for northern hilly regions.

In naturally ventilated greenhouse, the temperature is maintained 1 to 3^{O}C above ambient conditions due to wind and thermal buoyancy and these do not need any electric power for maintenance of temperature and R.H. Under Indian conditions naturally ventilated greenhouse are most suitable due to low operating costs. These are used in the climates of Southern Peninsula. The naturally ventilated greenhouses are also economical for cultivation in northern hilly regions during summer.

The Plasticulture scheme, which was launched during the VIII plan, apart form drip irrigation had a significant component of green house cultivation. However, with the launching of the National Horticulture Mission (NHM) during 2005-06, aspects relating to plasticulture applications including green house cultivation (hi-tech as well as normal) are being covered under the Mission. An amount of Rs. 190.00 crore has been earmarked for plasticulture applications during the X Plan under the NHM. The Technology Mission on Integrated Development of Horticulture in the North Eastern (TMNE) States including Sikkim, Himachal Pradesh, Jammu & Kashmir and UttaraKhand also has provision for promoting plasticulture applications in the Region.

The investments required for promoting green house technology during the XI Plan will be Rs. 380.00 crore.

6.3.3 Plastic Mulching

Covering of soil around the root zone of plant with a plastic film is called plastic mulching. It is an effective practice to restrict weed growth, conserve moisture and reduce the effect of soil borne diseases through soil solarization. Black plastic prevents the germination and growth of weed seeds in contrast to clear plastic. It absorbs more sun energy and retains higher heat underneath the plastic.

Mulching has been helpful not only in preventing moisture loss through evaporation from the soil and lowering the temperature but also reducing nutrient loss by leaching and weed control where chemical fertilizers and weedicides are used. Mulching also reduces run-off, increase penetration of rainwater, controls erosion, corrects the chemical balance of the soil and reduces damage done by pests and diseases. Apart from these major results mulching produces secondary effects such as improvement of soil structure, increase in micro-activity, earthworm populations and more extensive root systems.

In tomato, mulching with straw, hay, sawdust, asphalt paper and black polyethylene plastic can be used in districts where shortage of water is a problem. Mulching also reduce the extent of blossom end rot and infection by soil-borne disease. Straw mulching and paper mulching has proved beneficial for brinjal and peppers. It has given very consistent increase in yield, earliness and prevented fungal infection in both. Sawdust, straw mulching and light-coloured paper mulch improve seed emergence and increase yields of root crops like carrots, beets, potatoes and lettuce in dry regions. Straw mulching is of special value in the production seed potatoes in hot climates and in areas where summer temperatures are above the optimum for tuber development. Aluminium foil is also a promising mulch material for onions and broccoli since its benefit is related to the conservation of nutrients.

Soil moisture could be conserved through mulching either with black polyethylene or locally available mulches, growing cover crops or inter-culturing in the orchards to check soil erosion and runoff of rain water. Application of farm yard manure or vermin-compost for improving soil health and water holding capacity of the soil is another way to efficiently use and conserve the water that is available in limited quantity. Area under plants if remain covered with mulches preferably grass mulch (10-12 kg/basin) and black polyethylene mulch (100 micron) throughout the growth period, it helps in conserving the soil moisture, saving water for more critical stages during summer and reducing the weed population by 60% with grass mulch and 100% with polyethylene mulch. This reduces the cost of cultivation. The polyethylene mulch maintained 29% more soil moisture compared to un-mulched trees on soil available water content basis. Experiments on onion and chilli under rainfed conditions proved the utility of black polyethylene mulch and also dry grass mulch at the rate of 5 t/ha for increasing the productivity under moisture stress situations. A Plastic Mulch Laying Machine was developed at CIAE, Bhopal

In India plastic mulching is yet to grain momentum. Inadequate awareness about the usefulness of mulching is one of the reasons. Besides, non availability of the mulch material in interior areas is another factor. Although assistance is being extended under NHM and TMNE for promoting plastic mulching, the coverage of area is meager in the country when compared to other countries like China. It would, therefore, be necessary to adopt an aggressive strategy during the XI Plan for promoting this technology. Farmer participatory demonstrations will have to be taken up extensively besides providing assistance for adopting plastic mulching practices. The unit cost of plastic mulch, which is presently Rs.14,000/- per ha need to be revised after taking into account the marker value of the mulch material. Plastic film manufacturers and suppliers need to be considered.

Mulching has been an age old practice among farmers to conserve moisture, aid temperature moderation and hence have better yield of good quality crop. In India, of late, farmers are shifting from hay or other organic mulching to black plastic mulching especially in annuals such as strawberry, tomatoes etc., to reduce the weeds near the crop, to warm the soil in early spring, to maintain the moisture, etc. Mulching consists of placing of organic materials on the surface of the soil. These organic materials can be compost, dry leaf, straw, sawdust, etc. Various synthetic mulches such as Al foil and plastic can also be used. Mulching with plastics has become a standard practice of both commercial and home gardeners all over the world.

The estimated requirement of funds for promotion of organic and plastic mulches in horticulture during the XI Plan will be to the tune of Rs.150.00 crore

6.3.4 Other Plasticulture Applications

There are other plasticulture applications such as shade net houses, low tunnels, anti-hail/ bird protection nets etc, which are becoming popular in different parts of the country. These technologies need to be promoted during the XI Plan. Summary details of area to be covered and the estimated expenditure for protected cultivation and other plasticulture applications are given in Table 6.8.

Table 6.8 Area under use of plastics during XI Plan period (2007-2012)

Sl. No.	Item	Area expansion under XI Plan (ha)	Budget allocation suggested for XI Plan (Rs. in crores)
1.	Greenhouse		
a.	Hi-tech	100	80.00
b.	Low cost	500	300.00
2.	Plastic Mulching	100000	150.00
3.	Shade Nethouse	200	100.00
4.	Low Tunnels	2000	60.00
5.	Anti-hailnets/ bird protection nets	4000	100.0
	Total	**1,06,800**	**790.00**

The GOI share of investment for the above will be Rs.395.00 crore @ 50% of the cost.

6.3.4.1 Sub-surface drainage system

Sub surface drainage (SSD) is a proven technology in reclaiming saline and water logged land and restoring the productivity of the land to its full potential. SSD is designed to lower the water table to a level, which allows optimum root development and prevents the capillary movement of salts into the root zone. The basic principle of sub-soil drainage is that a set of corrugated/perforated PVC pipes are laid in a systematic order to collect excess from the water logged soil. The water so collected is led into a collector pipe system, which in turn drains into the main drains.

Some of the advantages of sub surface drainage systems are:

- It is the most effective measure to remove soil salinity and water logging.
- It helps to control run-off and flood waters.
- It requires less maintenance and long life and most reliable system
- There is negligible wastage of land.

The cost of establishing SSD system is approx. Rs. 50,000 to 60,000 per ha.

This technology needs to be promoted in the areas covered under horticultural crops which are affected by soil salinity and water logging. An outlay of Rs.50.00 crore needs to be earmarked for this purpose during the XI Plan.

6.3.4.2 Plastic lining

Plastic lining assumes importance, particularly in areas where there is high infiltration as seepage losses from ponds and water harvesting structures. Plastic sheets, by virtue of its non-degradable and impermeable nature, are highly suitable for preventing seepage losses. Hence creation of water resources in the form of community tanks and ponds, duly supplemented with plastic lining is a component of the NHM and TMNE schemes. This has enabled to create ponds and tanks at extensive areas, which is providing supplemental irrigation to horticultural crops.

Support for creating water resources along with plastic lining need to be continued during the XI Plan. An outlay of Rs.100.00 crore needs to be earmarked for this purpose during the XI Plan.

6.3.5 NCPAH Initiatives

National Committee on the Use of Plastics in Agriculture (NCPAH) was constituted by Ministry of Agriculture for the promotion of plasticulture in India. The committee has established 17 Precision Farming Development Centres (PFDC) in different agro climatic Regions of India for conducting research on micro irrigation through farmers participation. NCPAH is funded by the NHM as a National Level Agency for taking up R & D work on precision farming through the Precision Farming Development Centre (PFDC). Besides, the NCPAH is responsible for monitoring the plasticulture programs being implemented by the State Horticulture Missions. NCPAH is also responsible for overseeing the implementation of the micro irrigation scheme in the country. The NCPAH is headed by the Agriculture Minister whereas the executive committee of NCPAH is chaired by Secretary (A & C). The committee does not have any legal status. The recommendation of the Task Force on Micro Irrigation for constituting a national body in the form of National Council of Precision Farming needs to be implemented at the earliest for addressing all the activities relating to plasticulture and precision farming. An outlay of Rs.150.00 crore will be needed for making the Apex Body fully functional during the XI Plan.

6.3.6 Budget Allocation for Programmes on Use of Plastics

The total estimated requirement for funds for promoting the use of plastics in agriculture during the XI Plan will be to the tune of Rs.15,335.00 crore (Table 6.9).

Table 6.9 Budget allocation for programmes on use of plastics in horticulture

Sl. No.	Activity	Amount (Rs. in crore)
1.	Micro Irrigation*	14,160.00
2.	Precision Farming	500.00
3.	Protected cultivation	395.00
4.	Sub-surface drainage	50.00
5.	Plastic lining	100.0
	Total	**15,205.00**

*Including all crops.

Though the use of plastics in Indian horticulture was late compared to different countries of the world, it is felt that its promotion should be top on the priority programmes of the both central and state governments. These technologies help in better utilization of resources in efferent geographical locations with production of good quality produce which can fetch better prices for the growers. It also opens up avenues in export of quality produce and processing sectors. The different programmes on use of plastics should be promoted more rigorously since the shrinking land holdings, limited availability of inputs etc. with a proper subsidy driven programmes in different production clusters.

6.4 INTEGRATED NUTRIENT MANAGEMENT

Integrated nutrient management (INM) refers to maintenance of soil fertility and plant nutrient supply to an optimum level for sustaining the desired crop productivity through optimization of the benefits from all possible sources of plant nutrients in an integrated manner. Therefore, it is a holistic approach where we first know what exactly is required by plants for optimum level of production, in what different forms at what different timings in best possible method, and how best these forms can be integrated to obtain highest productivity levels with efficiency at economically acceptable limits in environmental friendly way.

Addition of inorganic fertilizer constitutes one of the most expensive inputs in agriculture. However, their excessive and indiscriminate use in commercial horticultural crops has resulted in several problems. Heavy application of nitrogenous fertilizers has resulted in high quantities of nitrates in well bodies near vineyards in Maharashtra and Karnataka state making it unfit for cultivation and also for human consumption. Therefore, it is essential that

such approaches be followed, which do not adversely affect yield and quality and are simultaneously cost-effective and eco-friendly.

Another important aspect in nutrient use is enhancing the fertilizer use efficiency (FUE) by proper placement of fertilizer in close proximity to the rhizosphere of the highest root activity. Root activity studies carried out in a few crops like grape have shown that roots present between 15-25 cm depth and 45-60 cm lateral distance are more efficient in the absorption of P. Similarly, in mango, the highest zone of root activity has been found at a depth of 30-60 cm and at a lateral distance of 120 to 240 cm. Therefore, an urgent need is to carry out fertilizer placement and root activity studies using both stable and radioactive isotopes in important fruit crops to generate information on the optimum time and method of fertilizer application, which would help in achieving maximum fertilizer use efficiency (FUE/NUE).

Maximizing quality through judicious use of nutrients is a well established fact that assumes a greater significance in perennial fruit crops. A large number of diagnostic methods namely leaf analysis, soil fertility evaluation, juice analysis & biological markers aided analyses have been recommended but their authenticity is in under continuous scrutiny as many have been made based on assumptions. Hence, use of precise technology for fertilizer norms for different crops and regions assumes greater significance. The recommendations are based on different diagnostic tools when used independently have their own usefulness & limitations.

The nutrient diagnostics that have emerged from world over covering diverse nature of fruit crops have lacked considerably in universal applicability due to variety of interpretation tools [regression analysis, best fit model, diagnosis & recommendation integrated system, compositional nutrient diagnosis, principal component analysis, boundary line approach etc. used in developing the diagnostics and influenced by the factors like genotype of the crop, age & position of index tissues, stionic combination, meteorological conditions, targeted yield, quality of inputs & that of irrigation water & soil, its nature & properties, the outcome of the interpretation.

Therefore, use of diagnostic tool for nutrient management in horticultural crops is considered best for both diagnostic and long term applications. Index tissues [leaf or petiole or both] of crop plant were found best in this regard. Therefore, changes in nutrient supply are reflected in the composition of the index tissues. These changes are more pronounced at certain stages of the development and the leaf nutrient concentration at specific growth stages are related to crop performance. Soil test, particularly in perennial fruit trees and vines have been found complementary to leaf analysis in making nutrient recommendation based on stage of bud differentiation, root distribution and plant density per unit area.

Leaf analysis as a guide to nutrient management of fruit crops is based on the premise that “crop behavior is related to the concentration of nutrients in the index tissues”. A carefully worked out sampling technique for the index tissue will make a sound foundation of leaf analysis programme.

Modern methods of interpretation of leaf analysis data such as “Diagnosis & Recommendation Integrated system (DRIS)”, “Compositional Nutrient Diagnosis (CND), Principal Composition Analysis (PCA)” and “Boundary line Approach” are generally adopted to diagnose the growth/yield-limiting nutrient and to recommend optimum use of manures and fertilizers. DRIS though suggest plant tissue test at any stage of crop growth, it has its own limitation but is a veru useful approach in nutrient management in perennial crops.

Soil fertility evaluation has been found complementary till crop is physiologically capable of providing index tissues for evaluation, however, only 1 to 2% of the soil surface is in direct contact with plant roots & therefore soil test crop response relationship is not very strong with fruit crops where $1/10^{th}$ of the soil surface is occupied by roots and covered by the irrigation through drips.

Identifying nutritional deficiency exclusively based on morphological symptoms makes the problem further confounded by other co-factors under the conditions favouring the occurrence of multi-nutrient deficiencies. These deficiencies lead to different disorders with affect growth, flowering fruiting and quality of the produce. A lot of data have been accumulated in crops like mango, citrus, grape, apple, guava, pineapple and banana but leaf/petiole analysis has so far been used only to a limited extent. However, this diagnostic system has been demonstrated in grape particularly in Maharashtra, Andhra Pradesh, Uttar Pradesh and Karnataka. Growers have realized optimum yields from efficient use of nutrients by adopting this technique avoiding the risk of pollution of soil and water.

6.4.1 Initiatives by Different ICAR Institutes/ SAUs

Integrated nutrient management system is the main focus all research programmes of ICAR under it AICRP projects on different horticultural crops. At present, the tissue nutrient based guides have been developed for crops like mango, banana, citrus, grape, guava, *ber*, pineapple, papaya, coconut, etc. It is imperative that these systems receive more focus during the XI Plan to organize the entire horticulture using scientific nutrient management systems, which has direct bearing on production, productivity, quality, and plant and soil health. ICAR institutes like IIHR, Bangalore, CISH, Lucknow, IARI, New Delhi, NRC on Grape, Pune, NRC on Citrus, Nagpur, CIAH, Bikaner, CITH, Srinagar, etc. have developed nutrient management packages under INM mode which can be popularized in the cluster areas. Different SAUS and their regional stations are also working on different aspects of nutrient management in annual and perennial horticultural crops and are coming out with region-specific recommendations. However, time has come that some referral laboratories be established for providing dedicated services of nutrient analysis and recommending doses for manures and fertilizers for efficient crop production

6.4.2 Tissue and Soil Nutrient Referral Laboratory

Plant analysis, more particularly leaf and petiole analysis has been widely used in fruits as a basis of fertilization in many countries. U.S.A., Australia and some European countries also have a large number of Plant Analysis Laboratories operated both in public and private sector. Leaf sampling techniques and nutrient guides have been developed for a number of fruit crops. In India, however, well organized Leaf Analysis Advisory Service does not exist except in a few Institutes/States. While, by and large, the plant sampling techniques developed elsewhere for most of the crops can be adopted in our country with some modifications, leaf nutrient guides for various tree crops, applicable under various soil and agro-climatic conditions have yet to be developed. While some work on these lines is underway at IARI, IIHR and some other institutions, huge effort is needed at the national level to establish standards for various crops/ varieties/ regions as also to promote establishments of commercial leaf analysis laboratories.

Leaf analysis, particularly in perennial crops, offers a means of assessing nutritional requirements. Leaf nutrient standards for a large number of crops have been developed and are in use in developed countries. Work on these lines is also underway in India. This needs to be intensified to ensure economy in fertilizer use through optimized application. To aid practical application, however, there is ct need to correlate nutritional composition of leaf with fruit yield on the basis of extensive nutritional surveys of orchards and comprehensive field experiments. Hence, for a sound nutrient management system it is imperative that such laboratories be established at different identified centers so that they function as referral labs for service to the growers. These centers would not only develop tissue nutrient based guides for different crops grown in the region but also develop and popularize the INM technologies developed/ recommended for the regions.

6.4.3 Biofertilizers

Among organic inputs bio-fertilizers, more commonly known as microbial inoculants, are artificially multiplied cultures of certain soil organisms that can improve soil fertility and crop

productivity. Hence, the cultured microorganisms packed in some carrier material for easy application in the field are called “Bio-fertilizers”. These are capable of mobilizing nutritive elements from non-available forms to available form through biological processes. They are less expensive, eco-friendly and sustainable for long term. Bio-fertilizers have various beneficial benefits, i.e. besides accessing nutrients, for current intake as well as residual, different bio-fertilizers also provide growth-promoting factors to plants and some have been successfully facilitating composting and effective recycling of solid wastes. By controlling soil-borne diseases, improving soil health and soil properties these organisms help not only in saving, but also in effectively utilizing chemical fertilizers which result in higher yields besides maintaining the soil and plant health. Commonly explored biofertilizers in India are mentioned below along with some salient features.

(i) *Rhizobium (RHZ)*: These inoculants are known for their ability to fix atmospheric nitrogen in symbiotic association with plants forming nodules in roots. RHZ are, however, limited by their specificity and only certain legumes are benefited from this symbiosis.

(ii) *Azotobacter (AZT):* This has been found beneficial to a wide array of vegetable crops. It is free living and non-symbiotic nitrogen fixing organism that also produces certain substances good for the growth of plants and antibodies that suppress many root pathogens.

(iii) *Azospirillum (AZS)*: This is also a nitrogen-fixing micro-organism beneficial for non-leguminous plants. Like AZT, the benefits transcend nitrogen enrichment through production of growth promoting substances. It is effective in vegetables like onion, leek, plantation crops, etc.

(iv) *Blue green Algae (BGA) and Azolla:* *BGA* are photosynthetic nitrogen fixers and are free living. They are found in abundance in India. They too add growth-promoting substances including vitamin B_{12}, improve the soil’s aeration and water holding capacity and add to bio mass on decomposition after completion of life cycle.

(v) *Phosphate solubilizing (PSB)/Mobilizing bacteria:* Phosphorus, both native in soil and applied in inorganic fertilizers becomes mostly unavailable to crops because of its low levels of mobility and solubility and its tendency to become fixed in soil. The PSB are life forms that can help in improving phosphate uptake of plants by solublising the fixed P in soil.

The other green or bio-inputs commonly employed in agriculture includes, composts, Farm Yard Manure (FYM), green manure etc. The beneficial microbes in the soil, which are of great significance to horticulture, are i) Biological nitrogen fixers, ii) Phosphate solubilisers; and iii) Mycorrhizal fungi. There lies a huge demand for these inputs for present day area expansion in under eco-friendly horticulture. However, there are very limited numbers of well-established firms, whose production is still limited to small and local producers of bio-fertilizers, vermi-compost and other microbe’s producers who are in large numbers. Different benefits of using bio-fertilizers are listed in Table 6.10.

Table 6.10. List of commonly produced bio-fertilizers in India

Name	Crops suited	Benefits	Remarks
Rhizobium (3 to 4 strains)	Legumes like pulses, groundnut, soybean, garden pea	10-35% yield increase, 50-200 kg N/ha	Leaves residual N in the soil and there is reduction in N dose.
Azotobacter (1 species)	Soil treatment for non-legume crops including dryland crops	10-15% yield increase- adds 20-25 kg N/ha	Improves quality in citrus and mango. Also controls certain soil-borne diseases.
Azospirillum (1 species)	All non-legumes	10-20% yield increase	Produces growth promoting substances. It can be applied to legumes as co-inoculants
Phosphate Solubilizers*	Soil application for all crops	5-30% yield increase	Can be mixed with rock phosphate.

(*there are 2 bacterial and 2 fungal species in this group)			
Blue-green algae and *Azolla* (2 to 3species)	Rice/wet lands mainly used as green manure	20 -30 kg N/ha, *Azolla* can give biomass up to 40-50 tonnes and fix 30-100 kg N/ha	Reduces soil alkalinity, can be used for fishes as feed. They have growth promoting hormonal effects.
Mycorrhizae (VAM) (1 mixed species)	Many fruit trees and annual crops including a few ornamental plants	30-50% yield increase, Enhances uptake of P, Zn, S and water.	Usually inoculated to seedlings/ propagules.

The pure mother cultures of various strains are being maintained in Agricultural Universities, IARI, few ICAR institutions, Regional bio-fertilizer labs of MoA, etc.

6.4.3.1 Use of bio-fertilizers in horticultural crops

All biofertilizers are the beneficial micro-organisms which help in uptake and availability of different essential macro and micro-nutrients. As mentioned above the symbiotic effects are exploited in different ways, i.e. enhanced nutrient availability and uptake, bio-control properties, enhanced growth, yield and quality, endurance to abiotic stresses etc. Some of the known beneficial effects in horticultural crops are listed hereunder;

- Enhanced growth and yield improvement in different crops like apple, litchi, mango, banana, citrus, strawberry, cocoa, coffee, tea etc.
- Dual microbial inoculation (VAM + PSBs) has proved to be effective in cultivation of banana and pineapple.
- VAM + PSBs + *Azotobacter* + *Azospirillum* found very effective in papaya, citrus, mango, pomegranate and grape.
- Nursery inoculation of VAM was found very effective in mango, citrus, cashew, etc. for successful transplantation in field.
- Beneficial effects of VA mycorrhizal fungi have been reported in almost all the vegetables worldwide. Furthermore, beneficial effect of *Rhizobium* in different legume vegetable, *Azotobacter*, *Azospirullum*, PSBs is very effective in onion, garlic and spice crops.
- Spices and MAPs have also shown marked improvement in quality due to bio-fertilizer inoculation.
- Cashew, Cocoa, tea and coffee have shown beneficial effects of biofertilizers on their yields, quality and reduction in application of fertilizers by 25 to 50%.

6.4.3.2 Present demand and target for XI Plan

In 1993, about 1,000 tonnes of *Rhizobium* inoculants were produced, but it was forecasted that, by the year 2000 its consumption may rise to 8,000-10,000 tonnes/yr, covering 50-60% of the 30 million ha of land planted with leguminous crops. Based on the total gross cropped area in India (190 M ha) and recommended doses of bio-fertilizers, the potential demand is estimated to be of 6,27,000 MT. This demand can further be segregated into different categories of bio-fertilizers such as *Rhizobium*, *Azotobacter*, *Azospirillum*, Blue Green Algae, VAM, Phosphate solubilizers etc. (Table 6.11). However, it is very difficult to estimate the total quantum of these inputs, since large segment of the bio-fertilizer market in India is unorganized.

Table 6.11 Estimated total potential demand for bio-fertilizers in India

Type of bio-fertilizer	Total demand (Million tonnes)	Demand for horticultural crops (million tonnes)	Share of the horticultural crops (%)
Rhizobium	35,730	5,000	13.9
Azotobacter	162,610	15,000	9.2
Azospirillum	77,160	1,500	1.9
BGA	2,67,510	-	-
Phosphate solubilizers	2,75,510	5,000	1.8
VAM	5,75,500	50,000	8.6
Total	**13,94,020**	**76,500**	**-**

For 2000, the production target for bio-fertilizers was projected at 39,165 Mt, which was only 4.8% of the total estimated demand (81,159,375 Mt). But the actual production and the distribution of bio-fertilizers are below the target. This shows the huge gap between potential market demand and production besides providing an opportunity for establishing more number of bio-fertilizer producing units in every production clusters. Though with continued support from the central government, there has been a positive trend with respect to bio-fertilizer production in India (Table 6.12). The total production of bio-fertilizers in India during 1992-93 was 2,005.0 tonnes, which increased to 8,010.1 tonnes by 1998-99. Similarly, the consumption/ distributions of bio-fertilizers have also increased from 1,600.01 to 6,700.27 tonnes during the same period. This production covers all agricultural crops.

Table 6.12 Installed production capacity, total production and distribution of bio-fertilizers (Tonnes) in India (1992-99)

Year	Installed capacity (tonnes)	Actual production	Total consumption
1992-93	5,400.5	2,005.0	1,600.01
1993-94	6,125.5	3,084.0	2,914.37
1994-95	8,114.5	5,800.5	4,988.90
1995-96	10,680.4	6,692.3	6,288.32
1996-97	12,647.0	7,406.6	6,681.44
1997-98	N.A.	7,104.6	6,295.63
1998-99	16,446.0	8,010.1	6,700.27

(Source: FAI, 1999)

Region-wise production trend analysis shows wide variations across the country. Western India has the highest bio-fertilizer production capacity and accordingly had the highest estimated production (6,429.9 tonnes) by 2000-01 (FAI, 1999-2000). Southern India had the second largest bio-fertilizer producing region (6,117.5 tonnes) for 2000-01. At state level, Maharashtra is the highest bio-fertilizer producing state with 3,173.0 tonnes (2000-01) followed by Karnataka with a production of 3,152.5 tonnes for same year (FAI, 2001). Increase in use of vermi-compost has been observed for kitchen gardens and for cultivation of high value cash crops, but the information about actual quantity applied by the farmers and other users is not available.

6.4.3.3 Programmes for promotion and use bio-fertilizers

Central Government is presently promoting both production and use of bio-fertilizers in agriculture including horticultural crops through different schemes financed by MoA through NHB, NABARD, NCDC, etc and R&D organizations like ICAR, DBT, DST etc. MoA has already initiated a mega-project entitled “National Project on Development and Use of Bio fertilizers” with the major objectives: (a) Production and distribution of bio-fertilizers (BFs), (b) Developing Standards for different bio-fertilizers and quality control, (c) Releasing of grant for setting up new bio-fertilizers units, (d) Training to farmers and agriculture officers, and (e) Publicity for use of bio-fertilizers through press and media.

6.4.3.4 Adoption of bio-fertilizers and their commercial prospects

At present bio-fertilizers are procured by the State Agriculture Departments and distributed to the farmers at concessional rates. Maximum area, almost 90% has been covered in the states like Maharashtra, Gujarat, parts of Karnataka and Tamil Nadu, i.e. there is very high degree of awareness and also continued supports by the State governments which are mainly responsible for the adoption of this technology. The current trends indicate that there is a steady increase in the demand for bio-fertilizers in southern states (except Andhra Pradesh) and all western and central states (including Madhya Pradesh and Rajasthan). Still this technology is not properly adopted by the farmers in the north and eastern India.

6.4.3.5 Bio-fertilizer production

It is estimated that the production of bio-fertilizers by the existing units in the country is about 7,500 to 9,000 Tonnes per annum (TPA). This is far below the potential requirement of 7.6 lakh TPA by the year 2000-2001 as projected by the National Bio-fertilizer Development Centre (NBDC), Ghaziabad (UP). At present, there are 122 recognized /registered bio-fertilizers units in the country, which have been established or are operating under the financial support from the Ministry of Agriculture. Out of which 83 have been established with the central financial assistance. Total production of bio-fertilizers in the country is 10,000 tonnes. The size of a bio-fertilizer units so far existing in our country are small to medium-scale types varying with production capacity from 75 to 300 TPA. The maximum number of registered bio-fertilizers units are in Maharashtra (19 Nos.) followed by Tamil Nadu (18 Nos.) and West Bengal (14 Nos.). There is a big scope in area expansion in eastern, northern and NE states. The quantity of bio-fertilizers produced by the NBDCC, Ghaziabad and the six Regional Bio-fertilizer Development Centres (RBDCs) are as listed below (Table 6.13).

Table 6.13 Projected bio-fertilizer demands (Mt) in the country

Sl. No.	Type of bio-fertilizers	2000-2001 (MT)	Demand by 2011-2012
1.	*Rhizobium*	34,999	50,000
2.	*Azotobacter*	1,45,953	2,00,000
3.	*Azospirillum*	74,342	1,00,000
4.	Blue green Algae (BGA)	2,51,738	3,00,000
5.	PSBs	2,55,340	3,50,000
6.	AMF (VAM)	25,450	50,000
	Total	**1,34,791**	**3,00,000**

During the XI Plan it is projected that 50% of the cultivated area under horticulture should be brought under use of bio-fertilizer under INM system. However, to meet this target there lies a huge gap between the actual production and the projected demand.

6.4.3.6 Bio-fertilizer use and promotion activities through Govt. initiatives

Considering the increase in growing areas under INM and organic farming practices in the horticulture sector, it is estimated that there will be additional requirements of many new production units, particularly in the states of Maharashtra, Gujarat, Rajasthan, Madhya Pradesh, Tamil Nadu, and Karnataka. The bio-fertilizer products are picking up mainly in cultivation of fruit and plantation crops, vegetables and spices, tea, coffee, MAPs etc. The capital cost of establishing a model biofertilizer unit with 150 TPA capacities is Rs. 75 lakhs. The Department of Agriculture and Cooperation under the Ministry of Agriculture is already implementing the central sector scheme "National Project on Development and Use of Bio-fertilizers". The region-wise distribution of bio-fertilizers is more dispersed relative to chemical fertilizers with highest share going to west followed by south while north and east claimed lower shares. The distribution does not follow the pattern of chemical fertilizers they supplement, where north is the largest claimant. However, the eastern region comes last in share in both chemical and bio-fertilizers though the share in the latter case is even more diminutive suggesting relatively poor adoption in east and north. The comparison however is

not complete without bringing in the cropped area in the regions where the industry witnessed a steady increase in the number of units producing the input.

Under the above project, a subsidy up to Rs. 20 lakhs is provided for setting up a biofertilizer production unit of 150 TPA capacities. The entire bank loan is repayable in ten years including three-year grace period during which only interest is recovered by banks like NABARD. Initially, a subsidy of 25 % of the project cost is borne by the Ministry of Agriculture.

6.4.3.7 Mechanism for quality control in bio-fertilizers

Till recently, the BIS standards existed for only two microbial species, *viz. Rhizobium* (IS: 8268-1976 and *Azotobacter* (IS:9138-1979). Still there is no systematic quality certification system and monitoring mechanism in bio-fertilizers. Since the bio-fertilizers products are living microorganisms, the quality check, certification batch-wise is highly essential. It is essential that each manufacturing unit should have infrastructure and arrangements for quality control. As per the BIS specifications, cell number at the time of manufacture should not be less than 10^8 and 10^7 per gram of carrier material, respectively for *Rhizobium* and *Azotobacter*. Similarly, the number of cell count and permissible contamination at expiry dates are also to be specified by manufacturer. At present some guidelines and certification arrangements have been made.

During X Plan, formulation of standards for bio-fertilizers was one of the important activities under the National Project on Development & Use of Bio-fertilizers along with National Biofertilizers Development Centre, Ghaziabad. Accordingly, in association with the experts of BIS authorities, National Biofertiliser Project prepared (2000-2002) quality standards of *Rhizobium*, *Azotobacter*, *Azospirillum* and phosphorus solublising bacteria (PSBs). All these standards have now been notified by BIS as presented in the box:

For ensuring proper legislation and quality monitoring through accredited laboratories (Referral labs) is proposed for testing during XI plan period under Ministry of Agriculture along with a network of Regional Production cum Demonstration Centers to ensure quality and scientific promotion of these products under different SAUs and Central Institutes.

6.4.3.8 Government interventions in bio-fertilizer production and quality assurance

To attain production targets, the Government of India implemented a central sector scheme entitled “National Project on Development and use of Bio-fertilizers (NPDB)” during the Ninth Plan for the production, distribution and promotion of bio-fertilizers. A National Bio-fertilizer Development Centre was established at Ghaziabad as a subordinate office of the Department of Agriculture and Cooperation with six regional centers in X Plan (from a grant of 100 crores in X Plan). The purpose of the scheme covered organization of training courses for extension workers and field demonstrations and providing quality control services. Production and distribution of different biofertilizers were also undertaken but subsequently discontinued as the centers redefined their role towards R&D and HRD related activities. Capacity creation and production was, however, encouraged through one time grant for new units. The financial assistance, given as grant-in-aid to the tune of Rs. 13 lakhs and now increased to Rs. 20 lakh per unit and thrown open for all, was routed through the State governments but owing to delays in release of grants the onus is transferred to NABARD/NCDC. The public sector organizations form a bulk of the units in the industry, while similar units in the private sector are also coming forward. Different State governments also provide subsidies sometimes up to 50% of the sales realization. The government also plays a dominant role in marketing bio-fertilizers in three possible channels: (a) State government via District level Officers and Village level workers to farmers, (b) State Marketing federation via cooperative bodies to farmers and (c) State Agro-industries *via* Agro Service Centres to farmers.

6.4.3.9 Factors favoring expansion in area under bio-fertilizers and INM in India

- Organic horticulture provides economic opportunities for different stakeholders, i.e. domestic and international trade.
- Premium price for organically produced products (from10 to 100% higher) is already realized in many crops.
- Diverse agro-climatic regions across the country provide environment for wide range of crops that can cater to different market demands.
- Increased awareness and health consciousness, especially among certain urban sectors of domestic consumers.
- Availability of comparatively cheap labour for labour-intensive INM and organic agriculture.
- Presence of Non-Government Organizations (NGOs) as active promoters of Organic farming in different agro-climatic regions
- Increasing involvement of private companies in field of agricultural extension, trade, consultation and other services.
- Enhanced Government attention and support to promotion of bio-fertilizers and organic agriculture through various policy initiations and action programmes.

6.4.3.10 Factors limiting bio-inputs market in India

Major problems that hinder the growth bio-fertilizer in Indian agriculture can be listed as follows:

i) Producers' and traders' level

- Lack of proper infrastructure for distribution and conservation of bio-inputs.
- Existence of poor quality bio-inputs in market reduces the credibility of input providers. Lack of quality control mechanisms for bio-inputs furthers the mistrust among farmers.

ii) Farmers' level

- Lack of awareness and adoption in northern, eastern and north-eastern states.
- Bio-fertilizers and bio-pesticides are generally perceived as less yielding resources.
- Adverse climatic regions and soil conditions are not suitable for specific microbial strains favouring organic production.
- Limited shelf-life is also a major constraint (4-6 months) and peak seasonal demand.
- Circulation of spurious products in market discourages the farmers for future adoption.

iii) Central and state governments' level

- Agricultural departments, research institutions and extension services have for long been oriented towards chemical input agriculture. It requires a total reorientation of these officials towards developing technologies and promoting eco-friendly horticulture through bio-fertilizers.
- Large number of small and marginal farmers adopts the change with difficulty when there is no subsidy.
- High level of subsidies on fertilizers and pesticides impede the growth of bio-inputs.

iv) Policy changes to promote use of bio-fertilizers in horticulture

- There are two layers of challenges with regard to incentives and risk that the government has to encounter in the process of launching the bio-fertilizer based technology in agriculture, one at the level of farmers or users and the other at the level of the producing units or investors. For greater farm level acceptance the government should do the following:
- Promote and fund research projects for developing improved microbial strains suitable for different agro-climatic conditions, especially for the north-east and dry areas.
- Explore the possibility of insurance or buy-back of bio-fertilizer products to reduce farmers' risk, with the cost of the scheme being shared by the government and the distributing/producing firms.
- Assess the need for subsidizing sales through scientific studies on 'willingness to pay' and provide for affordable inputs to encourage acceptance at this stage. Discriminatory and non-uniform subsidies must be abolished.
- Involve the Ministry of Environment in subsidization and the local bodies for effective monitoring and regulation since bio-fertilizers are directly related to the environmental issues.
- State governments need to organize promotional campaigns and demonstrations drawing the cooperation of producers and gather market feedback for effective utilization of bio-fertilizers.

6.4.3.11 XI Plan new programmes

i. Due to the increasing demand for bio-fertilizers, there is a need to strengthen the existing infra-structures during the XI Plan period by taking new initiative keeping in view the long term demands. Furthermore, in the era of integrated nutrient management systems and organic farming it is imperative to have an Authority under the Ministry of Agriculture, GOI or to accredit the existing laboratories in the country for monitoring the quality and genuineness of different bio-fertilizers produced and marketed. These centers will also frame guidelines for maintenance of genuineness and quality for any commercial production and sale of bio-fertilizers in the country and would, thus, act as National Referral Laboratories besides the network of existing National Biofertilizer Development Centre; Ghaziabad along with its six centres would continue to function. A National Network Centres on Bio-fertilizer Production and demonstration is initiated at the identified public centers under ICAR/SAUs.

ii. A national scheme sought to spread the new biofertilizer based technologies through on-farm demonstration, research and financial assistance to growers. At present about 90% of bio-fertilizer use is in western and southern regions. There should be the programmes for new bio-fertilizers units near all production clusters. Some units must also be developed in the peri-urban areas under entrepreneurial ventures for promotion of such activities

iii. The State governments' to play a proactive role in guiding the spread of the technology than the central government's schemes.

iv. Public intervention through monetary or other means is justified for building up a market for an input promising social and longer term gains. The emphasis of any government policy would be in popularizing the use at the farmer level through varietal improvement, information dissemination, risk coverage and also sales subsidies, if applicable. The government must, however, help the small units financially or otherwise in developing suitable strains and carriers through research.

v. Due to the increasing demand for bio-fertilizers, there is a need to strengthen the existing infra-structures during the XI Plan period by taking new initiative keeping in view the long term demands. Furthermore, in the era of integrated nutrient management systems and organic farming it is imperative to have an Authority under the Ministry of Agriculture, GOI or to accredit the existing laboratories in the country for monitoring the quality and genuineness of different bio-fertilizers produced and marketed. These centres will also frame guidelines for maintenance of genuineness and quality for any commercial production and sale of bio-fertilizers in the country and would thus act as National Referral Laboratories. Any bio-fertilizers production units under public and private domain would seek annual certification from these laboratories.

6.4.4 Popularizing of Composting Units, Establishing Bio-Degradable/Organic Matter Composting Units and Vermi-Composting Units

Composting is a biological conversion of heterogeneous organic substrates under controlled conditions into a hygienic, humus rich, relatively stable product that conditions soils and nourishes plants. Composting offers several benefits such as improved soil health, fertility, biodiversity, agricultural productivity and better environment. Compost is more acceptable by both urban and rural masses interested in utilizing nutrient rich organic waste as value-added products. With the aim to expedite the process and improve the quality of finished product, efforts are being made to use effective microorganisms, microbial slurry, use of worms, cellulolytic and lignolytic microorganisms along with organic waste to prepare compost. Each method has its own merits and demerits and the choice of method depends upon the availability of resources.

6.4.4.1 Substrates suitable for composting

- Agricultural and farm wastes, plant residues and byproducts, animal wastes and biogas slurry.
- Municipal solid waste including city waste, household, canteen and restaurants, etc.
- Wastewater sludges include aerobic or anaerobic sewage from treatment plants.
- Food processing wastes like canning industries, fish and shellfish wastes, slaughterhouse residues and effluents.
- Industrial wastes as press mud, distilling effluents, paper wastes, cellulosic and lignolytic residues, wood bark and cork residues.

6.4.4.2 Methods of composting

Basically, there are two methods of composting *viz*., one, that is based on traditional or passive composting approach and active approach. The first involves stacking the material in pits or heaps to decompose. It takes about 1-2 years for the final product (no turnings). The second method is rapid composting method, which involves pulverization, addition of water, aeration, mechanical stirring and use of microbial inoculants. This method is fast and yields usable compost within two months.

6.4.4.3 Use of microbial inoculants

Lignin and cellulose occur as major components in plant wastes as a lignocellulosic complex, which is highly resistant to decomposition. Microorganisms as cellulose and lignin decomposers can hasten the process of decomposition and reduce bulkiness of material by 6-10%. Commonly used microbes are cellulytic fungi *Aspergillus* sp., *Penicillium* sp., *Trichoderma viridae*, *Trichurus spiralis* and *Chaetomium* sp., whereas the lignolytic fungi are in *Pleuretus sajor caju*, *Ployporus versicolor* and *Phanerochatae chrysosporium*. These are applied at the rate of 300g/tonne substrate. All the fungi should be grown separately and

mixed in equal proportion to make the consortium. Similarly, bacterial inoculants should be grown on synthetic medium before use.

Presently, effective microorganisms (EM) concept is employed for effective composting It is basically a consortium of selected microorganisms like lactic acid and photosynthetic bacteria, yeast and filamentous fungi. All these microbes are mutually compatible with one another and co-exist in liquid culture below pH 3.5. Use of EM as activator brings down the composting period to 4 weeks. This technology can effectively be employed to degrade kitchen waste, municipal solid waste, radioactive waste (reduction of radioactivity through bioremediation), industrial effluents and sewage, and agricultural wastes to get compost ready within 40-60 days depending on temperature, moisture and type of biomass used. EM has powerful antioxidant property and, thus, removes odour by suppressing harmful gases.

6.4.4.4 Vermi-culture, composting and organic waste recycling

Harnessing earthworms as versatile natural bioreactors is referred to as farmer's friend. The process of composting organic wastes through domesticated earth worms under controlled organic wastes through domesticated earthworms under controlled conditions is vermin-composting. Earthworms have tremendous ability to compost different biodegradable materials. Wastes subjected to earthworm consumption decompose 2-5 times faster than in conventional composting. During composting the wastes are de-odourised, pathogenic micro-organisms are destroyed and 40-60% volume reduction in organic wastes takes place. This technology depends on the feeding, excreting and breeding potentialities of the worms. Of many species of earth worms tested, *Eisenia foetida*, *Eudrilus eugeniae* and *Perionyx excavatus* are in the order of preference for their ability to compost organic wastes. It is estimated that the earthworms feed about 4-5 times their own weight of material daily. Thus one kg of worms decomposes approximately 4-5 kg of organic wastes in 24 hours. Vermiculture Biotechnology is gaining acceptance for management of organic solid waste of diverse categories including leaf litters mixed with cow dung, leaf litters, agro-wastes like straws, feed residues, green leaves, grasses, toppings from trees, cattle shed wastes, kitchen wastes, animal dung (with the exception of droppings of poultry), vegetables / fruits / flower wastes from markets etc. This technology denotes the use of earthworms as versatile natural bioreactors for efficient biodegradation of organic solid wastes.

Box
Advantages of Vermi-compost

- Rich in nutrients (0.50 - 1.0% N, 0.15 - 0.56% P_2O_5 and 0.06 - 0.30% K_20)
- For organic farming, vermin-compost is the ideal nutrient resource.
- It improves the pH of the soil (acidic or alkaline soil to neutral soil). Wastelands can also be converted to fertile land.
- Vermi-compost increases the soil texture, fertility and soil moisture and reduces the water requirement in long run.
- The optimal carbon / nitrogen (C/N) ratio is available in vermin-compost which determines the quality of compost.
- Increases productivity and quality in different horticultural crops.
- Provide safe and clean environment.

6.4.4.5 Scope of vermi-composting

With the present day organic movement and adoption of safe INM practices, vermi-compost play a major role. Civic bodies, municipal corporations, NGOs and farmers have started production and demonstration of vermin-composting. By using vermi-compost as a soil amendment, yield and quality have been enhanced in growing of different horticultural crops like grape, pomegranate, banana, mango, cashew, coconut, orange, lime, strawberries, different vegetable and spices crop in peri-urban and urban areas, kitchen gardens, farm houses, contract farms, etc.

It has been estimated that organic resources available in our country can produce about 20 million tonnes of plant nutrients (NPK). The five major crops, i.e. paddy, *jowar*, wheat, *bajra* and maize alone are estimated to yield approximately 141.2 mt of straw and legumes add another 10 mt. Furthermore, the estimated domestic waste is about 25 mt, cattle manure 320 mt and poultry manure of 3.3 mt generated annually in India. On the supply / demand side the estimated domestic fertilizer production during 2003-04 is about 14.2 mt as against the consumption of around 17.5 mt leaving a gap of 3.3 mt which is now met through import. Thus, vermin-compost technology has potential to meet the organic manure requirements in both irrigated and rain fed areas. It has tremendous prospects in converting agro-wastes and city garbage into valuable agricultural input. It will also provide a safe and clean environment.

6.4.4.6 Government initiatives

The Department of Science and Technology promoted the adoption of vermi-compost technology in over 20 states in India. Several vermi-composting units have been established producing 5 to 1,000 tonnes per year of compost. The various techno-economic parameters for establishing a 150 tpa vermin-hatchery cum compost unit cost is Rs. 6.265 lakhs. In a state like Punjab, more than 1,500 vermi-composting units were set up by individuals and/or organizations in rural / urban areas. Furthermore, there are several R&D and demonstration projects being supported by the Department of Science & Technology & Department of Biotechnology, Ministry of Science and Technology, Government of India.

Besides, different DST and DBT programmes, other organizations like NABARD and NHB have initiated several schemes for establishing such units for imparting trainings on different aspects of vermin-composting. The well worked out training module and complete technology package on vermin-culturing/ vermi-composting have been implemented in the entire country. A national workshop was organized in Wardha in order to test the module at field level. The state level training workshops on vermi-composting are also conducted in various parts of the country.

Amongst research institutions, Indian Institute of Technology, Kharagpur (WB), Gramodaya Vishwavidyalaya, Chitrakoot (MP), etc. are working on developing model units for effective composting of different types of organic wastes.

6.4.5 Establishing a National Bio-fertilizer and Bio-Pesticide Training Institute

Bio-fertilizers and bio-control agents are to play a major role in the era after adoption of INDIAGAP, which is under discussion. Almost all the different growing systems, integrated nutrient management, organic framing, GAPs, etc. demand huge requirement of different bio-fertilizers and bio-control agents for different agro-climatic regions. Hence, to impart practical hands-on training on different aspects of bio-fertilizer and bio-control agent production maintenance of quality and storage techniques are to be imparted on pilot scale to farmers, small scale rural entrepreneurs, etc. Hence, to accomplish this goal, a second institute other then NIOF, Ghaziabad is proposed to be established at Baramati (Maharashtra) exclusively for training personnel for production and popularization of this sector. This institute will be initially granted a sum of Rs. 10.0 crores.

In this new millennium, concerted efforts should be made to adopt integrated approach in nutrient management using inorganic and bio-fertilizers and organic manures for sustained production of different crops for sustainable production in horticulture.

6.4.6 XI Plan Programmes/ Initiatives

Increasing awareness among the farmers about the ill effects of inorganic fertilizers on ground, water pollution and soil salinity has resulted in increased application of organic compost to the crops. Many farmers across India are now venturing into organic farming to cater to the niche markets. In such a scenario, organic manures generated from crop

residues, city/urban wastes would continue to be applied on large scale in years to come.

Besides being a routine programme, vermi-composting and organic waste composting should be popularized more for waste recycling and income generation in rural and peri-urban areas. Suburbs of cities and villages around urban centres can be ideal locations for setting up vermin-culture hatcheries on a large scale, from the view point of availability of raw material and marketing of the produce. As use of the compost is said to have ameliorative effect on product from fruit, flower and vegetable crops, the units can be established in areas with concentration of fruit and vegetable farms and floriculture units or in areas where raw material is available freely or at a nominal cost.

6.4.6.1 Strengthening of centres for diagnosis of tissue nutrients and soil health and establishing new centres

Traditional framing systems have caused a lot of damage to soil, ground water and water bodies, flora and fauna, wide-scale micro-nutrient deficiencies, problems of pesticidal residues, etc. Establishing Tissue Nutrient Analysis Laboratories in different regions can help in better nutrient management and their use efficiencies, better use of natural resources, minimal nutrient loss through leaching and volatilization etc. Hence, it is proposed that different laboratories at SAUs be accredited after providing different sophisticated equipment for efficient plant, soil and water analysis. Following centres are identified;

Table 6.14 Strengthening of the existing units and establishing new units of tissue nutrient analysis laboratories

Sl. No.	Particulars	Budget allocation during XI Plan (Rs. in crores)	Total (Rs. in crores)
1.	**Strengthening of existing Tissue Nutrient analysis laboratories**		
a.	IARI, New Delhi	0.5 x 22	11.0
b.	PAU, Ludhiana		
c.	SKUAST, Srinagar (J&K)		
d.	RAU, Udaipur		
e.	NRC Citrus, Nagpur		
f.	YSPUH&F, Solan		
g.	GBPUA&T, Pantnagar		
h.	CISH, Lucknow		
i.	BCKVV, Kalyani		
j.	AAU, Jorhat		
k.	RAU, Samastipur		
l.	JNKVV, Jabalpur		
m.	IIHR, Bangalore		
n.	TNAU, Coimbatore		
o.	UAS, Dharwad		
p.	IISR, Calicut		
q.	MPKVV, Rahuri		
r.	GAU, Anand		
s.	NRC on Grapes, Pune		
t.	IGAU, Raipur		
2.	**Establishing new Tissue Nutrient Analysis Laboratories**	1.0 x 10	10.0
a.	ANGARAU, Hyderabad		
b.	CAU, Imphal		
c.	BAU, Ranchi		
d.	OUA&T, Bhubaneswar		
e.	ICAR Complex, Barapani		

f.	UAS, Bangalore		
g.	KAU, Thrisur		
h.	BSKKV, Dapoli		
i.	BHU, Varanasi		
j.	CPCRI, Kasaragod		
		Total	**21.0**

Table 6.15 Financial requirement for establishing the national referral laboratory on bio-fertilizers and strengthening the national network centre for bio-fertilizer production and demonstration

Sl. No.	Particulars	Budget allocation during XI Plan in crores (Rs.)	Total (Rs. in crores)
1.	**National Referral Laboratory on Bio-fertilizers**		
	a. IARI, New Delhi	2.0 x 5	10.00
	b. GBPUA&T, Pantnagar		
	c. MPKKV, Rahuri		
	d. CAU, Imphal		
	e. UAS, Dharwad		
2.	**National Network Centres on Bio-fertilizer Production**	1.0 x 12	12.0
	a. College of Agriculture, Pune		
	b. TNAU, Coimbatore		
	c. KAU, Vallanikara		
	d. RAU, Samastipur		
	e. AAU, Jorhat		
	f. OUA&T, Bhubaneswar		
	g. IIHR, Bangalore		
	h. NIOA, Faridabad		
	i. GAU, Anand		
	j. BAU, Ranchi		
	k. JNKVV, Jabalpur		
	l. HAU, Hisar		
3.	**National Biofertilizer Development Centre, Ghaziabad and its six centres**		25.0
		Total	**57.00**

Table 6.16 Programme for vermi-composting, organic waste recycling/composting units

Particulars	Total units existing in the country	Units established during X Plan	New units to be established under XI Plan	Budget allocation (Rs. in crores)
Popularizing of composting units				
Establishing vermi-composting, bio-degradable/organic matter composting units	50	12	50	50 x 0.50 = 25.0
			Total	**25.0**

Table 6.17 Establishing a National Bio-fertilizer and Bio-pesticide Training Institute

Sl. No.	Particulars	Budget allocation during XI Plan (Rs. in crores)	Total (Rs. in crores)
1.	Establishment of National Bio-Fertilizer and Bio-pesticide Training Institute at KVK, Baramati (Maharashtra)	10.0	10.0
		Total	**10.0**

6.5 INTEGRATED PEST AND DISEASE MANAGEMENT

Integrated Pest Management in Agriculture as one of the key requirements for promoting sustainable agriculture and rural development. It aims at a judicious use of cultural, biological, chemical, host plant resistance/tolerance, physical-mechanical control and regulatory control methods. Application of chemical pesticides during flowering leads to destruction of natural enemies, pollinators and honey bees, human/cattle poisonings; bio-magnification and accumulation in non-target niches, deleterious effects on wildlife; development of resistance; secondary pest outbreak, pesticide residues, and soil and water pollution. Indiscriminate use of pesticides has led to resurgence of sucking pests like leafhoppers, white flies and mites. Besides, a few pests like fruit borer, *Helicoverpa armigera* on tomato, diamondback moth, *Plutella xylostella* on cabbage and cauliflower, and pink mealy bug, *Meconellicoccus hirsutus* on grape are difficult to control even with repeated pesticide applications. Spraying the canopy of horticultural crops can result in large-scale environmental pollution, mortality of bees, and other pollinators and birds besides animal and human health problems. High levels of pesticide residues have been detected in cabbage, cauliflower, tomato, capsicum, gherkins, leafy greens, okra, brinjal, grape, guava and spices like pepper and cardamom. Therefore, use of biocontrol agents can provide sustainable protection from pests and diseases enhancing the quality by way of pesticide residue-free produce.

6.5.1 Bio-pesticides

These are green pesticides of biological origin, e.g. viruses, bacteria, fungi, Bacloviruses {nuclear polyhedrosis virus (NPV) and gramilosis viruses (GV)} etc. are important and specific in infecting closely related species of caterpillars attacking various crop plants e.g., tomato and potato. Use of commercial formulations of *Bt* has been effective in controlling shoot borer of ginger, turmeric and *Metarrhizium* sp. and *Baeuveria* sp. in control of root grub of cardamom and mango mealy bug are some of the proven technologies.

During 1999, there was a severe incidence of Diamond Back Moth (DBM) on cauliflower/cabbage crop around Delhi, which was controlled effectively with *Bacillus thuringiensis* (*Bt*) and neem based bio-pesticides. The incidence of coconut mite in the states of Kerala, Tamil Nadu, Andhra Pradesh, Karnataka and Pondicherry is being controlled with the use of neem-based formulations. Field trials with *Hirsutella thompsonii* are also being tested in the above states and the results are encouraging.

6.5.2 Antagonists in disease management

These microbes being used against the pathogenic soil-borne plant pathogens like *Pythium* sp., *Phytophthora* sp., *Fusarium* sp., *Rhizoctonia solani*, *Sclerotium rolfsii*, *Ganoderma* sp., *Thielaviopsis paradoxa* etc. causing pre- and post-emergence damping-off, root rots, collar rots, wilts, or other complex diseases in several crops like vegetables, ornamentals and plantation crops can effectively be controlled by application of *Trichoderma* spp. Bacterial antagonist, the fluorescent pseudomonads (*Pseudomonas fluorescens*) is an effective fungicide.

6.5.3 Components of IPM

- IPM strategies include a number of components and as listed below;
- Use of safe pesticides
- Proper field sanitation practices.
- Practicing deep tillage and optimum fertility management operations.
- Adopting beneficial agronomic manipulations like crop rotation, shifting of planting dates and crop duration, trap-cropping, destruction of alternate hosts, destruction of off- types and volunteer plants, pruning and defoliation.
- Efficient water and nutrient management.
- Conservation and utilization of natural enemies.
- Several biocontrol strategies have been tried to control pests. Some of the promising bio-control agent used for horticultural ecosystem includes Bio-control.
- Trichogrammatid Kegg parasitoids used alone or in combination with *Bacillus thuringiensis* var*. kurstaki* or baculoviruses for management of lepidopterans.
- Coccinellid beetles for the management of mealy bugs and scale insects.
- Lace wing bugs for control of aphids and soft bodied insects.
- Parasitoids for management of coconut leaf-eating caterpillar.
- Parasitoids and predators for San Jose scale and woolly aphid in apple.
- Phytoseiid mites for tetranychid mites.
- Entomophilic nematodes for soil-borne pests.
- Baculoviruses for Rhinoceros beetle control in coconut and several other lepidopterans.
- Entomofungal pathogens for several insect pests and mites.
- Fungal and bacterial antagonists for plant diseases and phyto-nematodes. In addition, exotic biotic agents have been introduced for the management of accidentally introduced exotic pests.
- Modification in cultural operations like avoiding prophylactic sprays, adopting strip treatment, spot application of pesticides to only those areas with heavy incidence of pests, applying pesticides to the soil to avoid direct contact of pesticides with natural enemies.
- In fruit crops, the infested trees could be marked and if no biotic agent is able to suppress, then only the marked trees could be sprayed with suitable pesticides.
- In vegetable and certain spice crops, skip row treatment with pesticides has been effective conservation of natural enemies.

6.5.4 Technologies Developed for use of Bio-Control Agents

Due to the continued research by different institutions, there are different IPN and IDM packages available. Some of technologies developed on horticultural crops are listed hereunder;

i) Citrus

- Control of cottony cushion scale (*Icerya purchasi* Maskell) by introduction of ladybird beetle (*Rodolia cardinalis*) population.

- The Californian red scale (*Aonidiella aurantii*) can be parasitized by *Aphytis* spp. and predated by *Chilocorus nigrita* (@ 10-15/tree) or *Aphytis melinus* (@ 2000/tree).
- *Verticillium lecanii* (@ $3x10^8$ spores/ml) is effective in reducing the population of green scale under humid conditions.
- *Cryptolaemus montrouzieri* is suggested for the suppression of mealybug (*P. lilacinus*).
- Release of *Trichogramma chilonis* (500 adults per tree) is recommended for suppression of *Papilio* spp.
- Citrus aphid (*Toxoptera aurantii*) can be suppressed by releasing *Cheilomenes exmaculata* (@ 50/plant).
- Release of *Mallada boninensis* @ 20 to 50/plant is recommended for controlling citrus leaf miner (*Phyllocnistis citrella*).

ii) Custard apple

- Release of *C. montrouzieri* (250/tree) helps in clearing the mealy bug.

iii) Grape

- The pink mealy bug (*Meconellicoccus hirsutus*) and scale can be controlled by *C. montrouzieri* (@ 5000/ha). This has been commercially practiced by farmers of Maharashtra, Andhra Pradesh, Karnataka and Tamil Nadu.
- *Spodoptera litura* and *Helicoverpa armigera* can be minimized by the application of NPV @ $1.5x10^{12}$ POB/ha.

iv) Guava

- The guava aphid (*Aphis gossypii*) is effectively suppressed by *C. sexmaculata*, *Scymnus* sp., *C. nigrita* and *C. montrouzieri* (@ 20 adult beetles/tree).
- Kalisena S.L., a formulation of *Aspergillus niger* can applied on guava cv. Sardar (1.5 kg/tree with FYM as food base)caused decrease in population of wilt pathogen.

v) Mango

- The release of *Cryptolaemus montrouzieri* @ 50/tree is found very effective in controlling mango mealy bugs.
- *Bacillus thuringiensis* is recommended @ 1kg/ha for the control of leaf webber.

vi) Pomegranate

- The parasitoid (*Leptomastix dactylopii*) is recommended for the suppression of *P. citri*.
- Release of *T. chilonis* @ 2.5 lakhs/ha four times at 10 days interval reduces the fruit borer (*Deudorix isocrates*) infestation

vii) Sapota

- The scale insect (*Coccus viridis*) can be suppressed by *C. nigrita* and *C. montrouzieri* (@ 20 adult beetles/tree).

viii) Brinjal

- The brinjal shoot and fruit borer (*Leucinodes orbonalis*), could be controlled with BIPM (i.e. seedling priming with VAM, seedling root dip in *Trichoderma*, release of *T. chilonis* @ 100,000/ha in two releases and use of EPN @ 1 billion/ha twice at weekly interval; hand picking of affected shoots and destroying; spraying of Bt @1kg/ha

twice at weekly interval.

- Three sprays of Bt. (Halt) @ 2kg/ha at weekly interval starting from initiation of flowering for minimizing fruit borer.

ix) Cole crops

- The diamond back moth (DBM)(*Plutella xylostella*) of cabbage and cauliflower can be controlled by release of *Cotesia plutellae* (Kurdjumov).

x) Okra

- Shoot and fruit borer (*Earias vitella*) are effectively parasitised by *Bracon* and *Chelonus.*

xi) Potato

- Four releases of *Copidosoma koehleri* @ 50,000 adults/ha/release are effective for controlling potato tuber moth.

xii) Tomato

- The combined use of *T. chilonis*, *C. carnea*, Bt. and HaNPV effectively controlled *H. armigera* in tomato.
- BIPM strategy using five releases of *Trichogramma pretiosum* and four sprays of HaNPV were significantly more effective in reducing the larval population of *H. armigera* and fruit damage.

6.5.5 Ongoing Programmes

During the IX Five Year Plan, a central sector sponsored scheme entitled "Promotion of IPM in India" was implemented it covers training programmes of 7 and 15-day IPM was initiated as refresher courses for master trainers and Agricultural Extension Officers and farmers. Furthermore, there was also provision to conduct training programmes on mass production of bio-control agents as well as quality testing of bio-control agents and bio-pesticides. There is also provision for under taking pest/disease monitoring, conservation and augmentation of bio-control agents.

Similarly, under the UNDP project entitled "Development and strengthening of IPM in India" during 1999 several “Season long Training courses” were conducted of which some are exclusively on horticultural crops. As a result some beginning was made and it got further strengthened during X Plan through DBT sponsored training, demonstration and establishment of bio-control production plants in the country.

During January 1999, a national plan of action on IPM was finalized in consultation with the State Departments of Agriculture. Under this programme, among other issues each state envisages to spend at least 50 per cent of their budget on plant protection for promotion of IPM.

6.5.5.1 Ministry of Science and Technology initiatives

Under “Technology Development and Demonstration project” about 24 Integrated Pest Management technology packages were developed of which seven were transferred to industry. At present, about 1,50,000 ha covered has been covered in different agro-climatic zones involving 65,000 farmers. Maharashtra has the maximum users. Several insect sex pheromones successfully synthesized and field-tested for the mass trapping of brinjal shoot and fruit borer. It has also made different botanicals for insect control. A commercial product named ‘Bioprahar’ a bio-pesticide developed by ICGEB, New Delhi has been launched commercially in 2004 for insect control in cabbage and cauliflower.

6.5.5.2 Programmes of Ministry of Agriculture

Different programmes are being carried out under the Directorate of Plant Protection Quarantine & Storage, NH IV, Faridabad along with its network centres be continued. At present, the regional centres exist only in 22 states and one union territory. Therefore, it is proposed that the remaining states and Union Territories. The Central sector scheme "Strengthening and Modernization of Pest Management Approach in India" launched by the central government be continued by the Directorate PPQ&S. Most of the regional programmes in operation under central or state governments to be strengthened during XI Plan need and some 50 more units need to be created in different states. It is also proposed that referral labs status be accredited to the IARI & NCIPM, New Delhi and GBPUA&T, Pantnagar, which have good research infrastructure. These need to establish state-of-the-art facilities for research and act as referral. These centres would work in coordination with PPQ&S, Faridabad. At present the production of bio-control agents and demonstration is being done by the government machinery, it is proposed that during new plan period 12 Regional Centres on Demonstration and Promotions of IPM strategies be established at different SAUs. This would help in creation of facilities for research and also aid in production of quality bio-control agent and demonstration of the proven technologies. These centres will also impart trainings on commercial production of different bio-control agents and their purity maintenance. Besides these, there will be a network of Regional Centres for effective research, demonstration and promotion of IPM strategies in horticultural crops.

To coordinate and promote IPM activities at the national level, the Government of India during 1993 has constituted a Standing Committee on IPM. This Committee reviews IPM strategies for large-scale adoption in the country. An IPM Coordination Committee has also been constituted in each State. These Committees plan, implement and review the IPM programme in the States.

6.5.5.3 International programmes

Over the past two decades, India has received continued assistance through UNDP/UNIDO of the FAO for strengthening the national capabilities in pesticide development and safer and effective application of crop protection agents through Integrated Pest Management (IPM) Programmes. The UNDP/UNIDO supported Sub-programmes namely “Pesticide Development Programme India” and “Strengthening of Pesticide Development Centre” with an aim to improvement of technology in the pesticide formulation by replacing toxic, persistent carriers/ingredients with water based user and eco-friendly formulations. The present sub-Programme is in operation to promote and develop technology for production of environment friendly neem-based products for use in agricultural sector.

6.5.6 Major Achievements under IPM Programmes

6.5.6.1 Development of IPM packages

In order to disseminate the IPM approach uniformly among the extension functionaries and farmers, IPM packages for fruit and plantation crops vegetable crops, spices, tea and coffee have been developed for use by extension functionaries and farmers. The IPM packages are encompassing various management strategies for containing the pest and disease problems. The major IPM practices are cultural (deep summer ploughing, use of tolerant/resistant varieties, crop rotation), mechanical (collection and destruction of pests stages, removal of infested plant parts), biological (conservation and augmentation of natural enemies) and need based use of chemical pesticides preferably in combination with botanicals and bio-pesticides, use of pheromone, stick/yellow pan traps etc. are being designed as a package.

6.5.6.2 HRD through training

Governmental efforts for human resource development in IPM during last seven years have created substantial manpower resources: Master trainers: 2,320; Extension functionaries :

31,326; Farmers : 11,75,451; Women farmers : 1,67,400; NGOs : 7,417; Total : 13,83,914 Training of personnel abroad: A total of 41 policy makers and scientists under the UNDP project "Development and Strengthening of IPM in India" have visited abroad on study tours and 28 officers underwent fellowship training on biological control in cotton and vegetables.

6.5.6.3 Establishment (of central and state) bio-control laboratories

Following enormous research and extension efforts, demand of bio-control agents and bio-pesticides is gradually increasing. In this direction, production units under the control of Central and State Govts. as well as cooperatives are producing different eco-friendly inputs. Various State Departments of Agriculture and Horticulture have taken positive steps for the production of bio-control agents through Central and State Bio-control Laboratories. The Government has recognized the usefulness of biological control approach in the IPM programme. In its effort to promote biological control as a viable input in the IPM approach, the Government of India is providing grants-in-aid @ Rs. 50 lakhs per laboratory for construction of building and purchase of equipments to set up 30 State Biological Control Laboratories. Some of the States have already set up bio-control laboratories from their own resources for mass production of potential bio-control agents for field releases. Besides, some of the NGOs, Private entrepreneurs, SAUs and Cooperatives have also set up mass production units to supplement the governmental efforts.

6.5.6.4 Monitoring pests and diseases occurrence

A working group has suggested measures to the State Governments to identify hot-spots of pest/disease occurrences and keep a watch on the pest/disease situation to undertake timely control measures.

6.5.6.5 Creating bio-control production units

To meet the huge demand for bio-control agents in agriculture, establishment of adequate number of bio-control laboratories in the country is essential. The Government of India has now involved NGOs and other private social sector organizations etc. in setting up of laboratories and provide them grants-in-aid for purchase of equipment for the production and demonstration of IPM technology. Under the Central Sector Plan Scheme "Strengthening and Modernization of Pest Management Approach in India" at present the amount of subsidy is 35% (50% for SC/ST/Women's Organizations) of total cost of equipment subject to maximum of Rs. 5.00 lakhs per unit. These units have to obtain registration of bio-pesticides to be produced from Central Insecticide Board and Registration Committee (CIB & RC) as per Insecticides Act, 1968. These units work in close coordination of Central Integrated Pest Officer-in-charges of CIPMCs of Management Centers in the respective states.

6.5.6.6 promotion of neem based pesticides and other botanicals

A versatile plant like neem offers a wide variety of choice of products and helps the farmers economically in addressing pest management, organic manure, besides several other requirements, as generation of income and employment opportunities. It is popular amongst farmers who have developed traditional management techniques, including seedling production, planting techniques, etc. Beneficial effects of neem-based pesticides are many as neem extracts reportedly control more than 200 species of insects, mites, nematodes, and other major agricultural pests. They are found to be effective against some target pest like Bollworms, Aphids, Jassids, Thrips, Whitefly, Leaf folder, Pod borer, Fruit borer, Leaf hopper, Diamond backmoth etc. which cause damage to crops like Garden pea, Okra, Cauliflower, Cabbage, Tomato, chilli, sweet pepper, brinjal etc.

Other green inputs for agriculture are used in very minimal quantity in India. Some of the popular bio-pesticides include neem-based formulations and *Bacillus thuringiensis* (*Bt*). Consumption of bio-pesticides in India has increased from 83 MT (Tech. Grade) during

1994-95 to 686 MT during 1999-2000 and in case of neem-based pesticide formulation it has increased from 40 MT to 71 MT during the same period in case of *Bacillus thuringiensis*.

6.5.7 Impact of IPM

As a result of implementation of IPM programmes, there is significant reduction in the consumption of pesticides from 61,357 MT (Tech. Grade) during 1994-95 to 46,195 MT (Tech. Grade) during 1999-2000. Safe produce in now available to the consumers. Safe limits in fresh produce has lifted ban on export of crops like grape.

6.5.8 Status of IPM Industry

The Department of Biotechnology is promoting mass scale production of biocontrol agents together with the Biotech Consortium of India Ltd. It has assisted in setting up two pilot plants for the mass production of bio-control agents. The DBT plans to promote small production units in villages by providing training and credits to entrepreneurs. These include Sandoz India Ltd., producing *Bacillus thuringiensis* Berliner-based bio-pesticide since 1992; Hindustan Lever Ltd., producing *Bacillus thuringiensis isreaelensis*- based bio-pesticide using molasses as a culture medium, which is effective against insect pests of vegetables.

Presently, 409 small and medium bio-control units are functioning in the country. Similarly, there are about 50 registered companies producing neem-based pesticides in the country which need to be increased in the XI Plan. EID Parry is still the major manufacturer of neem-based pesticides. Besides, a Delhi-based company is one of the largest producers of bio-pesticides in the country. Now the farmers are using formulations based on Bt, viruses like NPV, and GV, as well as neem-based pesticides. To meet the increasing demand, the industry has to scale up investments in biofertilizers and biopesticides.

6.5.9 Focus During XI Plan

Each state/union territory should have at least one Nodal Officer for proper planning and implementation of the entire IPM activities.

The proven IPM packages developed at the different centres/ AICRP should be fine-tuned by setting up demonstration units on farmer's fields to suit different horticultural crops.

Programmes funded under central/state schemes be further strengthened for production of sufficient quantity of bio-control agents/bio-pesticides as a rural industry. Existing units under public domain should be upgraded with adequate facilities and different private units registered for maintaining the quality and genuineness of the products.

Diverting budget allocation by the states/union territory by 50% from (use of pesticides towards providing increase in area coverage under IPM activities and bio-fertilizers.

Phase wise implementation of programmes on Human Resource Development for improving the knowledge and skill of farmers on use of IPM and bio-fertilizers.

States should ensure implementation of IPM packages on priority horticultural crops especially the export oriented commodities like Spices, Coffee, tea, Cashew nut, fruits (Mango, Apple, Grapes), vegetables (Tomato, Cabbage/Cauliflower and MAPs).

6.5.10 Budget Allotments For XI Plan Programmes

Following budget is proposed for strengthening programmes for promotion of IPM in horticulture (Table 6.18 and 6.19).

Table 6.18 Establishing National Referral Laboratories for Bio-control Agents and Regional Centres for demonstration and promotion of IPM technologies in horticulture

Sl. No.	Particulars	Budget allocation during XI Plan (Rs. in crores)	Total (Rs. in crores)
1.	**National Referral Laboratory for Quality Control of Bio-control agents** a. NCIPM, New Delhi b. PDBC, Bangalore	5.0 x 2	10.00
2.	**Regional Centres on Extension and Promotion of IPM strategies**	1.0 x 14	14.0

South	North	East	West
i. IIHR Banglore	iv. YSPUH&F, Solan	vii. Ranchi	xi. BSKKV, Dapoli
ii. TNAU, Coimabatore	v. PAU, Abohar	viii. RAU, Samastipur	xii. NRC on Grape, Pune, xiii. NRC on Citrus, Nagpur
iii. IISR, Calicut	vi. CITH Lucknow	ix. CAU Imphal, Meghalaya. x. OUAT, Bhubaneswar	xiv. GAU, Anand
		Grand Total	**24.00**

Table 6.19 Number of existing units producing bio-control agents, neem based and other botanicals and organic waste recycling/composting units

Particulars	Total units existing in the country	Units established during X Plan	New units to be established under XI Plan	Budget allocation for XI Plan (Rs. in crores)
Bio-control agent producing units				
Strengthening of the existing units and establishing new units	409	25	50	15.0
Neem-based and other botanicals producing units				
Strengthening of the existing registered units and establishing new units	25	5	50	25.0
			Total	**40.0**

6.6 PRECISION FARMING

A closely related emerging field is precision farming which involves the deployment of modern tools of Information and Space Technology for enhancing productivity through judicious use of resources like land, water, sunlight energy as well as time. In view of the advancements made in plasticulture applications, a beginning has been made for deployment of precision farming technology.

Precision farming, which involves the application of advanced technologies to manage spatial and temporal variability associated with all aspects of production for improving crop performance and environment quality, is one of the components of the NHM. The technology

is being developed and disseminated in a regionally differentiated manner through 17 Precision Farming Development Centres (PFDC) located in different parts of the country.

The enabling technologies of Precision Farming could broadly grouped into five major categories, *viz.* Computers, Global Position System (GPS), Geographic Information Systems (GIS), Sensors and Application Control. Although these systems have been in use individually in the past, it is the integration of these technologies that has enabled farmers and their service providers to do things not previously possible, at levels of detail never before obtainable, and, when done correctly, at level of quality never before achieved. Availability of contiguous blocks of mono crops and equipments needed for survey, recording and analysis on near real time basis has made the Precision Farming technologies in the developed countries heavily dependent on instrumentation.

In the Indian context, vast amount of data on various aspects like soil characteristics, climatic parameters, topographic features, crop requirement in terms of consumptive use and nutritional requirements have been generated and instruments needed for recording these parameters are also available. Technology for delivering the required amount of inputs to the crop through fertigation/chemigation has also been developed in the country. However, the application of Precision Farming as a package in the farmers' field has received attention only in recent years through the initiatives of the PFDCs. The focus is on technology development, which is suitable under Indian conditions. Under the NHM, the PFDCs are being equipped further with the necessary hardware and software needed for perfecting the Precision Farming technology for its application in a cost effective manner.

During the XI Plan, efforts will be needed to transfer the technology to the field level through demonstrations, trainings and incentives to farmers for technology adoption. An amount of Rs.500.00 crore needs to be earmarked for this purpose during the XI plan.

6.6.1 Promotion of Hi-Tech Mechanization and Use of GIS Technologies in Horticulture Production and Post-Harvest Handling

6.6.1.1 Introduction

With the increasing area under horticulture and other allied activities, there is a sharp decline in the labour force to cater to different activities of farm and industry. This trend has caused a concern in every agriculture sector. Since non-availability of labour both skilled and unskilled is the main concern of to make this sector make progress at the desired pace. This condition necessitates the role of mechanization and automation to bring about the required development in this sector. In garden or farm operations there a need for mechanization at every stage. This may start with filling of pots, digging of soil, application of fertilizers, weeding, spray of chemicals, training and pruning, protected cultivation, micro irrigation, harvesting, washing, grading, sorting, packaging, processing, value addition, new product development, etc.

In the area of post-harvest management in fruits and vegetables there is urgent requirement of mechanization/ automation, safe mechanical harvesting, use of computerized systems for handling, development of cold chain technology, designing of environmental friendly biodegradable packages to preserve sensory attributes and enhance marketability, and establishment of cold chain technology, efficient cold storage methods, machine for new product development, etc. Maintenance of nutritional quality and extension of shelf-life and greater appeal are the major attributes of high-tech storage systems.

With stringent WTO and HACCP standards coming into force, it is imperative that production and post-harvest management systems in diverse horticultural crops gradually be made effective, safe and precision oriented.

6.6.1.2 Achievements in mechanization

Different machines have been developed for effective cultivation, intercultural operations, harvesting, grading, packaging and value-addition. These machines need to be popularized at farmers' level for providing subsidies. The different machinery ranging from sprayers and harvesters, potato digger, coconut peeler, etc. need to supply to the farmers to reduce the drudgeries to the farm women, who do the major part of farm operations ranging from harvesting to post-harvest handling activities indifferent horticultural crops.

Machines have been developed for different purposes like cool sterilization for checking sprouting in potato and onion, dehydration of different produce, use of vapour heat treatment (VHT) in major mango for immediate treatment and packaging, mango desapping machine, fruit clipper in Kinnow and other mandarins, banana fig and chip making machine, coconut water packaging, solar driers, juice extractors, etc. need to be popularized in different growing regions.

In Post Harvest Management, mechanization in several places has taken place. This includes, asceptic packaging now being commercially utilized for several juices, requires high capital investment but enables continuous processing.

A large number of machines have been developed for handling of tuber and plantation crops, which are gradually being adopted by the growers.

6.6.1.3 Programmes for XI Plan

There is a need to develop nursery automation for media preparation, budding and grafting, training and pruning, sprayers for different purposes, harvesting devices for perennial tree crops. Harvester for coconut, coconut tree climbing gadget, layout machines for tuber crops, pit diggers and harvesters, imperative that machines be developed in different horticultural crops for different operations. Machines have to be developed for safe handling of produce, machines for different operations like grading (size and colour), sorting, washing, packaging, cold chain management, etc.

There are huge opportunities in developing specialized processing and value-addition machines in tuber crops, spices and MAPs. Hardly, any facilities exist under public domain for processing these produce. Technologies for primary processing of MAPs produce are required so that distress sale by the growers can be minimized by establishing such units in different production clusters.

With booming urbanization there is a need to make available technologies for ready to use/cook semi-processed products in vegetables/greens, spices and condiments, purees, mushrooms, greens, etc. Hence, standardization of simple machineries for primary processing of high value fruits, vegetables, mushrooms, etc. are desired. There is a need to make available cut and graded and packaged/ semi-processed vegetables for city retail outlets chains. Ohmic heating systems are now commercial in USA, Japan in aseptic processing plants. Heat transfer problems in conventional heat transfer techniques have been overcome by use of ohmic heating system thereby preventing the destruction of flavour and nutrients. Commercial ohmic heating based plants are now available with fully automatic temperature control systems. Accordingly, processing of fruits and vegetables for value addition is an indispensable part of horticulture industry. With newer advancement, high tech processes such as asceptic packing, ultra-filtration, hurdle process, vacuum concentration are replacing traditional technologies. These technologies are required all major and minor horticultural crops to make the whole sector more commercially viable and export oriented.

To get precision in different on and off farm operations it is important that machineries be developed. There is ample scope in developing and using GIS based technologies for managing diseases and pests, natural resources, yield prediction, etc. in horticultural crops. Different crop based model need to be developed and validated for major horticultural crops.

Similarly, mechanization has to be continued in the tea, coffee and rubber sector for efficient

processing and value-addition. In coconut, areca nut and spices there is ample scope for development of new machines for different operations ranging from cultural operation to processing. Machines for preparation of different value added products are also desired.

In protected cultivation there is a need to develop computer-aided photo-control, irrigation and fertigation programmes to be standardized to suite Indian crops and low cost structures.

6.6.1.4 Budget Allocation for XI Plan

The budget allocation for different development of mechanization is a must in Hi-tech system is mentioned below. The primary activity of these centers would be to create facilities and capacity building in R&D to cater to the need emerging needs of the horticulture sector. The crop/commodity based programmes are to be implemented by these centers and devise/refine effective technologies on different aspects.

Table 6.20 Promotion of Hi-tech Mechanization and use of GIS technologies in Horticulture

Sl. No.	Particulars	Budget allocation during XI Plan in crores (Rs.)	Total (in Rs. crores)
1.	**Programmes for promotion of Hi-tech Mechanization in horticulture**	2.5 x 8	20.0
a.	CIPHET, Ludhiana		
b.	IIHR, Bangalore		
c.	CPCRI, Kasaragod		
d.	CTCRI, Thiruvanathapuram		
e.	CPRI-RS, Modipuram		
f.	CIAE, Bhopal		
g.	CISH, Lucknow		
i.	IIT, Kharagpur		
j.	Different SAUs	1.0 x 10 = 10	10.0
2.	**Development and use of GIS and computer aided technologies in Horticulture**		
a.	CPRI, Shimla	**2.5 x 2**	**5.0**
b.	IIT Kharagpur		
		Total	**35.0**

6.6.2 Major Recommendations for XI Plan

- Machinery /implement development for mechanization of farm and nursery operations to processing should be given priority.
- Machines should be developed for spraying perennial fruit trees, processing of indigenous horticultural crops, developing new products.
- Different Research centres need to be supported for designing proven prototypes of different machines for different intended uses in different garden operations, spray and nursery activities, harvesting, grading, packaging, processing and value addition etc. For this purpose a sum of Rs. 30.0 crores is allotted to meet the future demand of the industry including the cash crops.
- GIS and computer based technology has to be strengthened with practical services in nutrient and soil based surveys and management, disease and pest management out break and surveillance, etc. For this the identified centers be supported with a grant Rs. 5.0 crores.

CHAPTER VII
ORGANIC FARMING

7.1 INTRODUCTION

The use of organic farming is regarded as the best solution to restore our natural resources, and to safeguard our environment. It is a holistic production management system, which promotes and enhances agro eco-system health including bio-diversity, biological cycles and soil biological activities. The farming system emphasizes upon management practices wherein agronomic, biological and mechanical methods are used for sustainable production avoiding the use of synthetic materials. With increasing health consciousness and concern for environment, organic farming system has been drawing attention all over the world. As a result, there is widespread organic movement. Demand for organic products, especially in developed countries, has been increasing by leaps and bounds. Besides, it is also an alternative for safe agriculture with assured returns.

Almost at a time when India was including organic farming for the first time in its five-year plan in 2001, Organic Farming was simultaneously taking roots in the country. The factors attracting private and public sector attention include; (i) Increasing prospects of organic agri-business trade because of increasing demand for green safe food; (ii) - An approach to sustainable development of farming based rural livelihoods for small farmers, especially in marginal areas. The first factor dominates the organic priorities of the developed world' while the second factor curium the organic farming priorities of the developing world. Even though developing countries have been the late starters the organic as farming and agribusiness tool has spread to over 140 countries during the past five years. Global figures on growth of this sector are impressive. At preset it has taken only 1-2% of agricultural sector but its growth is exponential (15 -25%). In a Country like India it is important to note is that the first initiatives in organic cultivation were taken by farmers NGOs and the private sector agri-business players. Government institutional interventions largely followed to respond to the farmer's and trade needs. Government interventions are mostly related to institutionalizing quality assurance mechanisms, however, the focus is also on supporting of farmland conversion to organic production and mandating/incorporating a comparative element in all related aspects the rough scientific to research.

7.1.1 Farming Systems Approach in Organic Production

The inherent characteristic of organic farming is that, even if one was to focus on a commodity, such as mango or sector such as horticulture, across the agro-climatic regions; it encompasses the entire farming system. Generally, either the farmer is practicing organic system or he is not with including focus on lead crops horticulture cash crops. Similarly, organic system integrates various components of farming. If the farmer is an organic fruit producer, the other food crops he produces will also be organic, and so will be his livestock husbandry system – the fodder, manure and milk he produces. Therefore, owing to the strong inter-linkages of this sector within the farming activities; the sector will be better addressed in the XI Five-year plan of the country this monument can target interventions to support Farm CONVERSION to ORGANIC by FARMERS and DECLARE ORGANIC AREAS (Mountains and Hills, Dry Lands, North East, Watershed, etc. where conventional agriculture has not been successful, rather than individual ORGANIC CROPS/ COMMODITIES.

This report, therefore, even though keeping horticulture in mind (diversification of farming for better income generation by the farming families), ensures focus on organic farming systems and agri-rural communities with direct or lateral impact on several components of organic farming.

7.2. ORGANIC PROGRAMME AND PERFORMANCE DURING X PLAN

During the tenth five-year plan, for the first time, organic farming was selected as one of the new areas for attention. Resources were allocated to launch a National Programme on Organic Production, which is being implemented by Ministry of Commerce. At the same time, Ministry of Agriculture, through National Centre of Organic Farming (NCOF) launched a major focus by implementing an Rs 57 core project on improving organic input supplies and training.

The first chapter of this report describes the activities and achievements of this institutional support to the movement that still remains firmly in the hands of farmer's organizations and private sector.

In the X Plan only one scheme was included which the Ministry of Agriculture; is implementing; qualifies for assessment here. In addition, organic received attention under several other programmes of APEDA and other boards of Commerce ministry, National Horticulture Mission and National Horticulture Board. The achievements of these other agencies are covered under state of the affairs of India organic but the performance appraisal of their schemes is not done here. Further, to maintain focus, the detailed reporting on the activities and achievements of the scheme is presented in Annexure 7.1 and only brief narration is given here.

7.2.1. Objectives

- To promote organic farming in the country
- To promote production of organic inputs

7.2.2. Interventions

The schemes were implemented through following interventions,

- Support to Organic Input Industries, demonstration, training
- Service Providers Scheme to help organic farmers Trainings for capacity building of farmers and institutions
- Model organic farms and market development and promotion

7.2.3 Programme Thrust/Milestones

The programme thrusts and milestones achieved are briefly listed below:

- Under promotion for organic input production scheme, so far the capacity has been created for production of 13,000 MT of agro waste compost, 3150MT of biofertilizers and 30,000MT of vermi culture (for onward production of vermicompost).
- Under promotional activities more than 1000 training programmes have been conducted and more than 22,000 personals have been trained in different aspects of organic farming.
- More than 2000 demonstrations on organic management and inputs have been arranged.
- Out of 150 model organic farms sanctioned more than 60 farms have so far been developed and with in next one year time they will come up as technology dissemination centers.
- With the help of over 200 service providers about 1,50,000 farmers have been identified and are being supported for conversion of organic. Out of these 50,000 farmers have already been registered with certification agencies. Total registered area brought under conversion is over 52,000 ha.

- In collaboration with FAO defined and documented organic package of practices for 20 important crops for six different states of the country.

7.2.4 Budget

Of the total budget allocation of Rs 57 crores, the total funds utilized are Rs 35.12 crores

Table 7.1. Major components, target and achievements (Physical and Financial)

Components	Total target for X Plan	Funds earmarked (lakh)	Target achievements (till 09/06)	Funds Sanctioned
Training activity				
1. For Certification/Inspection/SP	50	25.50	35	17.85
2. On Prod and QC of inputs	200	102.0	135	68.85
3. Training for extension staff	200	78.00	190	74.10
4. Training for farmers	800	104.00	752	97.76
Demonstrations				
1. On Organic Input	3200	320.0	2309	230.90
2. On enriched biogas slurry	600	96.00	641	102.56
Establishment of input industry				
1. Agro-waste compost	30	1200.0	NA	832.00*
2. Biofertilizers	30	600.0	21	200.00*
3. Vermiculture	350	525.0	347	520.50
Appointment of Service providers for group organic farming and certification	300	900.0	272	816.00
Setting up of model organic farms	200	800.0	175	700.00
Market Development and Promotion	-	125.50	-	86.00
Establishment cost of NCOF and Building construction etc.	-	NA	-	NA
Total		**4876****		**4156.52****

* Expected (as the implementation is in process). Funds provided to NABARD and NCDC

** Excluding the establishment cost of NCOF

Table 7.2 September 2006 Major components, target and achievements (Physical and Financial)

Components	Total target for X plan	Funds earmarked (lakh)	Target achievements (till 09/06)	Funds utilization
Training activity				
5. For Certification/Inspection/SP	50	25.50	35	17.85
6. On Prod and QC of inputs	200	102.0	135	68.85
7. Training for extension staff	200	78.00	190	74.10
8. Training for farmers	800	104.00	650	84.50
Demonstrations				
3. On Organic Input	3200	320.0	1500	150.00
4. On enriched biogas slurry	600	96.00	520	83.20
Establishment of input industry				
4. Agro-waste compost	30	1200.0	NA	832.00*
5. Biofertilizers	30	600.0	21	200.00*
6. Vermiculture	350	525.0	200	300.00
Appointment of Service providers for group organic farming and certification	300	900.0	202	606.00
Setting up of model organic farms	200	800.0	150	600.00
Market Development and Promotion	-	125.50	-	86.00
Establishment cost of NCOF and Building construction etc.	-	829.00	-	410.00
Total		**5705.00**		**3512.5**

* Expected (as the implementation is in process). Funds provided to NABARD

7.2.5 Targets and Achievements

Under this scheme so far 150,000 farmers have been identified and are being supported for conversion to organic. They are already registered with the certifying agencies. Total area brought under organic conversion is over 52,000 hectares as of today (October 2006), which is over and above the existing area of 173,000 hectares, already converted to organic.

7.2.6 Implementation Constraints

The following constraints were identified during the implementation of the programme:

- Due to late sanction the project really took off only during 2004-05 and significant activities started only from the year 2005-06.
- Absence of research support for conversion and management strategy
- Limited availability of funds under limited components
- Reluctance of state Governments in accepting a technology without research and field data support
- Limited infrastructure and man power at the disposal of NCOF
- No support for certification cost

7.2.7 Other Constraints

- Agricultural research and extension institutions, specially universities- KVKs were assumed to provide the expertise to promote organic farming for implementing the scheme. It was not so.
- Inputs were considered a key constraint to promoting organic farming. And therefore there was unbalanced support to promoting vermicomposting and biofertilizers. Farmers instead needed support to conversion to organic through their efforts and to compensate them for undergoing the certification process.
- The scheme provided much needed thrust to organic in many states but it could not be molded to fit organic needs of many states.
- The schemes created institutional mechanism under the scheme (NCOF and RCOF) at the central level but it did not support states to establish separate institutional infrastructure with adequate human resources to for promote organic farming. The same officers at the Centre and at the state, district and local level, were dealing with fertilizer and pesticide promotion as well as organic farming. The group feels the approach remains flawed in institutional structure to promote organic farming.
- Scheme assumed there is availability of field level technical people to spread organic. Further, most of the field level extension staff of many service providers, simplified their understanding of organic as replacement schemes of inorganic fertilizers with vermin compost. The needed special focus on creating a critical mass of well trained organic extension specialists who could train farmers / organic producers is as yet missing. India needs to build human resources and institutional capacities in all fields, technology research, extension, awareness, strategy development, marketing, supply chain development etc.
- It was assumed that inputs and production need focus but conventional marketing and supply chain systems will take care of organic trade. That can not happen. Needs of organic commodity trade and marketing are very different and unless infrastructure investments are not made in this area and policy changes removing some trade constraints are not made, the limitations will not allow growth of organic marketing and trade.

7.2.8 Performance Evaluation and Impact Analysis of the Scheme

The key players of growth and performance of organic in India during the five year plan included:

i. The X five year plan scheme implemented by Ministry of Agriculture through national Centre of Organic Farming Programme/Schemes

ii. Efforts of other agencies in the Ministry of Commerce supporting organic initiatives, under its other existing schemes such as APEDA, Coffee Board, Tea Board, Coconut Board, Spices Board.

iii. National Horticulture Board and National Horticulture Mission programmes

iv. Organic agribusiness community

v. NGOs who got engaged in promoting organic farming as a strategy to sustainable livelihoods of small and marginal farmers of India

vi. The large number of organic farmers and their groups / associations who largely led the technology innovations for organic production.

The key players are listed here to explain that planned schemes though important were supplemented by the efforts of other key players to have an impressive growth of organic farming and agribusiness in India during these years.

The institutional interventions by APEDA, Tea Board, Coffee Board, Spices Board of Ministry of Commerce, made tangible contributions towards building institutional capacities of India in organic export sector, in particular of horticulture commodities, which put India on the organic map of the world. India is, today, among the few countries alongside EU, US, Japan, Brazil, Argentina, and Switzerland which have adopted organic standards and put in place an inspection and certification mechanism.

7.2.9 Some Successful Components

The organic group debated on the objectives and achievements of X Plan. There was general consensus that the scheme was an appreciable step of institutional intervention to build institutional capacities of India to facilitate promotion of organic farming and marketing.

The scheme contributed, along with efforts of other agencies, NGOs, private sector and farmers, in building the organic movement of India, which did not exist in 2001. It made tangible contributions to increase the number of organic farmers and put in place, through innovation, the SERVICE PROVIDER APPROACH. The service providers filled the institutional gap which existed due to the lack of interest of agricultural universities and ICAR institutions in joining the organic initiative, during this period. It deserves appreciation. The group felt that the most important achievement under this scheme is the institutionalization of Service Provider concept in which NGOs and farmers organizations have been made partners. It is a good innovation and will need to be strengthened further during XI Plan.

The target of the scheme to help convert over 300,000 farmers owning 200,000 hectares of farmland into organic by March 2007 is an appreciable achievement. This will increase the certified organic farmland area of India from 173,000hectares to 373,000 hectares. We believe that there is under reporting of certified organic area as per NPOP norms, in India and the actual organic farmers and organic area in all probability is much higher.

The inherent limitation in the mission and objectives of the scheme, identified by the group, was partly the problem of perception, where organic programme included production and supply of organic inputs. It simplified the organic concept too much. The scheme was dominated by the focus on organic inputs production on large scale, with the assumption that

it will help replace use of inorganic inputs. Trainings and other programmes likewise remained dominated by vermi compost production. Other production factors for building the organic carbon content of the soil, crop choice and much needed strengthening of weak supply chain systems remained ignored.

7.2.10 Recommendations

- Expansion of Service Providers Initiative is recommended strongly. It will help build a strong and credible institutional mechanism to facilitate farmers conversion to organic farming through training and other back up support, production technologies, setting up internal control systems for easy and cheaper certification, post harvest, processing value addition, enterprises, supply chain management systems and domestic marketing.
- Networking of model organic farms across the country is recommended; as places for training and supply of organic technologies relevant to local agro ecological conditions.
- Organic market development sector needs major thrust on developing supply chains and related infrastructure. It is necessary for strengthening both domestic markets and export.
- What should be discontinued is dominating attention to input promotion, biofertilizer industry, vermicomposting plants etc. The strategy that inputs need to be essentially generated on farm should be promoted. Government should only create a favourable policy environment for the private sector to invest and operate in this area.

The understanding reached between the Ministry of Agriculture and Commerce through the Synergies Paper *viz. a viz.* organic farming (August, 2004) is appreciated because it clears the way for keeping same NPOP standards for organic production standards, both for domestic and international markets. WTO and other organic trade agreements between EU, USA, Switzerland and other nations will require that we have international standards to control organic imports into the country. Lesser domestic standards will allow exporting countries dump sub standard organic commodities in India. That will not be in the interest of Indian organic producers.

7.3 OTHER SCHEMES ON ORGANIC HORTICULTURE AND PLANTATIONS

Organic horticulture and plantation commodities farming received support under several other schemes of the National Horticulture Board, National Horticulture Mission, and the Commodity Boards such as Tea Board, Coffee Board, Spices Board, Coconut Board, Cashew nut Board etc. Information on organic area and production of each commodity by the end of X Five Year Plan was difficult to ascertain, except the following figures (Table 7.3) on export of organic commodities form India. It gives fair assessment of the scale of business and potentials.

Since these schemes covered organic under their over all programme and do not fall under planned five year organic schemes, explicitly approved, therefore, no more details are provided here on budget, programme efficiency and recommendations for continuation.

Please see Table 7.3 and 7.4 for data on export of organic commodities from India during the X plan and potential for XI Plan.

Table 7.3 Major organic products exported from India in last four years

Products	2005-06		2004-05		2003-04		2002-03	
	Export QTY. (in M.T.)	Value (in Lakhs)	Export QTY. (in M.T.)	Value (in Lakhs)	Export QTY. (in M.T.)	Value (in Lakhs)	Export QTY. (in M.T.	Value (in Lakhs)
Honey	2117.3	3904.8	3814	2318.80	526.0	686.0	122.0	164.0
Tea	1875.0	3841.5	1876	4788.63	1996.6	2886.9	1531.3	4071.0
Spices	543.9	374.6	350	516.66	625.0	394.1	79.0	141.7
Coffee	167.2	136.1	162	146.63	97.2	82.0	46.2	46.4
Rice	1630.1	893.2	1070	164.59	578.0	118.0	962.0	378.0
Others	1619	3666	1072	1598	2465	3098	1421	1395
Total	**7953**	**12816**	**8344**	**9533**	**6288**	**7265**	**4161**	**6196**

Table 7.4 Showing projected export targets of agro products for the XI five year plan period. Source: APEDA, Ministry of Commerce

Figures in Rs Crores

	2007-08	2008-09	2009-10	2010-11	2011-12
Scheduled Products					
Floriculture & Seeds	544	625	718	825	950
Fruits & Vegetables	2775	3190	3665	4115	4845
Processed Fruits & Vegetables	2655	3050	3505	4030	4635
Livestock Products	5285	6075	6958	8030	9235
Other Processed Foods	3690	4060	4465	4910	5400
Non Basmati Rice	4645	4875	5115	5370	5635
Total Scheduled Products	19564	21875	24453	27280	30700
Non Scheduled Products					
Basmati Rice	4245	4455	4680	4910	5155
Wheat	0	0	0	0	0
Other Cereals	545	570	595	625	655
Total Non Sch Products	4625	5025	5275	5535	5810
Grand Total	**24219**	**26900**	**29728**	**32815**	**36510**

Note: Many of these items are organic, e.g. Basmati. Organic by itself is value addition and therefore considerable percentage of most of these commodities can be produced and sold as organic, adding premiums in between 35% to 70 % or even more.

7.4 ORGANIC FARMING DURING XI PLAN

7.4.1 Current Status

From the state of an unknown opportunity in agriculture in the beginning of X Plan (except known to few in agribusiness)to being talked about a viable alternative tool to address some of the ills of Indian agriculture, organic agriculture has made a credible performance during these years. It is a combined effect of farmers efforts, NGOs work, Govt interventions and market forces push to organic that Indian organic movement has reached a stage where it can swiftly move to occupy desired space in Indian agriculture, which was left as a vacuum by the green revolution. National Commission on Farmers considers it as a tool for second green revolution in the rain fed and hilly areas of the country.

Nine states of India pushed either policies or programs on Organic Farming. Some states like Uttaranchal made organic a thrust area for improving mountain agriculture based farm economy and livelihoods. The north Eastern states like Mizoram, and Sikkim declared the intentions to move towards total organic farming, even without necessary infrastructure, human resources and programmes. States like Karnataka formulated organic strategy and programmes to help spread organic in every block. In Maharashtra there were double efforts; the initiatives by the organic farmers associations across the state were supported by the state. The emerging examples of public private partnership for promoting organic farming

are available from the states of Maharashtra, Karnataka, Tamil Nadu and Kerala. The role of NGOs and farmers associations is very strong in South India.

Today, Organic farming means different to different states hence it is subject to state perspective. In states like Uttaranchal, Mizoram and other mountain states, organic farming is perceived as a tool to harness niches for high value cash crops, medicinal and aromatic plants, fruits and vegetables. To Maharashtra it means a way which can help farmers reduce cost of cultivation and save them from desperation and suicides. For farmers in the states like Punjab and Haryana organic means restoring the soil health and grow certified organic commodities for export. The interest of several state Governments in the organic farming is acting as a precursor for dynamic change for an otherwise stagnant agriculture sector.

From the view point of commodities, India today produces range of organic products from fruits and vegetables, spices to food grains, pulses, milk and organic cotton. In addition Indian produce also includes wild harvest of medicinal, aromatic and dye plants. Some of these are organically cultivated and exported from South India. While data for export commodities is available but data on domestic availability of organic commodities still relies on best guesses of stakeholders. It is definitely emerging, with organic retails stores, super markets and packaged deliveries visible in big cities and small towns.

To create the domestic market for organic produce, the so called pull factor, is still missing because of low awareness among consumers about food safety and also because of lack of access to organic products, not because of production per se but because of weak supply chain systems, at present. Organic producer is looking for the market to get good price and quick sales but is partially successful. The organic retailers are looking for constant supplies, specially of vegetable, fruits and food grains, which he does not know from where to get, and the prospective organic consumer does not have an easy access to organic products so far.

The success stories of organic farming are a result of the efforts of many government and private initiatives. Two examples are quoted here, one of Organic Morarka studies documenting the economic value of organic farming and enterprises and second of Uttaranchal Organic Commodities Board, which is engaged in restoring value of forgotten mountain food crops which grow on marginal lands

The status of organic farming in India can be summed up as follows:

- Indian organic movement is moving towards mainstreaming
- There are different reasons, both ecological and economic which are driving farmers towards organic farming.
- The small and marginal farmers primary intention to go organic is to come out of the debt trap
- There are also agribusiness oriented farmers who are going organic to capture export opportunities.
- Land degradation and abandonment of farm land is a crisis in the waiting in many parts of India, NGOs and farmers in some parts of the country are containing it by promoting organic ways of farming
- Women farmers in many areas got dis-empowered during the spread of green revolution, but new evidence shows that households adopting organic farming have a pleasant story to share about the experiences of women empowerment and social equity.
- Indian organic export is a niche market, and is increasing steadily because of desirable enabling initiatives by the Government. Govt has set the National Standards for Organic Production, and institutional support for certification capacity building is being provided.

7.4.2 Guiding Factors for the XI Plan

7.4.2.1 Reasons for expanding the organic programme

- Organic agriculture is one of the viable solutions to the multiple crisis facing our food and agriculture by improving production in rain fed and marginal areas and reducing food insecurity of small and marginal farmers.
- It will help promote pesticide and fertilizer free agriculture, which is helping farmers reduce the costs of purchased inputs, and get rid of debt related to capital inputs for farming. *As demonstrated the organic farmers movement in Maharashtra (MOFF) organic agriculture is the solution to the epidemic of farmers' suicides.*
- Organic agriculture will help provide safe and healthy food and is the solution to food fears and food hazards that are gripping our society.
- Organic agriculture can help India increase its share in the global agribusiness market, while increasing income of farmers (See Annexure –2, export targets for India)
- Poverty elevation remains the single most agenda for all development policy. Here Organic farming has the capacity to bring about a dent in the economic condition of the small and marginal farmers. Several experiences across the states have shown how in the rain fed conditions costs have cut down and production has increased.
- The market for Organic products has moved from "a niche" towards mainstream in the markets of the developed countries. World organic market understand the enormous potential of India as supplier of certified organic agricultural products in the coming decades, because of the inherent organic mindset and practices of Indian farmers which will make conversion to organic farming easy.
- A survey conducted by the International Competence Centre for Organic Agriculture (ICCOA) in 2005 indicates there is already a ready market worth 1000 crores for organic products in the country. The domestic market for Food & Grocery is estimated to be about Rs 6,75,000 crores and is growing at the rate of 5 % to 6% per annum. Various estimates indicate that Organic products can take about 5% to 6% of the overall food & grocery market in the medium / long term. This could translate into a market of about Rs 50,000 to 60,000 crores.
- Planning Commission, in its working group report has proposed to develop all the rain fed areas (88.5 million ha.) in a period of 20 years (i.e. up to XIII Five Year Plan) at a cost of Rs. 72750 crore with peoples' participation.
- The Technical Committee on Water Shed Programs- Parathasarthy Committee has brought out sharply the crisis which India is facing in agriculture, making a strong case for a coherent strategy for the development of rain fed regions to ensure food security and its argues forcefully that watershed development needs to grow out its conservation cocoon and focus on sustainable livelihoods.

7.4.2.2 Recommendations of National Commission on Farmers

- The reports of the National Commission on Farmers have clearly highlighted that India is in the grip of an agrarian crisis. This multi dimensional crisis in agriculture has made it necessary for India to make a paradigm shift in agriculture development. The Farmers Commission in its report, has recognized Organic Farming as one of the potential options to help solve the agrarian crisis, Keeping in mind the need for scaled up public interventions to promote organic farming, the commission estimated the need for investing over Rupees 2500 crores during the XI Five Year Plan.
- The Commission has made a recommendation that 25,000 Organic Villages with niche commodities should be developed in the hills during the next five years, and

the local farm graduates and youth be involved in it as entrepreneurs *(Item 4.6.2. pages 1334-134 of the Fifth and Final Report Volume 1, October 4, 2006*).

- The report highlights that organic farming is specially suited to hill agriculture and for growing high value horticulture crops, as well as other cash crops, such as the medicinal and aromatic plants, and spices.
- Under item 4.6.3. of the fifth report, the Commission has observed, "The institutional intervention for promoting organic farming is as yet far from satisfactory. It recommends that a focused national movement on organic agriculture be launched, which is fully backed up by a credible certification process to maintain quality assurance. The movement should include organic trade awareness and literacy *sine qua non* for mainstreaming and integrating organic farming in the national agriculture economy. The commission understands that establishing and running credible organic farming systems is much more complex and demanding than the usual inorganic based agriculture. But it is do-able and should be done for harnessing the unique opportunities in India and abroad.
- The National Programme for organic Production (NPOP) has already developed organic standards and these be implemented across the country. Unless the NPOP is adopted and notified for application to the domestic market, there is very little that could be done to prevent un-certified organic products from being imported.
- The hills states should be given priority for organic farming given their comparative advantages".
- The Commission in its second report, has recommended a budget of Rs 2500 crores for the next five year plan.

  The Group on organic farming, concurs with the recommendations of the National Commission on Farmers and has made it a basis for designing the XI Plan programme on organic farming.

7.4.3 THE XI PLAN ORGANIC PROGRAMME

7.4.3.1 The Organic Farming with four goals

Our efforts should be focused on realizing full benefits of organic farming. To link it with major ongoing initiatives/ programmes of the Government, the added emphasis of XI Plan organic sector may give thrust to organic horticulture to improve the farm economy of a large sections of Indian farmers and enterprises. In this context, the proposal is made for adopting an **Organic Farming Mission, which includes following four goals as Pillars of the mission:**

- To improve food and income security of small and marginal farming families;
- To open up employment / self employment opportunities for educated youth through small and medium organic enterprises
- To enable India take its share of global organic market, and provide safe and nutritious food supplies to domestic consumers
- To ensure ecological and economic sustainability of Indian agriculture

  Based on these goals, the target goals of XI Five Year Plan are identified;

  This Mission should have a wide mandate, be autonomous and function to serve all stakeholders from organic producer to consumer, international cooperation and trade regulations, setting and maintaining standards etc.**"**

7.4.3.2. The objectives (targets)

- to make India number one organic country in the world in next ten years

- to convert five million hectares of farm land and 5 to 6 million organic farmers into organic, during the XI Plan period
- by the end of the XI Plan, produce Rs 15,000 crores worth of organic commodities; wherein 80% production is for domestic and 20% for export.
- to increase self employment opportunities through organic enterprises

7.4.3.3 Organic programme

i) ***Farm Conversion, Crop Production and Quality Assurance***

- Conversion of 5 million hectares of farmland into certified organic farmland
- Promote setting up of model organic farms.
- Location based **package of practices on range of lead crops in horticulture**, that become the basis of organic farming under different agro-ecological conditions and agricultural systems
- Increase and make cheaper access to organic certification of farms.
- Support record keeping systems, internal control systems and farmer participatory quarantine systems so as to reduce cumbersome procedures and farmers burden in going for certification
- Support to farmers to go organic by way of incentives to remove unfavorable treatment, access to skill development, technologies
- Facilitate organizing organic farmers to generate marketable surplus of commodities.

ii) ***Supply Chain and Marketing Infrastructure***

- Developing well functioning organic supply chains for easy access to market.
- Development of accredited certification bodies. Develop a vibrant domestic market
- Investments in building infrastructure in the area of post harvest handling, cool chains, organic storage and transportation, value addition
- Develop a vibrant domestic market with well functioning supply chain system, number of retail stores in cities and towns by the end of 11^{th} plan, should be visible.

iii) Policies, Human Resources and Institutional Capacities

- Reshaping agricultural sector policies to create a favourable policy environment for organic sector.
- Policies are framed, favoring Bank financing for conversion to organic farming and developing organic enterprises (which are presently not available).
- To save farmers from market risks, support price system is designed and put in place (Recommendation of National Commission on Farmers).
- Develop organic strategies for the states and create enabling environment for putting in place institutional mechanisms for promoting organic farming and enterprises in states.
- Creating effective service providers for organic farming in the field.
- To build institutional capacities at central, state and local levels for providing effective support to organic farmers
- Introduction of formal education in organic farming practices, through Agricultural Universities/specialized institutions.
- Developing human resources in the fields of organic production, quality assurance, extension, value addition, trade and marketing.
- Launching ‘India Organic’ campaign abroad to enhance exports.

For better performance, during the XI Plan, interventions are identified to further encourage non government organic stakeholders and organic farmers associations to continue playing their roles effectively and efficiently.

Having achieved equivalence in the major markets of EU, USA and Switzerland, the responsibility now is to provide a demand-pull to organic production.

This can be achieved through vigorous promotion campaigns abroad and implementing projects in India on a project mode through setting up of model organic farms, preparing packages of practices on a product-specific location-specific basis, developing linkages between group farms, service providers and the certification bodies as well as through replication of such models.

While organic programme expands, there is need for an Autonomous Organic Agency for implementing diversity of programmes/ projects/ schemes from production to quality assurance to domestic and export market development, human resources development and strategies studies. National Centre for Organic Farming can be upgraded/merged in this mission, which should have larger role than at present played by NCOF.

7.5 IMPLEMENTATION MECHANISM

Two pronged implementation mechanism are proposed for implementation of programmes of organic farming. i.) Through a Mission Mode approach by formulating National Mission on Organic Farming or ii) through a Producer Company concept.

7.5.1 National Mission on Organic Farming

It will be in the best interests of the country to create an umbrella organization **National Mission on Organic Farming.** This national mission should have a wide mandate, be autonomous and function to serve all stakeholders from organic producer to consumer, international cooperation and trade regulations, setting and maintaining standards etc.**"**

The increasing public and private investment and other initiatives in organic sector may not yield desired results because they face a key constraint -- the absence of proper national institutional set up that can take care of all aspects—promotion, research, development and regulation on standards and trade. Today there are many players and as many stakeholders with diverse perceptions, goals and agenda, that may be sometimes counter productive. Ministry of Agriculture, Ministry of Commerce, ICAR, National Steering Committee on organic farming, commodity boards, organic farmers associations, NGOs and above all new business houses coming as investors for organic retail and exports. Further, International developments in organic regulations, trade and development promotion demand that India creates such a body so as to represent and take care of national interests in such fora and formulate comprehensive national strategy.

7.5.1.1 Goals

- to improve food and income security of small and marginal farming families through organic farming;
- to open up employment / self employment opportunities for educated youth through small and medium organic enterprises
- to enable India take its share of global organic market, and provide safe and nutritious food supplies to domestic consumers
- to ensure ecological and economic sustainability of Indian agriculture through organic farming

7.5.1.2 Mandate of Mission

- **Watch dog and representative body** for domestic and international developments in organic sector, specifically standards and trade regulations. It is recommended that this body facilitates creation of National Federation of Organic Stakeholders and

support their operations so as to maintain organic relationship with it as feedback organ. Federation should be playing a strong advisory role to the national mission.

- **Institutional Infrastructure development**; formulating national policies, regulations and standards for organic farming promotion and regulating trade in organic and be the agency for monitoring and implementation of these aspects. Have the capacity to offer services to states in developing their respective organic policies, plans, policies, strategies and infrastructure
- **Resources Planning and Management**; Prepare investment plans (e.g. 5 year plans) of the country for organic farming and agribusiness development and be the agency to monitoring and implementation of schemes.
- **Physical Infrastructure Development;** the body be made responsible to assess the needs, plan and implement such programmes which strengthen physical facilities for enhancing organic agribusiness in the and of the country.
- **Organic Research, Technologies and Human Resources Development;** it should create or be able to hire a pool of expertise in all sectors of organic so as to offer services on demand to Govt. and private institutions/ agencies.

Organizational Structure should be such that it should appear competent in all sectors of organic; policy, planning, professional & technical aspects, trade and regulations areas. It should be able to maintain autonomy in functioning, is able to interact, coordinate and direct central ministries, departments as well as states on common interest programmes and issues**. Led by a Chief Executive Officer of the rank of Secretary (may be official or non official**) it may consist of a board of professionally competent members for each of the above identified areas. This new body may facilitate merger of various present institutional set ups initially created for organic farming and agribusiness promotion under different ministries, such as National Centre of Organic Farming, National Steering Committee on organic farming, APEDA programme in organic agribusiness promotion, Horticulture Board and NHM programme on organic commodities promotion etc.

- When the Mission is created, the XI plan program of the organic sector proposed in this report may be put under the responsibility of this body for implementation.

7.5.1.3 Producer Company(PC)

An autonomous institute in each state, namely Institutional Producer Company(IPC) is proposed to be created as per Companies Amendment Act 19 A 2002. Producer companies (PC) should be constituted at the block level with affiliation to the IPC at state level. The PC will work in the local area, with farmers and other stake holders in the organic farming with interest in local, domestic and export marketing through the IPC. All the central funds for the development of this sector will be routed through IPC to PC to beneficiary. The Intervention should be

- to promote democratic institutes with all stake holders as share holders and each having one vote only
- responsible for all activities right from planning, budgeting to ensuring the 'cash to cash cycle'.
- document the organic farming practices successfully adopted by the farmers.
- ensure scientific Validation of on farm inputs used and local/traditional farming systems.
- develop innovative new techniques and practices to produce all the inputs using the locally available resources.
- lay emphasis only on extension and on field research, leaving scientific research to Scientific institution like ICAR, SAUs and CSIR
- design programmes which are farmer centric – bottom up approach.
- Facilitate capacity building and training of farmers and farming organizations involved with the cash to cash to cycle.
- Organize and participate in fairs, trade shows and awareness programs.

Table 7.5 Proposed national programme on organic agriculture and budget

Sr No	Proposed Activity	Budget in Crores of Rupees
1.	**FARM CONVERSION TO ORGANIC AND PRODUCTION PROCESSES**	150
	a. Continuation of ongoing NCOF scheme with modifications as proposed.	
	b. Organic Crop Guides on about 40-50 lead horticulture crops and associated crops of organic farming systems	650
	c. Conversion of farms in to organic, accessing technologies, knowledge and skills on organic conversion	
	d. Organic technologies development, refinement and participatory testing and demonstration,	
	e. Institutional capacity building and support for alternatives to record keeping by farmers (Indian farmers main source of difficulty)	
	f. Support for using credible quality assurance systems – ICS, TPC,PGS	
2.	**DEVELOPING DOMESTIC ORGANIC MARKET**	500
	a. Developing supply chain infrastructure, which includes organic post harvest facilities,	
	b. Organic storage facilities for all kinds of products	
	c. Organic packaging facilities	
	d. Organic products transport facilities	
	e. and a major effort in consumer awareness,	
	f. Facilitating domestic retailing of organic commodities through policy changes in marketing regulations	
	g. Support for India Organic trade fairs, trade shows.	
3.	**EXPORT MARKET DEVELOPMENT**	300
	a. developing marketing infrastructure	
	b. developing supply chains	
	c. supporting services, trade fairs and popularizing BRAND INDIA-India Organic Logo	
4.	**HUMAN RESOURCE DEVELOPMENT AND INSTITUTIONAL CAPACITY BUILDING**	500
	a. Training scientific resources	
	b. Training extension level human resources	
	c. Training farmers	
	d. Training people along the supply chain systems such as the trader, shopkeeper, transporters etc. (so far ignored)	
	e. Component of service providers in the on going scheme fits well here	
	f. Organic Research and Technology Institute/ Regional Centres	
	g. Organic education research and training in the universities-courses, scholarships for higher studies and research in organic	
5.	**SUPPLY CHAIN SYSTEMS**	300
	a. Infrastructure development	
	b. Institutional development	
	c. Supportive Policy	
	d. Supporting public private partnership	
6.	**AWARENESS PROMOTION**	100
	a. About organic among domestic consumers	
	b. About India Organic Logo in domestic and international markets.	
	c. National, regional and local media campaigns.	
	Total	**2500**

CHAPTER VIII
POST HARVEST MANAGEMENT

8.1 INTRODUCTION

Horticultural produce are of perishable nature. Losses in quantity and quality affect horticultural crops between harvesting and their consumption. The magnitude of post-harvest losses in fresh fruits and vegetables is estimated at 5-25% in developed countries and 25-50% in developing countries. In India, the estimated losses range up to 40% depending upon the commodity.

Fruits and vegetables are fastest growing sectors within agriculture. In the X Plan it is proposed to double horticulture production by 2011-12 through National Horticulture Mission linking ICAR, DAC, MFPI and the private sector. The subgroup of XI Five Year plan revealed that there is 97% marketable surplus in fruits, if it is, true then there is need to have strong post harvest infrastructure for post harvest management of these perishables. This is not only loss of produce of crores of rupees but also wastage of labour, energy and inputs involved in production.

Thus, creation of post-harvest infrastructure and awareness need utmost attention to increase the availability of quality foods. To reduce these losses, producers and handlers like wholesalers, agents, sub wholesalers and retailers must understand biological and environmental factors involved in deterioration and use of post-harvest technology to minimize these losses so that best possible quality could be maintained. With the technological advancement in horticulture, it is a proven fact that per unit reduction of post harvest losses is cheaper than equivalent increase in production of high value horticultural corps.

8.2 POST HARVEST LOSSES

8.2.1. Channel of Marketing

Post harvest losses occur at each and every step of the value chain. These can be classified as losses at the farm level, losses at the wholesellers level and losses at the retailer's level.

8.2.1.1 Farm Level

The losses at the farm level occur due to improper harvesting methods, handling techniques and aggregation of the produce and then in transportation. Farmers are not used to employ the scientific methods of harvesting, collection of the produce and appropriate transportation practices.

8.2.1.2 Whole Sellers Level

At the whole seller level the major losses occur due to rough handling and inappropriate storage. Bruising, physical and mechanical injury more often occur during the various stages of loading, unloading, handling and storage. The produce is handled in a casual manner. Losses of fresh fruits and vegetables in developed countries at wholesalers level are estimated to range from 2 per cent for potatoes to 23 per cent in fruit crops, with an overall average of 12 per cent losses between production and consumption sites. In contrast, the range of produce losses in developing countries varies widely.

8.2.1.3 Retail Level/Consumer Level

Losses at the retail, food-service, and consumer levels are estimated at approximately 20 per cent in developed countries and about 10 per cent in developing countries. Overall, about one third of horticultural crops produced are never consumed by humans.

8.3 CAUSES OF POST HARVEST LOSSES

Fresh fruits, vegetables and flowers are living tissue subject to continuous changes after harvesting. While some changes are desirable, most from consumer point of view are not. Post-harvest changes in fresh produce cannot be stopped but these can be slowed down within certain limits. Fresh horticultural crops are diverse in morphological structure (roots, stems, leaves, flowers and fruit) composition and in general physiology. Thus, commodity requirements and recommendations for maximum post-harvest life may vary with commodities. All fresh horticultural produce are high in water content and thus are subject to desiccation (wilting and shriveling) and to mechanical injury. These are also susceptible to attack by bacteria and fungi, with the result pathological breakdown of the produce. Both biological and environmental factors are involved in deterioration of horticultural produce. It would, therefore be desirable to understand these factors first.

8.3.1 Physical/Mechanical Injuries/Damages

Mechanical injury is a major cause of losses. Many of these injuries cannot be seen at the time that the product is packed and shipped, such as bruising in apples, banana, citrus etc. The expression of which appear at much later stage. Other sources of loss include over-ripening, senescence, the growth of pathogens and the development of latent infection.

8.3.2 Physiological Disorders

Physiological disorders can result from factors like very high and low temperatures, relative humidity etc. The main types of disorders are listed below-

i) **Heat injury:** High temperature conditions are also injurious to perishable crops. Transpiration is vital to maintaining optimal growth temperatures in growing plants. Organs removed from the plant, however, lack the protective effects of transpiration, and direct sources of heat, such as sunlight, can rapidly elevate the temperature of tissues to above the thermal death point of their cells, leading to localized bleaching, necrosis (sunburn or sunscald) or general collapse.

ii) **Relative humidity (RH)** is defined as the moisture content (as water vapor) of the atmosphere, expressed as a percentage of the amount of moisture that can be retained by the atmosphere (moisture holding capacity) at a given temperature and pressure without condensation. The moisture holding capacity of air increases with temperature. Water loss is directly proportional to the vapor pressure difference (VPD) between the commodity and its environment. VPD is inversely related to the RH of the air surrounding the commodity.

   RH can influence water loss, decay development, the incidence of some physiological disorders, and uniformity of fruit ripening. Condensation of moisture on the commodity (sweating) over long periods of time enhances decay.

iii) Water Stress**:** Severe water stress results in increased sunburn of fruits, irregular ripening of pears, tough and leathery texture in peaches, and incomplete kernel development in nuts. Moderate water stress reduces fruit size and increases soluble solids content, acidity, and ascorbic acid content. On the other hand, excess water supply to plants results in cracking of fruits (such as cherries, plums, and tomatoes), excessive turgidity leading to increased susceptibility to physical damage (such as oil spotting on citrus fruits), reduced firmness, delayed maturity, and reduced soluble solids content.

iv) **Freezing**: Perishable commodities are generally high in water content, and possess large, highly vacuolate cells. The freezing point of their tissues is relatively high (ranging from -3 °C to -0.5 °C), and disruption caused by freezing generally results in immediate collapse of their tissues and a total loss of cellular integrity. Freezing

occurs in cold storage systems either due to inadequate refrigerator design, or to thermostat failure. Freezing can also occur upon exposure to inclement weather conditions as occurs when produce is allowed to remain for even short periods of time on unprotected transportation docks during winter.

v) **Chilling injury**: Some commodities (chiefly those native to the tropics and subtropics) respond unfavorably to storage at low temperatures which are well above their freezing points, but below a critical temperature termed their chilling threshold temperature or lowest safe temperature. Chilling injury is manifested in a variety of symptoms including surface and internal discoloration, pitting, water soaking, failure to ripen, uneven ripening, development of off flavors and heightened susceptibility to pathogen attack.

8.3.3 Nutritional Disorders

Nutritional disorders result due to a number of factors. Some of them are- Bitter pit of apples; blossom-end rot of tomatoes, peppers, and watermelons; cork spot in apples and pears; and red blotch of lemons are all associated with calcium deficiency in these fruits and vegetables. Boron deficiency results in corking of apples, apricots, and pears; lumpy rind of citrus fruits, and cracking of apricots. Poor color of stone fruits may be related to iron and/or zinc deficiencies. Excess sodium and/or chloride (due to salinity) results in reduced fruit size and higher soluble solids content.

8.3.4 Microbial Attack

Fresh produce can become microbiologically contaminated at any point along the farm-to-table food chain. Human and/or animal faeces are the source of microbial contamination of fresh produce; whenever water comes in contact with produce; its quality dictates the potential for contamination. The potential of microbial contamination from water used with fresh fruits and vegetables must be minimized. The use of animal manure or municipal biosolid wastes as fertilizers should be closely managed in order to minimize the potential for microbial contamination of fresh produce; and Worker hygiene and sanitation practices during production, harvest, sorting, packing, and transport play a critical role in minimizing the potential for microbial contamination of fresh produce.

8.4 STATUS OF POST-HARVEST INFRASTRUCTURE

Initially, emphasis was on increasing the production of horticulture crops to meet the requirements of growing population of the country. It was mainly from eighth plan that attention was paid towards development of post-harvest infrastructure in the country. The National Horticulture Board, Gurgaon a Pioneer Institute set up by Government of India is providing technical and financial support for creation of post-harvest infrastructure for horticultural crops. Other organization like Directorate of Marketing and Inspection, NCDC, APEDA, Ministry of Food Processing Industries, have also formulated a number of schemes to strengthen post-harvest infrastructure for these crops.

Lack of sorting grading facilities, inappropriate packaging, and slow transport systems and inadequate storage facilities add to deterioration of these perishables. The position of present infrastructure available could be described in brief as under:

8.4.1 Grading / Packing

Grading of horticultural commodities is very important aspect particularly from marketing point of view to get better returns. It is, however, not being followed generally at producer's level in our country. Maturity, shape, colour, quality and other physical parameter have to be kept in view while going for grading of products. It is well-known that graded products gets better price in market even that farmers do not follow it because of slackness only while on the other hand some size grading is done by sub-wholesaler or retailers. There is, however,

need to follow grading practices at the produces level. Such facilities have to be developed at packing houses/grading and packing centre for farmers.

8.4.1.1Creation of grading/packing infrastructure is very important aspect. However, it has not been created to the desired level. Some states Governments have taken steps while others have not. For example, Andhra Pradesh is one of the largest producer of fruits and vegetables in the country, yet there is no match between production and post-harvest infrastructure. State Government is developing cool chain facilities, especially in mango growing areas and has also identified Agri Export Zones for three important horticultural regions in the state. State Government is also providing financial support for establishment of packing houses and packing materials.

In Himachal Pradesh and Jammu and Kashmir, grading/packing centres particularly for apple have been established. There are 11 grading and packing centres in Himachal Pradesh with an installed capacity of 37,500 tonnes. Most of these packing houses installed after eighties for apple but presently, the technology of these packing houses is outdated and not being utilized properly by farmers. Here HPMC is playing a pivotal role in functioning of these centres. Similarly, Jammu and Kashmir also developed apple grading/packing centres in Srinager, Baramulla, Kupwara, Anantnag, Pulwama and Budgam. Walnut Hulling and Drying centers of 500 tonnes capacity each have also been set up in Anantnag, Pulwama and Budgam.

There are not many packing-houses existing in Gujarat. Few entrepreneurs like Vadilal Industries Dharampur Plant Valsad, which has storage, processing and packing, unit for fruits and vegetables. Similarly Amar Cold storage Hambhval, district Kheda, is involved in purchasing vegetables from farmers and after grading/packing sells in domestic and export markets.

Maharashtra is not only leading in production of important fruits like mango, banana, grapes, orange, pomegranate, onion etc but also leads in creating post-harvest infrastructure in this state. Maharashtra State Agricultural Marketing Board (MSAMB) has set up its own full-fledged Post-harvest Technology Institute in 1993 to develop core competence for activities relating to agriculture in general and for agricultural marketing in particular. The MSAMB is also a nodal agency for development of Agri Export Zones in the State for identified fruits and vegetable where a number of infrastructure facilities and interventions have been proposed to facilitate exports quality production, post-harvest management, value addition and export production activities. MSAMB has also set up a pre-cooling-cum-cold storage facility along with a packing house with mechanized grading/packing facility at Vashi, Navi Mumbai, which has helped in export of fresh mangoes and vegetables.

In Punjab, PAGREXCO has set up five mechanical sorting, grading, waxing centres with capacity of 2 tonnes/hour for kinnow at Hoshiarpur, Badal, Baluana, and Tahh Waterjalam. In Uttar Pradesh, agri export zones for mango at Lucknow and Sharanpur and for potato at Agra have been developed, where facilities from production to harvesting and marketing like sorting and grading centers, packaging and storage are available to farmers. One food pack is also being developed at Rai-Barielly, where all facilities for post-harvest of horticultural commodities would be provided.

The APEDA, New Delhi, has also recognized 106 pack houses in different states which have facilities of international standards for grading and packing of fruits and vegetable particularly for exports. After due verification recognition certificates have been issued by APEDA to these pack houses. These are given in Table 8.1.

Table 8.1 State-wise number of pack houses

State	Pack house (number)
Maharashtra	97
Andhra Pradesh	5
Uttar Pradesh	2
Karnataka	1
Gujarat	1
Total	**106**

8.4.2 Cold Storages

The cold storages are only one aspect, which is present since long as a part of post-harvest infrastructure. In fact, cold storage industry is over hundred years old, which has adopted gradual change in technology. A number of cold storages have been set up in the country mainly for potatoes. Among other perishables, apple, grape, orange, eggs, fish, livestock and dairy products are prominent from storage point of view. Commodity wise distribution of cold storages in the country is given in Table 8.2.

Table 8.2 Commodity-wise distribution of cold storage in the country

Commodity	Nos.	Capacity ('000 tonnes)	Percentage
Potato	2,618	14,792.3	81.23
Multipurpose	1,045	3,108.3	17.06
Fruit and vegetables	121	38.9	0.21
Meat and fish	464	174.7	0.96
Milk and milk products	202	79.1	0.43
Others	91	15.7	0.08
Total	**4,541**	**18,209.0**	**100.0**

Thus, 81.23% of the total capacity of cold storage in country is utilized by single product, i.e. potatoes. Since there are no potatoes from October to February, these cold storages remain unoccupied for 5-6 months in a year. The expenditure on electricity, watch and ward continues which affects the economy of these cold storages. Fruits and vegetables occupy only 0.21% of the total capacity, which needs to be enhanced by constructing multi-chamber and multi-commodity cold storages.

Most of the machinery for cold storages are manufactured indigenously and is of comparable quality. In recent years, there has been an improvement in the technology up gradation in the refrigeration field, which includes controlled atmosphere storages. It is now possible to maintain freshness of fruits and vegetables for a much longer period compared to conventional method. In India, this system of storage is not yet commercial and would need emphasis.

Present day compressors are both cooling and energy efficient. Now locally made insulating materials are being increasingly used. However, there remain certain gray areas. When we are concerned for environment friendliness, use of ammonia and freon refrigerants needs to be replaced by use of alternate technology. In recent years, there has been an escalation in the cost of land and building materials, and labour charges. These constraints coupled with high electricity tariff have made proposition of cold storages less attractive from profit point of view. The situation warrants for financial assistance and technological support to make this enterprise more attractive.

8.5 INTERVENTIONS TO COMBAT POST HARVEST LOSSES

8.5.1 Harvesting Operation, Machinery, Appropriate Maturity Indices

The method of harvesting (hand vs. mechanical) can significantly impact upon the composition and post-harvest quality of fruits and vegetables. Mechanical injuries (such as bruising, surface abrasions and cuts) can accelerate loss of water and vitamin C resulting in

increased susceptibility to decay-causing pathogens. Most fresh fruits and vegetables and all flowers are harvested by hand. Root crops (such as carrot, onion, potato, and sweet potato) and some commodities destined for processing (such as processing tomatoes, European plums, and tree nut crops) are mechanically harvested.

Management of harvesting operations, whether manual or mechanical, can have a major impact on the quality of harvested fruits and vegetables. Proper management procedures include selection of optimum time to harvest in relation to product maturity and climatic conditions, training and supervision of workers, and proper implementation of effective quality control. Expedited and careful handling, immediate cooling after harvest, maintenance of optimum temperatures during transit and storage, and effective decay-control procedures are important factors in the successful post-harvest handling of fruits and vegetables.

Attention must be paid to all of these factors, regardless of the method of harvesting used. These factors are nevertheless more critical in the case of mechanically harvested commodities. Some harvesting gadgets have been developed, e.g. mango harvester in Lucknow (CISH), Bangalore (IIHR) and Ratnagiri (KKV). These need to be popularized.

8.5.2 Pack House Operations

In order to reduce the value loss and to remove the field heat, the produce should be harvested during coolest part of the day, i.e. in morning. The produce should be transported preferably in plastic crates to avoid the mechanical injury during transportation. Since the pack house is required for handling multiple products, it should be equipped to handle various products. At the packing house, the produce should be unloaded in unloading area where grading and sorting operations are taken up. Keeping in view the variety of crops, 2-3 grading and sorting lines may be installed. These grading lines should take care of almost all varieties of fruits and vegetables. After sorting, the produce should be packed in various desired packings and pre-cooled. At this stage, the temperature is reduced and thereafter the produce either is stored in cold storages or dispatched to markets.

8.5.3 Sorting and Grading Operations

A preliminary sorting of produce should remove unmarketable pieces and foreign matter such as plant debris, soil, stone etc. before the produce is passed on for further operations.

Grading of horticultural commodities is very important aspect particularly from marketing point of view to get better returns. It is, however, not being followed generally at producer's level in our country. Maturity, shape, colour, quality and other physical parameter have to be kept in view while going for grading of products. It is well-known that graded products gets better price in market even that farmers do not follow it because of slackness only while on the other hand some size grading is done by sub-wholesaler or retailers. There is, however, need to follow grading practices at the produces level. Such facilities have to be developed at packing houses/grading and packing centre for farmers.

8.5.4 Appropriate Pre-Treatments viz. Curing, Hot Water Treatment, Fungicide Application, Gamma-Irradiation, Waxing

8.5.4.1 Curing

Curing is conducted immediately after harvesting. It strengthens the skin. The process is induced at relatively higher temperatures and humidity, involving suberization of outer tissues followed by development of wound periderm which acts as an effective barrier against infection and water loss. It is favoured by high temperature and high humidity.

8.5.4.2 Hot water treatment

A simple post harvest treatment that involves hot water spray at temperatures of 50–60^{0}C while the fruits is brushed (hot water brush). In mango the treatment significantly reduced

decay development caused by *A*. *alternata* to levels similar to these reached by using as prochloraz in several cultivars stored for 3 weeks at 14^{o}C. When fruits were stored for longer periods of time, the fungicide was more effective than the hot water brush.

8.5.4.3 Fungicidal treatment

Decay caused by moulds/bacteria is a major cause of loss of fresh produce during marketing. Post-harvest application of fungicide is usual on crops such as apples, bananas and citrus fruits which are to be stored for a long period or those undergo long period of transportation to distant markets. The fungicides should be applied only when produce has been washed and dried.

8.5.4.4 Irradiation

Gamma irradiated is an important emerging technology for extending post-harvest shelf life of various products, making them free from insect and pests, bacteria, fungus etc. The technology is being adopted worldwide for improving food hygiene and overcoming quarantine problems in international trade. Many advanced countries are using radiation for long however, India has only recently realized the advantages and safety aspects of this technology and clearance has been given for radiation processing of spices, onion, potatoes, cereals, pulses, wheat products and fresh fruits. This has opened up tremendous opportunities for commercialization of this technology in near future.

8.5.4.5 Waxing

The application of wax or similar coating to enhance appearance and limit water loss from produce requires equipments and has little relevance to small-scale packing.

8.5.5 Pre-Cooling: Hydro-Cooling, Air-Cooling, Forced Air-Cooling, Package Icing etc.

8.5.5.1 Pre-cooling

Temperature plays an important role in determining the keeping quality and freshness of fruits and vegetables. A crop harvested during mid-day under hot sun absorb a lot of heat. This heat gathered by the produce from the field is known as “field heat”. It is detrimental to the shelf-life of produce, as it accelerates biological processes such as respiration and transpiration. The heat within the produce comes mainly from the sun (convection) or from chemical reactions within the produce (respiratory heat).

The crop harvested in early morning is cooler, due to cool air and dew in the micro- climate, resulting in less accumulation of metabolic heat. This metabolic heat keeps increasing with advancement of the day. Therefore, it is a good practice to harvest the crop early in the morning. However, in case of large farmers, early morning harvesting may not be feasible as harvesting operations may continue for entire day. Under such circumstances, the shelf-life and freshness of the produce can be controlled by quickly cooling the produce to the conditions where metabolic activity is brought to bare minimum. This rapid cooling of the produce to bring down the metabolic activity to bare minimum is referred as pre-cooling. Rapid cooling of produce after harvesting is frequently essential as refrigerated ships, land vehicles and containers are not designed to handle the full load of field heat, but are designed to merely maintain preceded produce at the selected carriage temperature. Pre-cooling helps to:

- Slow down respiration and transpiration processes
- Restrict enzymatic activity
- Reduce burden on cooling system of transport vehicle or cold storage.

Rapidly respiring commodities, which have a short post-harvest life, should be cooled immediately after harvesting. Commodities that have a longer post-harvest life generally do

not have to be cooled so rapidly but still need to be cooled as soon as possible. Commodities that are susceptible to chilling injury should be cooled according to their individual temperature requirements.

8.5.5.2 Pre-cooling methods

Produce may be cooled by means of cold air (room cooling and forced air cooling), cold water (hydro-cooling), direct contact with ice, and evaporation of water from the produce (evaporative cooling and vacuum cooling).

8.5.5.3 Contact icing

An old method also called 'top-icing' is commonly applied to boxes (polystyrene) of produce by placing a layer of crushed ice directly on top of the produce. The ice melts and the cold water runs down through the crop, cooling it. This method is particularly used for more perishable commodities such as leafy vegetable.

8.5.5.4 Forced air cooling

Here also the produce is placed into the cold room but an arrangement to direct the air flow pattern through the produce is made. By forcing air through the packages and around each piece of the produce, the produce can be cooled in about one-fourth to one-tenth the time required for room cooling. The heat given out from the surface of the crop is then carried away in the stream of cold air, thus setting up a temperature gradient and cooling the crop more quickly.

8.5.5.5 Hydro-cooling

The transmission of heat from a solid to a liquid is faster than the transmission of heat from a solid to a gas. Therefore, cooling produce with cold water (close to 0^0C) is a rapid method and results in no loss of weight. In many hydro-cooling systems, the complete produce must be moved to a cool room to prevent re-warming. Hydro-cooling may also clean the produce. It is advisable to use chlorinated water to prevent contamination of the produce with spoilage microorganisms.

8.5.5.6 Vacuum cooling

At normal air pressure of 760 mm mercury, water boils at 100^0C. However, in reduced air pressure, the boiling point of water gets reduced, and at 4.6 mm mercury, water boils at 0°C. Thus, boiling of some of the water at low pressure cools the produce. This technique is known as vacuum cooling.

The produce is loaded into a sealed container and the pressure is reduced to about 5 mm mercury. At this pressure water boils at 1^0C and produce is cooled by the evaporation of water from the tissue surface. For every 5^0C drop in temperature, approximately 1 % of the produce weight is boiled off as water. Spraying the produce with water before enclosing it in the vacuum chamber may minimize this weight loss. Special vacuum coolers called 'hydro-vac' coolers have a built-in water spray, which is activated towards the end of cooling operation.

8.5.5.7 Transit cooling

Temperature at night is lower than that during the day. Therefore, if the produce is to be shifted on the day of harvesting to a place at considerably long distance, it may be transported at night. Cooling of the produce during transportation offers the same effect by stimulating the forced air-cooling method, especially in winter. Once produce is placed in the cold store, it radiates heat to the room by virtue of field heat and heat of respiration. The sooner the produce is brought to its optimum storage temperature then the sooner respiration is brought under control, which results in maximum storage life of the produce.

8.5.6 Packaging for Fresh Market

Packing can be viewed as a convenience in achieving orderly marketing. The package is convenient unit for transporting the produce from place of production to point of sale or consumption. Packing may be in wooden boxes, bamboo basket, jute bags, plastic crates, and corrugated fiber board boxes. These could be used depending upon the availability of raw material for packaging and type of market where the produce is to be marketed.

8.5.6.1 Palletization

Loading and unloading are very important steps in the postharvest handling of fruits and vegetables but are often neglected. The individual handling of packaged produce in India leads to mishandling and to high postharvest losses in India. With the introduction of CFB boxes, serious consideration should be given to the introduction of palletization and mechanical loading and unloading of produce particularly with the use of fork-lift trucks, in order to minimize produce mishandling.

8.5.6.2 CFB boxes

Corrugated fiberboard (often mistakenly called cardboard or pasteboard) is manufactured in many different styles and weights. Because of its relativity low cost and versatility, it is the dominant produce container material and will probably remain so in the near future. The strength and serviceability of corrugated fiberboard have been improving in recent years.

Most corrugated fiberboard is made from three or more layers of paperboard manufactured by the kraft process. To be considered paperboard, the paper must be thicker than 0.008 inches. The grades of paperboard are differentiated by their weight (in pounds per 1,000 square feet) and their thickness. Kraft paper made from unbleached pulp has a characteristic brown color and is exceptionally strong. In addition to virgin wood fibers, Kraft paper may have some portion of synthetic fibers for additional strength, sizing (starch), and other materials to give it wet strength and printability. Most fiberboard contains some recycled fibers. Minimum amounts of recycled materials may be specified by law and the percentage is expected to increase in the future. Tests have shown that cartons of fully recycled pulp have about 75 percent of the stacking strength of virgin fiber containers. The use of recycled fibers will inevitably lead to the use of thicker walled containers.

Double-faced corrugated fiberboard is the predominant form used for produce containers. It is produced by sandwiching a layer of corrugated paperboard between an inner and outer liner (facing) of paper-board. The inner and outer liner may be identical, or the outer layer may be preprinted or coated to better accept printing. The inner layer may be given a special coating to resist moisture. Heavy-duty shipping containers, such as corrugated bulk bins that are required to have high stacking strength, may have double- or even triple-wall construction. Corrugated fiberboard manufacturers print box certificates on the bottom of containers to certify certain strength characteristics and limitations. There are two types of certification. The first certifies the minimum combined weight of both the inner and outer facings and that the corrugated fiberboard material is of a minimum bursting strength. The second certifies minimum edge crush test (ECT) strength. Edge crush strength is a much better predictor of stacking strength than is bursting strength. For this reason, users of corrugated fiberboard containers should insist on ECT certification to compare the stackability of various containers. Both certificates give a maximum size limit for the container (sum of length, width, and height) and the maximum gross weight of the contents.

8.5.7 Transportation

Transportation is a big and often most important factor in the marketing of fresh produce. Fresh produce is transported by many means from head-load to air-freighting. These may be described as under:

8.5.7.1 Road transport

Most of the fresh produce is now transported through road, particularly by trucks, open pickup or bigger trucks. Specialized transport vehicles should be used for transporting the horticultural produce, which may have separate cabins and partial shade so that losses during transportation are minimized.

8.5.7.2 Rail transport

For distant marketing, rail transport is better but it should be fast. The produce should be handled carefully.

8.5.7.3 Water transport

Water transport is also used in places where market is not linked, with other source of transportation. These could be boat, water steamer etc where passenger and cargo are mixed and no special care is taken for fresh produce.

8.5.7.4 Air transport

Air transport is mainly used for export of fresh produce from one country to other or within the country. It is, however, quite costly. It may be economical only if high-value produce is exported.

8.5.8 Containerization

The use of containers for the transportation of goods was recently introduced into India. Relatively little attention has, however, been given to the use of containers for the transport of fresh horticultural produce. Containerization provides an excellent system for the shipment of goods from one place to another.

8.5.8.1 Refrigerated containers

Refrigerated containers are used in the transportation of fruits, vegetables and flowers in many developing countries.

8.5.8.2 Ventilated containers

The design and fabrication of ventilated containers which incorporate evaporative cooling systems should be considered for the Indian context. One of the greatest advantages of the container is that it can be placed on truck or rail, without interfering with the movement of the vehicle. Palletization and containerization will go a long way in developing local and international trade.

8.5.8.3 CA containers

Special controlled atmosphere refrigerated containers are available for transporting fruit and vegetables which may be stored for a longer period in a controlled or modified atmosphere. The atmosphere is usually established by flushing the container with nitrogen and CO_2. During transport, the atmosphere is regulated by nitrogen flushing or CO_2 and ethylene scrubbers. Controlled atmosphere containers must be as gastight as possible to prevent ambient air (oxygen) from penetrating.

8.5.8.4 Non-refrigerated vehicles

Non-refrigerated vehicles are generally open-sided trucks, with wire mesh frames. This type of transportation is inexpensive, convenient and easy. Truck can be used for the delivery of fresh produce, other goods and passengers when required. Layers of produce are not, however, separated in order prevent heat generation. Often the produce is stacked too high.

Non-refrigerated vehicles are used for transporting produce over distances of up to 850 km. On arrival the produce must be unloaded or sold as quickly as possible to overcome overheating. Fresh produce must not be watered prior loading, as this will lead to decay,

rotting and extensive losses.

Major causes of losses during the non refrigerated transportation of fresh produce, are:

- Improper handling during loading and unloading
- Over loading without separation of produce which leads to overheating and mechanical injury to produce at the bottom of the stack
- Rough roads
- Lack of ventilation of the produce

8.5.8.5 Refrigerated vehicles

Fresh fruits and vegetables are increasingly demanded in international markets. Meeting the requirements of these international markets, presents a considerable challenge to the post harvest handling of fresh produce. Packaging plays a major role in meeting this challenge.

8.5.9 Storage

In India, the production patterns, dietary habits and economic considerations warrant long period storage in large quantities of onion and potato. With other vegetables, the main need of storage is mostly for short periods and in many cases for a few days or weeks only. To store fruits and vegetables, low temperature and high humidity (90-95%) are required except in onion and garlic, which require low humidity (70%). Different structures, which are used for storage of mostly potatoes and onions, can be used for other commodities also.

8.5.9.1 Storage in cool dry rooms

It is mostly used for storage of seed potatoes kept on the floor or on bamboo racks with proper ventilation. The store is built of unbaked bricks. It has a thatched roof covered with tiles. Windows are provided on the side walls of the store which are kept open during night and closed during the day.

8.5.9.2 Storage in pits

The pit is dug under the shade of a tree or a roof 75-90 cm wide and 45 cm deep. It is soaked with water and allowed to dry for 5 days. The bottom and sides of the pit are covered with ‘neem’ leaves. The selected potatoes are heaped up in the pit to height of about one m and covered with a thick layer of straw or grass. At about 30-60 cm distance from the pit, a ditch is dug and filled with water occasionally. The condition of the tubers is examined by opening the pit from the top. The rotted tubers are removed.

8.5.9.3 Onion storage

In Panipat district of Haryana and Jalalabad in Uttar Pradesh, structures are made of bamboo/sarkanda nets and thatched roof with ‘ sirki’ which is covered on top with jute cloth. The size of 3.0m x 1.2m x 1.2m has the capacity to store 40 quintals. The bottom net is fixed at about 15-20 cm height from the ground level to have aeration.

In Nasik and Pune areas, the structures have side walls made of bamboo or locally-available wood spaced 1-2 cm apart. Roof is made of either thatch, asbestos sheet or tiles/tin sheet. There is, however, no bottom ventilation but flooring is done with the help of soil, stone particles and sand and it is raised from ground level. Before loading onion, sticks are spread on the floor. The size of the structure varies from area-to-area. Normally width is kept as 1.5m and height is about 1.5m. The length may vary from 13.5 to 30m. Its capacity is 200-450 quintals.

In Bihar and Gujarat, these structures have 3-4 tiers and the floors are made of bamboo pieces spaced 1-2 cm apart. The depth of loading is generally 30-60 cm. Ventilation in structure is provided by raised platform and windows on the side walls. Cold stores are rarely used for storage of onion in India.

8.5.9.4 Cool stores

Perishables can be effectively stored over different periods under low temperatures and high humidity condition as obtained in commercial cool stores. In India, the total installed capacity of about 2,522 cool stores is over 5 millions tones. Ninety per cent of this capacity is being utilized for the storage of potatoes including seed potato. Among fruits mainly apples are kept in cool stores.

During storages, chilling injury occurs in some commodities and hence these should be kept at optimum temperature of their storage. Physiological disorders and major post harvest diseases of fruits and vegetables also deteriorate their quality.

8.5.9.5 CPRI cool home for potato

The store is a brick masonry structure measuring 9.1m x 4.6m x 3.7m. The north and south sides are double walled with 11cm gap between them. It is filled with rice husk to provide insulation. The 23cm outer walls bear the weight of the roof. The outside of the walls are white washed to reflect heat. Eight ventilators (76cm x 60cm) are provided on the double walls on he northern side and three ventilators on the eastern walls. The ventilators are provided with 5 cm thick wood which is continuously moistened by water dripping from above through small holes in the GI pipe. The ceiling is made of plywood with 5 cm diameter holes drilled in it at 10cm x 10cm spacing so that the hot air within the room can rise above the ceiling and eventually escape into the open. The roof is made of galavinized iron sheets with provision of amply ventilation.

The potatoes are stored in 80kg bags on wooden pellets. The temperature inside the store remains 6^0-12^0C lower than outside during May and June.

8.5.9.6 AADF-CIP design cool home

It is a ‘c’ grade brick masonry structure with 35 cm thick walls in the mud with dimensions of 5.4 x 4.5 x 2.55m having 10 tonne capacity. The foundation of the structure is simple spread footing and the walls are solid with the insulation provided by the extra width of brick wall and mud plaster. Eight ventilators (60cm x 30cm) are provided at a height of 15cm from plinth level. A water trough is provided throughout the length of store except for the passageway. The roof is made of thatch using local materials. Ventilators are provided at the top for exit of hot air from the store.

The potatoes are stored loose on the bamboo platform above the water trough at the height of ventilator (30cm from the plinth level). Water or moist sand is kept in the water trough to facilitate evaporative cooling. As the day temperature rises, it heats up the air inside the store. The air becomes lighter and escapes through the ventilators at the top. Fresh air enters from the ventilators at the bottom gets cooled through contact with water/moist sand in the water trough of the store to replace the hot air by convection current.

8.5.9.7 Forced evaporation cool stores

These stores are cooled with industrial desert coolers which force the cool and humidified air through the heap of potatoes.

8.5.9.8 Two-tier onion storage structure

Its capacity is 40 quintals with the size of structure being 4.8m x 1.2m The side walls are made of bamboo splits with adequate support of wooden planks. The lower base is also made of bamboo splits with adequate structural support. It is raised from the ground level by about 20 cm for proper ventilation from the bottom. The second base is at a height of about 75 cm from the bottom base. The second tier facilitates better aeration, reducing the losses. The total losses in this structure are about 36.6% over a period of 4 months.

8.5.9.9 Bottom ventilated onion storage go down

Its capacity is 450 quintals having size of 15.8m x 4.8m x 2.4m. Ventilation is provided for free circulation from all sides including bottom ventilation. Below the floor, there is air gap of 60cm for this purpose. The columns of the structure are made of brick masonry which support the roof made of Mangalore tiles on timber trusses, purlins and rafters. There are 2 onion racks in each structure of 15m x 1.5m size with a passage of 1.8m between them for loading/unloading of onions. The onion racks are of wooden battons.

8.5.10 Cold storage

After pre-cooling, the produce is brought to cold storage to extend its shelf-life. The development of cold storages including cold chain for transportation has an important role to play in reducing post-harvest losses. The biochemical and microbial changes are slow at low temperature. As such refrigerated cold storages are used to prolong the shelf-life of perishable produce.

8.5.10.1 Modified and controlled atmosphere technology

Modified and controlled atmosphere technology is being adhered in ultramodern plants in developed countries. In such cases of storage, carbon dioxide and oxygen ratio is varied to slow down the respiratory changes in stored produce.

8.5.10.2 Cold storages

Commercial refrigerated preservation of perishable commodities is a short-term process. Costly produce like dry fruits, potato, orange, chemicals, processed foods like fruit juices, pulp, concentrate, dairy products, frozen meals; fish, poultry etc are being stored in cold storages. These cold storages should be multi-chamber having facilities for storage of various kinds of fruits, vegetables, spices etc at different temperature and humidity. This helps in better utilization of cold storages, throughout the year and is more economical. These cold storages should preferably be established in market yards/consuming areas.

8.6 RIPENING REQUIREMENTS

Fresh Fruits and Vegetables (FF&V) are an essential dietary supplement to standard operational rations. Mixed cases of FF&V are transported and stored in refrigerated containers. As FF&V ripen, they produce and release ethylene, which accelerates ripening, and spoilage. Some fruits, such as bananas and apples, produce very high levels of ethylene which leads to the acceleration of ripening and spoilage of other FF&V within the container. Concentrations as low as 0.1 ppm can affect the ripening process and ethylene gas levels as low as 1 ppm can destroy an entire shipment in a single day. By controlling ethylene the storage life of FF&V can literally be extended from days to weeks. For example, the shelf life of bananas can be extended from 3 days to 15 days or more.

The FF&V industry currently uses blankets and packaged pellet sachets of an ethylene adsorbent to control this problem. The Navy has used adsorbent blankets in the past but has since determined that the logistics of stocking, using, and disposing of these materials is too much trouble and their use has subsequently been discontinued. The logistics of maintenance and disposal of these products is also not practical for Military mobile applications. Current ethylene control technology is based on the use of ethylene adsorptive materials that are one-time-use, relatively bulky and heavy, and pose a considerable environmental and cost burden as the spent permanganate-based materials are considered a hazardous waste. Furthermore, these products are not suited for use in a military environment, where storage space and logistic support is very limited. Accordingly, a non-consumable device that can be installed or placed in a refrigerated container that will automatically control the level of ethylene is needed to ensure that FF&V can be stored long enough to be served. Though not a requirement, the ability to detect ethylene, or monitor a

minimum set point concentration, within the container may further enhance the Services' ability to reduce FF&V spoilage and losses in storage and transit.

8.7 SUPPLY CHAIN MANAGEMENT

Supply chain management refers to the process whereby the movement of a product(s) from the initial supplier to the penultimate user occurs with all non-value adding expenses. Usually supply chain management is between partners such as a retailer and a preferred supplier, or a restaurateur and a preferred supplier of a particular ingredient. From a supplier's perspective, supply chain management can mean more than this. It can alter the method of selling from being an FOB supplier to a CIF seller. It can mean that with due care, the seller can sell at a higher price to the penultimate user whilst actually providing the penultimate user with a lower cost.

Successful supply chain management can be summed in the one phrase; detail, detail, detail. In reality it means studying in detail the entire process from harvest to the penultimate user. In doing so, all steps and costs should be established. After that, it is a matter of establishing what economies can be exercised along the way to the benefit of both parties.

8.8 VALUE ADDED PRODUCTS

Most commonly, value-added products derive from fruit or vegetables that are transformed into gourmet food items. Typical value-added products include jams, jellies, preserves, fruit sauces and spreads, pickles, preserved vegetables, tapenades, hot chili sauces and vinegars. Value-added can also include other types of products: cut flowers, dried flower arrangements, wreaths and wall swatches, braided garlic, painted gourds, dried herbs, sachets, soaps made from home-grown herbs, and herbs grown and sold for medicinal properties. Any product can be considered value-added if it is originally grown by the farmer and increased in value "by labor and creativity." Value-added products are now being developed by small- to medium-scale farmers who do their own processing and sell direct to customers through farmers markets, individual and direct wholesale orders, or a Web site. Growers also typically sell wholesale to specialty outlets, such as high-end grocery stores or to exclusive catalogue businesses. The common factor is that the farmers develop and process the end product themselves and do not work through a distributor or middle person to distribute it.

Value addition in simple terms denotes – to make things valuable or important. This value for a product can be in terms of economic gain, time and money saving in preparations quantity and quality improvement or modification of raw ingredients for specific desirable characteristics. These characteristics can be organoleptic or compositional content which make a product suitable for specific purpose. With increased incomes, urbanization and changing eating habits, the demand for processed food has increased manifold.

In India, less than 2 per cent of fruits and vegetables produced are processed as against 65 per cent in the US, 70 per cent in Brazil, 78 per cent in the Philippines, 80 per cent in South Africa and 83 per cent in Malaysia. The annual wastage of fruits and vegetables is estimated to be Rs 25 thousand crores. The value addition in only 7 per cent in India as against 23 per cent in China and 88 per cent in UK.

Due to rapid expansion of internal and external market and processing industries, it is essential to develop such techniques, which reduce post harvest losses, do value addition and improve quality of the product. Changing dietary pattern, demand of fruits and vegetables in domestic market has increased. To meet the challenge fruit and vegetable production has increased many fold in the last few decades. There has been unprecedented increase in export of some fruits like mango, walnut and grapes in the last few years. There are still many more fruits, which have potential for export. Some of these are *bael, aonla, jamun*, sapota, jackfruit, custard apple, *ber*, kokum, pomegranate etc.

Most of the fruits and vegetables produced in India are still consumed fresh except for a very small quantity going for the manufacture of various products such as pickles, tomato ketchup, jams, dried and fried potato and raw banana and fruit drinks. The production of frozen peas, garlic and ginger paste, tomato puree, mango pulp etc. in a big way has been taken up only recently in India. Some of the popular processed or value added products in the country include potato and banana chips, dried onions and garlic powder, ginger and garlic paste, jams of mixed fruits, pineapple and strawberry; juice and concentrates of apple, pineapple, orange and litchi, squashes of litchi, canned pineapple, canned beans, frozen beans, cauliflower and okra; pickles of mango, lime, chillies and mixed fruits and vegetables; tomato ketchup and puree; mango fruit drink and nectar, chilli sauce, mango chutney etc. In addition to offering a higher return, value added products can open new markets, create recognition for a farm and expand the market season (Table 8.3).

Table 8.3 Existing and newer products from fruits

S.No.	Fruits	Existing Products	New Products
1.	Green mango	Pickle, chutney, dried slices, powder	Drink, juice concentrate
2.	Ripe mango	Canned slices, pulp, juices, nectar jam, bar	Frozen slice, pulp, mango powder, concentrate, wine, vinegar
3.	Pineapple	Canned slice, juice, jam	Juice concentrate, minimally processed, frozen and freeze dried slices
4.	Banana (unripe)	Fried chips	Defatted chips and powder
5.	Banana (ripe)	Pulp, osmo-dried figs	Pulp concentrate, powder, bar, toffee
6.	Grape	Raisins, juice, wine	Canned grapes, concentrate
7.	Guava	Jelly, juice, nectar	Pulp, concentrate, bars, powder
8.	Apple	Juice, jam	Pulp, slices, fruit bar, sauce
9.	Kinnow mandarin	Blended juice	Debittered juice, concentrates
10.	Aonla	Preserve, pickle	Juice and concentrate, osmo-dried segments, powder, salted segment preserve
11.	Bael	Pulp	Preserve, juice, canned
12.	Papaya (raw)	Tutti-fruitty	Papain/pectin
13.	Litchi	Juice, squash, canned	Wine, juice concentrate

Table 8.4 Products from vegetables

S.No.	Vegetables	Products
1.	Cucumber, shelled beans and peas	Slices, whole in brine solution
2.	Rdish, cucumber and onion	Whole in vinegar
3.	Carrot and tomato	Juices
4.	Tomato	Puree/concentrate
5.	Onion, garlic, cauliflower, peas, mushroom	Dehydrated
6.	Onion, garlic, mushroom, potato, chilli, bittergourd	Powder/flakes
7.	Potato, cassava	Chips
8.	Pea, mushroom, okra	Canned
9.	Carrot, parwal, ashgourd	Preserve/candy
10.	Chilli, tomato	Chutneys
11.	Chilli, carrot, radish	Pickle
12.	Cucumber, yam, mushroom, cassava, potato	Starch
13.	Cassava, sweet potato	Alcohol
14.	Sugar beet	Sugar

The value added products from flowers include dry flowers and pot pourri, essential oils, flavours and fragrances, pharmaceutical and neutraceutical products, pigments and natural

dyes, gulkand, rose water, vanilla products and insecticidal and nematicidal compounds. Spices are processed for essential oils, oleoresins, natural colours and spice extracts. Mushrooms are being processed into fresh, dried and pickled forms.

To attract the investment in the food processing and value addition sector, Government of India in its XI Plan should increase the number of industries to increase value addition, establish cold chain system, should promote primary/minimal processing at rural level to generate self employment and should establish more research and development institutes in the wake of the quality consciousness of the consumers.

Recent changes towards liberalized market economies, globalization and international consumer concerns for food safety, sustainable production practices, worker welfare and safety have however posed a threat to the processed food market in India. At the same time, the local markets are being opened up to competition from imports thus creating another challenge in marketing locally.

Table 8.5 Potential crop and their products

Aonla	:	Salted and sweet segments, whole powder
Bael	:	Whole powder, preserved juice
Ber	:	Candy, preserve
Strawberry	:	Essential flavour, whole powder
Pomegranate	:	Frozen arils
Carrot	:	Dried carrot shreds and powder, frogen bits
Bitter gourd	:	Flakes, powder, paste
Garlic	:	Flakes, powder, paste
Okra	:	Frozen bits
Cauliflower	:	Minimally processed prozen packs
Cabbage	:	Minimally processed prozen packs
Ginger	:	Minimally processed prozen packs
New products	:	Mango and carrot mix juice and powder
	:	Carrot and *aonla* mix powder
	:	*Bael* and *aonla* blended juice and powder
	:	Kinnow and ginger mixed juice

There are many **constraints** in the value addition sub-sector and some of the important ones include the following:

- Poor and inadequate rural infrastructure especially feeder access roads, power/electricity, telecommunication and market facilities in major urban centers.
- Strict food safety, traceability and good agricultural practice requirements as stipulated in the certification requirements.
- Lack or poor dissemination of local and external market information.
- Increasing competition from imports in to the local market.
- Poor availability of suitable processing variety of raw materials present
- Inadequate research, ineffective extension messages and delivery system and adoption
- Lack of implementation of quality standards in the local market
- Lack of trained manpower
- Lack of post harvest handling facilities
- Lack of cool chain system for proper management of highly perishable crops

- Inadequate access to new varieties of crops, information on market demands and other market information

The following **strategies** are proposed to address the above constraints: -

- There is need for concerted government effort to improve feeder roads and put up modern improved facilities in the urban wholesale markets through encouraging private sector participation
- Improve electricity distribution network to major production areas and make it more reliable
- Empower farmer groups to procure the agricultural inputs directly from suppliers and benefit from economies of scale.
- Encourage coordination and collaboration of public and private sector provision of extension services.
- Support for demand driven horticultural research.
- Implementation of horticultural quality standards in the local markets by the relevant regulatory institutions.
- To meet the competition in our traditional markets the exporters will be encouraged to add value, improve on quality, packaging, explore transportation by sea for some commodities, meet phytosanitary requirements; and diversify production.

In the effort to accelerate the growth of horticulture the following **broad objectives** are pursued in the sub-sector:

a) Facilitation for increased production of quality horticultural produce in order to contribute to food security, provide processors with quality produce and ensure sustenance of the export markets.

b) Diversification of crops grown for export to avoid reliance on only a few commodities.

c) Generation of employment opportunities within the horticultural sub-sector by introducing labour intensive enterprises and use of appropriate technology. In this regard value addition to exports has not been adequately exploited.

d) Promotion of horticulture production by small scale producers in the effort to increase rural incomes and alleviate poverty.

In our efforts to diversify our products and to meet the market requirements, there is an increased need to add value to our products in order to fetch better prices. These opportunities are through pre-packaged and high care products in addition to processing into juices, concentrates, chutneys, canning, and other products.

8.9 GOVERNMENTAL INITIATIVES

Realizing the need for strong PHM initiatives following initiatives have been implements;

- Boost to Public-Private sector is now eligible to get grant instead of soft loan. The quantum of assistance would be limited to 25% of the capital cost (upto a maximum limit of Rs. 50 lakhs) in plain areas and to 33.33% (upto a maximum of Rs. 75 lakhs) in difficult areas.
- Assistance upto Rs. 5.00 crores is available for setting up irradiation units by Central/state Government organization.
- In the scheme of backward linkage, assistance is available upto 10% (subject to a maximum of Rs.10 lakhs) of the cost of total raw materials purchased in a year from the existing limit of 5%. The minimum period of contract has been reduced to one year and the assistance is available for a maximum period of 5 years instead of 3

years.

- In the scheme for setting up of Food Parks, scope of the common facilities have been extended to include uninterrupted power supply, water supply, cold storage/ice plant, warehousing facility, effluent treatment plant, quality control and analytical laboratory and major processing facilities for making fruit concentrate/pulp making units etc. Project upto 4 to 20 crores are also sanctioned.
- Joint/ assisted/ Private Sector units are now eligible to get financial assistance as Grant instead of loan in the Scheme for development/ improvement of marketing, quality control, storage and transportation of meat and meat products.
- Both recurring and non-recurring financial assistance to the State nodal Agencies has been enhanced for setting regional needs and exhibition.

8.9.1 Drafting of National Food Processing Policy and Act

The Ministry Food Processing has constituted a National Task Force for Food Processing Industries on April 01,2001. After holding interactive discussions with the concerned including the Industry, State Government, R&D Organization, Industry Associations and Central Government Department, a Draft National Food Processing Policy has since been drawn up. It is being finalized. This Policy envisages among other things creation of enabling environments, infrastructural developments and linkages at farm level etc. An outline of the Draft, Food Processing Development Bill has also been drawn up by the Ministry which envisages inter-alia setting up of a Processed Food Development Authority to formulate standard for processed foods. The Draft is at present under discussion with concerned different ministries.

8.9.2 Reduction of Central Excise Exemption on Processed Products of Fruits and Vegetables

India is the world's second largest producer of fruits and vegetables. However, large percentage of these is wasted for want of proper handling, storage and processing facilities. It has been estimated that the wastage in food sector is as high as Rs.50,000 crores. The level of processing of food also is less than 2%. In order to promote higher level of processing of fruits & vegetables, which would also reduce huge wastage of fresh fruits, and vegetables, the Government of India in the budget for 2001-02 exempted the processed products of fruits and vegetables completely form Central Excise Duty of 16%. During April-October, 2001 the additional capacity of 28.000 tonnes has been created in fruits and vegetables processing as against 24,000 tonnes during the corresponding period of the last year. Further the prices of number fruits and vegetables products have come down by 8-10%.

8.9.3 Establishment of Food Parks and Cooperative Food Parks

As part of the strategy to develop food processing infrastructure, the Ministry has been pro actively pursuing the task of setting up of food parks in different pars of the Country. The idea behind setting up of food parks is that Small & medium entrepreneurs find it difficult to invest in capital intensive facilities, such as cold storage, warehouse quality control labs, effluent treatment plant etc. assistance for development of these as common facilities can make the cluster of food processing units in such food parks not only more cost competitive, but also have a better market orientation. PSUs/ joint/ assisted/ private sector/ NGOs/ co-operatives are eligible to grant upto Rs.4 crores for common facilities such as uninterrupted power supply, water supply, cold storage/ice plant, warehousing facilities, effluent treatment plant, quality control & analytical laboratory, and major processing facilities like fruits concentrate/ pulp making units etc. as part of a food park. Till date, 25 food parks have been sanctioned in different states and many are under operation.

8.9.4 Agri-Export Zones

The APEDA under the Ministry of Commerce is also implementing scheme of Agri Export Zone which attempts to take a comprehensive look at a particular produce/ product located in a contiguous area for the purpose of developing and sourcing the raw materials, their processing/ packaging, leading finally to exports. Thus, the entire effort is centred around the cluster approach of identifying the potential products in a contiguous geographical region and adopting an end-to-end approach of integrating the entire process right from the stage of production till it reaches the global market. The Ministry of Food Processing Industries and APEDA are coordinating their efforts so that the possible synergies and convergence between food parks and agri-export zones are realized.

8.9.5 Mini Mission

Govt. of India has approved a Technology Mission for integrated development of horticulture in North Eastern States. The programmes under MM-IV us being coordinated by this Agriculture Ministry aims to develop processing of horticulture produce by establishing new processing industries and strengthening of existing one. Processing Industries and APEDA are coordinating their efforts so that the possible synergies and convergence between food parks and agri-export zones realized.

8.10 POLICY INTERVENTION

8.10.1 Entrepreneurship Development

Common infrastructure facilities for sorting, grading and packing as well as post harvest treatment as required should be created at all the major seaports and airports for exports and major terminal markets for domestic marketing. In such cases, participatory management through registered exporters or growers association should be introduced for proper utilization of the facility. In cases where registered users associations are not forthcoming, cooperatives or private sector may be allowed to participate in the management of these units. Such participatory common infrastructure should be funded as follows:-

i.) In case the unit is set up by the Government agency and managed by a cooperative or registered users association. 90% of the capital cost and 75% of the revenue cost to be subsidized in the first year and gradually tapered off to 0% in seven years.

ii.) In case the unit is set up and managed by a private organization, 75% of the capital cost and 50% of the revenue cost to be subsidized in the first year and gradually tapered off to 0% in 5^{th} year.

8.11 SUGGESTED MODIFICATIONS

8.11.1 Suggested Modifications on The Existing Schemes/ Proposed New Schemes for the XI Five Year Plan

At present a number of schemes are being operated separately by Government of India, Ministry of Agriculture, National Horticulture Mission, National Horticulture Board, APEDA under the Ministry of Commerce and Ministry of Food Processing. They cater to different components of post harvest infrastructure. It is necessary to amalgamate and simplify these schemes. It is therefore suggested that a composite **Scheme for Improvement in Post Harvest Infrastructure** may be formulated which may have the following components:

i. Grading, Sorting and packing

ii. Pre-cooling facility

iii. Specialized storage including cold store, MA & CA stores, evaporative cooling storage, high humidity cold storage, silo storage etc.

iv. Specialized transport facilities such as refrigerated vans/containers

v. Post-harvest treatment facilities such as irradiation, electronic beam processing, fumigation, water drip treatment, x-ray, waxing, CIPC/MICP treatment etc. to enhance shelf life

vi. Integrated supply chain including any one or more of the above components. These schemes should be implemented as follows:-

vii. Scale of assistance in all such cases should be the same i.e. 25% of the capital cost in general areas and 33.3 % in case of hilly and tribal areas.

viii. The normative cost of each of the facility should be fixed on the basis of prevailing market prices from year to year.

ix. The beneficiary may be given the option to apply to any of the implementing agencies such as MOA, NHB, APEDA, MOFPI etc. subject to the condition that assistance can be availed from only one source.

x. The assistance should be extended for each facility created and not subject to any ceiling per beneficiary.

xi. The creation and utilization of the facilities should be strictly monitored.

Common infrastructure facilities for sorting, grading and packing as well as post harvest treatment as required should be created at all the major seaports and airports for exports and major terminal markets for domestic marketing. In such cases, participatory management through registered exporters or growers association should be introduced for proper utilization of the facility. In cases where registered users associations are not forthcoming, cooperatives or private sector may be allowed to participate in the management of these units. Such participatory common infrastructure should be funded as follows:-

i. In case the unit is set up by the Government agency and managed by a cooperative or registered users association. 90% of the capital cost and 75% of the revenue cost to be subsidized in the first year and gradually tapered off to 0% in seven years.

ii. In case the unit is set up and managed by a private organization, 75% of the capital cost and 50% of the revenue cost to be subsidized in the first year and gradually tapered off to 0% in five years.

iii. User charges to be notified by the subsidizing agency as a part of the concession agreement based on project repot.

8.11.2 Collection Centres and Pack House

Based on the above facts, models of a collection centre and a modern pack-house have been suggested. These collection centres/ packing houses could be modified according to the requirements of the area.

8.11.2.1 Collection centres

These collection centres would have facilities for sorting, grading and packing. A small cool store may also be required for temporary storage of produce. The criteria for setting up proposed collection centres should be

- To be set up in producing areas having concentrated production/compact area of horticultural crops i.e. 200-250 ha.
- Should have capacity to handle 10 tonnes/day produce or 2,000-2,500 tonnes per annum.
- Should be managed by producers themselves by forming a association or SHG or a cooperative society.
- At least 50-60 producers should be members of each collection centre for commercial activity.

The cost estimates of facilities proposed to be created at each collection centre is given in Table 8.6.

Table 8.6 Cost estimates of facilities to be created

Proposed facility	Estimated cost (Rs, lakh)
Land (2,000 m^2) including land development	2.00
Building and equipments	12.00
Dumping platform	
Grading/packing shed	
Cool store	
Weighing equipments	
Grading tables etc.	
Packaging material	3.50
Plastic crates (1,500)	
CFB boxes	
Gunny bags etc.	
Specialized transport vehicle	7.50
Water source (tube well)	1.00
DG set (25-30KVA)	1.50
Office equipments, furniture and fixtures	2.50
Total	**30.00**

8.11.2.2 Pack house

Following criteria should be considered for setting up a packing-house

- Packing house to be set up in urban areas of concentrated pockets of production
- Good connectivity of transportation of produce to target markets
- Round-the-year availability of electricity and water
- Hygienic surroundings
- Availability of land for expanding the infrastructural facilities.

The proposed packing house of 50 tonnes/day and will have facilities for automatic facilities for sorting, washing, grading, waxing lines, packing equipments, pre-cooling units and cold storage. Provision of refrigerated van or insulated van to have cool chain up to marketing may also is considered in packing house. It should aim be to market quality and graded products in distant markets for exports. These packing houses would handle 10,000-12,500 tonnes of fruits and vegetables annually. The facilities at packinghouse should include:

- Automatic sorting, washing, grading, waxing and packing lines having a capacity of handling 5 tonnes of fruits and vegetables per hour.
- A pre-cooling unit of 5 tonnes/ batch should also be established. Since the proposed packing house would process the fruits and vegetables, mainly for distant markets and exports, it would be desirable to have high humidity cold storage of 1,000 tonnes capacity.
- To maintain the quality of produce up to shipment/marketing, it would be desirable to have one refrigerated van of at least 10-15 tonnes Capacity. Besides two specialized vehicles for transporting fruits and vegetables from collection centres as well as for marketing in distant markets would also be required.

Facilities of good road/rail connections, availability of electricity, water, etc. As such, it would be desirable to establish packing house in urban market, or nearby areas collection centres in producing areas would also be supporting such pack-houses. The cost of Pack-House is

estimated as under:-

i. Land: An area of 5000 m^2 would be required to handle 50 MT capacity, with grading /packing lines, storages, pre-cooling and cold storage. The cost of land is estimated at Rs. 10.0 lakh.

ii. Building: The building of packing house should be specious, neat, clean and allow minimum temperature variations. Keeping in view the advantages of pre-engineered building such as short gestation period for construction and barrier to temperature fluctuations, insulated panels are suggested to be used for construction. The building would comprise, pack-house, pre-cooling unit and cold storage besides office, public utility and parking space. The cost of such building has been estimated at Rs 40 lakh only.

iii. Plant and Machinery: The cost of plant and machinery includes automatic grading/ packing line, packaging equipments, pre-cooling and cold storage. The cost has been discussed by consultants with leading suppliers like Blue star, Frick India etc. The estimated cost works out to Rs 90 lakhs. Thus, the estimated cost of setting up a packing-house would be (see box).

Facility	**Cost (Rs lakhs)**
Land, (5000 m^2)	10.00
Building	40.00
Receiving hall	
Grading/packing shed	
Pre-cooling/cold storage	
Office etc.	
Plant and machinery	90.00
Grading/packing lines	
Pre cooling unit	
Cold storage	
Refrigerated van (1)	20.00
Specialized transport vehicles (2)	20.00
Water source (tube well)	2.00

Looking into the present production base it is estimated that even if an average of 50% production is taken (after taking into consideration the daily consumption and requirements) which is being marketed in distant urban markets, post-harvest infrastructure would be required to handle 142.5 million tonnes by 2011-12.

The minimum post-harvest infrastructure like collection centres and packing houses suggested above for handling 142.5 millions tonnes of horticultural produce would require an investment of Rs 24,800 crores. As such, it would not be desirable to invest such a huge amount in creation of post-harvest infrastructure. It is, therefore, suggested that 10% of total 50% horticultural produce may be handled in next 5 years and another 10% up to 2011-12. Thus, total 20% produce may be handled by creation of post-harvest infrastructure which may require about Rs 5,000 crores only for setting up 1,400 packing-houses and 7,000 centres by 2011-12.

8.11.3 Cold storage

The development of adequate cold storage capacity/cool chain would help not only in increasing the shelf-life and minimizing post-harvest losses through proper storage but also help farmers in taking timely marketing decisions. Keeping in view of the perishability of horticultural produce cold storage play an important role in enhancing marketing season, avoid gluts, help in price stabilization, prolong supply of raw material to processing industries, besides reducing post-harvest losses. The present capacity of cold storage in the country as already stated in previous chapter is only 18.21 million tonnes as on 31 December 2003 which is only 12.49 % of the total horticultural production of 145.78 million

tonnes. It has already been suggested that each packing-house should have a cold storage of 1,000 tonnes. Thus, by adding 1,400 packing houses in different states, additional capacity of 1.4 million tonnes would be added. However, still 16.40 million tonnes capacity to be added. While considering the enhancement of capacity following criteria should be kept in view:

- Medium to small cold storages should be established with multi-chamber storage multi-products so that these could be used for maximum period.
- Small pre-cooling units and Zero-Energy Cool Chambers should be set up in the production areas where the field heat of the produce is to be removed at a fast rate to bring down the temperature of the produce to the desired level before putting the product in cold storage. The refrigerated transport units from farm to cold storage can also be utilized as mobile pre-cooling units for this purpose.
- Specialized cold storage with facility of built in pre-cooling high humidity and controlled/modified atmosphere are required for storage of the produce for a longer period. These specialized cold storages are essential for extended shelf-life of the produce.
- Emphasis should be on construction of cold storages with PUF panels instead of conventional method of construction.
- Plant and machinery should be used of latest technology to minimize the running cost and increasing efficiency of cold storage.
- Supply of continuous electricity and water should be ensured for at least 10-20 hours per day.
- Low-cost technology like CIPC particularly for storage of potatoes which constitute bulk of storage, need to be popularized
- Besides cold storages, attention also to be paid for improvement in storage of onions and model of onion storage developed by NAFFD needs popularization in onion-growing areas.

8.11.4 Establishment of Packaging Material Manufacturing Units

There is felt need of the quality packaging material in the specialized fruits and vegetable production zone. So the small scale packaging material manufacturing units are required to be established. These units should lace with state of art packaging machinery and should supply commodity specific packaging material to the growers/traders. By setting up 800 additional such units the demand for packing additional fruit and vegetables may be meet out.

8.12 HUMAN RESOURCES DEVELOPMENT

According to an conservative estimate the post harvest sector with grow at the tuna of 10 per cent in coming two decades. At present we do not have UG and PG degree programme at each Agricultural University of College level. Out of 42 Agricultural Universities and Deemed to be universities only 6 are importing P.G. degree in food technology and post harvest management. Hence fish it is worth to propose to start post harvest management diploma/courses at each polytechnique at district level in all the states.

8.13 TECHNOLOGY TRANSFER

For technology assessment and transfer establish centre for food distribution and retailing in SAUs / central institutes/situated in major metropolis for connecting suppliers and retailers should be used. The multidisciplinary teams in such centers will look after R&D needs of the entire cool chain in a holistic manner that will assure food quality and safety. External Advisory committee of these centers will be manned by leaders of food industry and

consumer organizations. R&D should be strengthened in public / private institutes with focused funding and training of manpower at centers of excellence in India & abroad. R&D by private industry at government institutes may be funded upto 40% of the actual cost of project subject to a limit of Rs 10 lakh. Technology results will be shared with funding agency and be a national asset. Such centre will also impart training to the farmers, traders, semi-skilled workers, technician and supervisor pertaining to their marketing problems. For capacity building, the central institute, like CISH, CFTRI, NIAM, CIPHET, IIHR, selected IIT'S and IIM's and State Agricultural University should offer specialized post harvest management and technology courses (diploma / degree) and short-term courses for operatives of the cool-chain.

CHAPTER IX
MARKETING

The present marketing system of agricultural produce in the country, particularly for fruits and vegetables, lacks system approach. Producers have often failed to realize expenses incurred their transportation to markets, let alone the cost of production and capital investment, during the period of glut. Fruit and vegetable growers are receiving only a small part of price paid by the consumers as lion's share is being taken by chain of middlemen. The high profit margin of intermediaries is quite disproportionate to their services. The private sector handles 80 per cent of the marketed surplus of agricultural products. The quantity of agricultural products handled by the government agencies has been about 10 per cent of the total value of marketed surplus. Further, around 10 per cent of the marketed surplus is handled by the producers or consumers cooperatives.

9.1 PRESENT MARKETING STRUCTURE

The prevalent fruit and vegetable marketing structure is given in Figure 9.1.

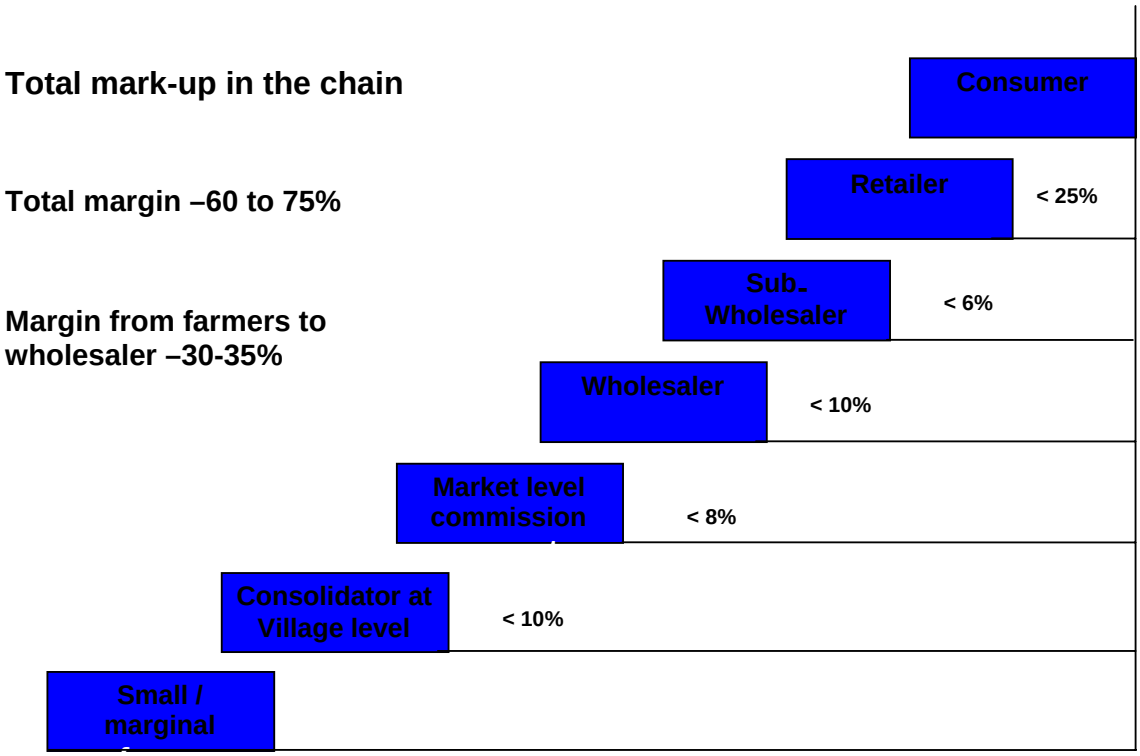


Fig. 9.1 Present structure of fruit & vegetable marketing chain

There are 3 types of market, which play a prominent role in organized marketing of fruits, vegetables and flowers.

9.1.1 Farmers' markets/village haats

These markets are simple retail operations where a place close to the cluster of villages producing fruits and vegetables by tradition has been designated as village *haat*. Most of such *haats* are organized on specific days of a week. The farmers bring their produce to these markets and sell directly to consumers. These markets may be in a covered hall or in an open street or community open area. Because of the direct sales to consumers the farmers get better price, however, quantities sold are quite small. There are at present

27,294 rural periodic markets (village *haats*) operating in the country.

9.1.2 Assembly markets

Assembly market is like farmer's market, but with a difference that the produce is sold to traders, who assemble the produce and consolidate a truck/LCV load for sales in the city or wholesale market. These types of markets play a very prominent role in the eastern part of the country. In other parts, such operations exist only in concentrated production belts. Many a times, these operations are carried out in an informal manner rather than a regularly convened market. In this system, some traders/transporters establish collection centre in a production area, where farmers bring their produce which is transported in truck loads to a city market. The payment is made to the farmers on the basis of sale price in regulated market.

9.1.3 Terminal markets

A terminal market is one where the produce is either finally disposed off to consumers or processors, or assembled for dispatch to distant markets and export. Merchants are well organized in these markets. Facilities for forward trading in specific commodities also take place. Such markets are located mainly in major metros like Mumbai, Chennai, Kolkata, Delhi and Bangalore.

9.1.4 Regulated markets

The Government has taken the initiative to promote organized marketing of agricultural commodities in the country through a network of regulated markets. The basic objective of setting up a network of physical markets has been to ensure reasonable gain to farmers by creating environment in markets for fair play of supply and demand forces, regulate market practices, and attain transparency in transactions.

With a view to coping with need to handle increasing agricultural production, the number of regulated markets has also been increasing in the country. By the end of 1950, there were 286 regulated markets in the country. The number stood at 7,161 as on 31 March 2001. The Central Government advised all the State Governments to enact Marketing legislation to provide competitive and transparent transactional methods to protect the interest of farmers. Barring a few, most State Governments and UTs embarked upon a massive programme of regulation of markets after enacting the legislation. Most of these regulated markets are wholesale markets. There are in all 7,521 wholesale markets in the country.

9.1.5 Effectiveness of regulated markets

The basic objective of market regulation is to regulate the trade practices, increase market efficiency through reduction in market charges, elimination of intermediaries and to protect the interest of producer-seller. Although regulation of the markets has improved their functioning and has helped in reducing the multiple trade charges and levies on producer-seller, verification of accurate weights and scales, establishment of market committees in which the agricultural producer is given due representation, Judicious \utilization of market funds, fair settlements of disputes, arrangements for better storage facilities, market intelligence etc, the existing machinery has failed to check trading malpractices and has made the agricultural marketing system highly restrictive and inefficient. There are a large number of domestic market distortions, which have had a negative impact on development of this sector. Wholesale markets have been established in most of the states under respective Agricultural Produce Marketing Regulation Acts.

9.2 STRATEGY FOR AGRICULTURAL MARKETING

There is a necessity to integrate farm production with national and international markets to enable farmers to under take market driven production plan and adoption of modern marketing practices. If agricultural markets are to be developed in private and cooperative sectors, and to be provided a level competitive environment vis-à-vis regulated markets, the

existing framework of State AMPC Acts will have to undergo a change.

The state has to facilitate varying models of ownership of markets to accelerate investment in the area and enable private investment in owning, establishing and operating markets. Working of existing government regulated markets also needs to be professionalized by promoting public private partnership in their management. Appropriate legal framework is also required to promote direct marketing and contract farming arrangements as alternative marketing mechanism. Therefore, there is a need to formulate a new model Act for agricultural marketing. Accordingly Department of Agriculture and Cooperation has formulated a Model Act "The State Agricultural Produce Marketing (Development and Regulation) Act 2003 in September 2003 and circulated to all State Government/UTs for adoption.

The Tenth Five Year Plan had identified strengthening of marketing, processing/value addition infrastructure and reforms to introduce proactive policies for the Farm sector in the thrust areas. The areas identified. (a) legal reforms, (b) direct marketing, (c) market infrastructure (d) pledge financial, (e) warehouse receipt system, (f) forward and future markets (g) price support policy, (h) IT in agricultural marketing and (I) marketing extension. The following measures were suggested for strengthening agricultural marketing in the country.

9.2.1 Legal Reforms

At present, though agricultural production is largely free from controls, the same is not true of marketing and processing agricultural commodities. The State Governments alone are empowered to initiate the process of setting up of markets for agricultural commodities in notified areas. Processing industries cannot buy directly from farmers, except through notified markets. Processed foods derived from agricultural commodities suffer from multiple taxes at various stages starting from harvesting till the sale of final processed products. There are stringent controls on the storage and movement of several agricultural commodities. In the present situation, these important roles in making the present marketing system more effective and efficient by removing unnecessary restrictions and by establishing a sound framework to reduce uncertainty of the markets. The State Agricultural Produce Marketing Regulations Act (APMC Act) and the Essential Commodities Act (EC Act) are important legislation that have to be amended to remove restrictive provisions coming in the way of an efficient and competitive marketing system.

Table 9.1 Progress of reforms in agricultural markets (APMC Act) as on 31.08.06

S.No.	Stage of Reforms	Name of States/ Union Territories
	States/ UTs where reforms to APMC Act have been done for Direct Marketing; Contract Farming and Markets in Private/ Coop Sectors	Andhra Pradesh, Arunachal Pradesh Chhattisgarh, Himachal Pradesh, Madhya Pradesh, Maharashtra Nagaland, Orissa Punjab, Sikkim and Rajasthan.
	States/ UTs where reforms to APMC Act have been done partially	a) Direct Marketing: Chandigarh, Haryana, Karnataka, NCT of Delhi, U.P. b) Contract Farming: Gujarat, Haryana c) Markets in Private/ Coop. Sectors: Karnataka (Only NDDB)
	States/ UTs where there is no APMC Act and hence do not require reforms	Andaman & Nicobar, Dadra & Nagar Haveli, Daman & Diu Kerala, Islands, Lakshadweep and Manipur.
	States/ UTs where APMC Act already provides for the reforms	Tamil Nadu
	States/ UTs where administrative action has been initiated for the reforms	Assam, Bihar, Goa, Jharkhand, J&K, Meghalaya, Mizoram, Pondicherry Tripura, Uttaranchal and West Bengal.

9.2.2 Direct Marketing

Direct marketing encourages farmers to undertake grading of farm produce at the farm gate and obviates the necessity to haul produce to regulated markets for sale. Direct marketing enables farmers and processors and other bulk buyers to economize on transportation cost and to considerably improve price realization. In South Korea, for instance, as a consequence of expansion of direct marketing of agricultural products, consumer prices declined by 20 to 30 percent and producer-received prices rose by 10 to 20 percent. This also provided incentive to large-scale marketing companies to increase their purchases directly from producing areas.

Direct marketing by farmers is being encouraged as an innovative channel. Some examples of these channels are Apni Mandi, Hadaspar Mandi, Rythu Bazars; and Uzhavar Sandies. These channels are mostly adopted in sales transactions of agricultural commodities like fruits, vegetables and flowers, which are highly perishable. In this channel, the produce moves quickly from farmers to consumer due to lack of middlemen. If farmers directly sell their produce to the consumers, it will not only save losses but may also increase farmers' share in the price paid by the consumer.

9.2.3 Market Infrastructure

A marketing system backed by strong, adequate infrastructure is at the core of agricultural marketing. Market infrastructure is important not only for the performance of various marketing functions and expansion of the size of the market but also for transfer of appropriate price signals leading to improved marketing efficiency. High investment and entrepreneurial skills required for creation and management of modern markets has to come from private sector. The situation of control by the state has to be eased to facilitate greater participation of the private sector, particularly to engender massive investments required for the development of marketing infrastructure and support service.

There is a huge **infrastructural gap** in the existing marketing system of the country, which needs to be addressed through requisite measures during the XI plan period.

Grading at primary market level is grossly inadequate. There are only 1968 grading units at the primary level, which include 587 units with cooperatives and 298 units with others. At the level of regulated markets, there are only 1093 grading units in a total of 7557 market yards/sub-yards. Only around seven percent of the total quantity sold by farmers is graded before sale. During 2004-05, 6.62 million tonnes of agricultural produce and 26.1 crore pieces valued at Rs 6224 crores were graded at primary market level.

The scientific storage capacity is only 30 percent of the required capacity. Cold storage facility is available for only 10 percent of fruits and vegetables.

Transportation and handling facilities for perishable commodities are inadequate and poor. The processing capacity is also inadequate and mostly inefficient.

Physical infrastructure in market yards is inadequate. Most of the rural primary markets have no infrastructure.

Due to lack of proper handling (cleaning, sorting, grading and packaging) facilities at the village level with about 30 percent of fruits and vegetables and 10 percent of spices are lost before reaching the market.

9.2.4 Forward and Future Markets

In the light of the perceived advantages from forward and future markets in terms of price discovery and risk management, as market based instruments, such markets have been identified as important tools of price stabilization. Extension of forward and future markets to all major agro commodities has, therefore, assumed great importance. Only if the markets are allowed to function under proper regulatory environment, the agricultural economy - one

of the largest in the world - can fully exploit the benefits of markets in the state, country and abroad.

9.2.5 Rationalization of Market Fee

The present system of levy of fee at multiple points for the same commodity at different stages of transaction needs to be replaced by single point levy of market fee in the entire process of marketing in the State. Further, collection of market fee should be more in the nature of service charge based on the quality of services provided. The levy of fee can be at different slabs inconsonance with the type of scale of services/facilities provided to all market users. There is also considerable variation in the structure of taxes and fee on the agricultural produce in various states, which distorts the operation of the domestic market. There is need for bringing uniformity in the state level tax structure in agricultural commodities for improving the marketing efficiencies.

9.2.6 Information Technology in Marketing

Market information is needed by farmers in planning production and marketing, and is equally required by other market participants in arriving at optimal trading decisions. The existence and dissemination of complete and accurate marketing information is the key to achieving both operational and pricing efficiency in the marketing system and IT has an important role to play in the process.

Data on various aspects of agricultural marketing is important for policy formulation, infrastructure planning and research. To facilitate both the Government as well as the private sector in planning development of an appropriate marketing strategy in agriculture sector, it would be necessary to created at national level an 'Atlas of Agricultural Markets' which would provide information in respect of each commodity, major areas of production, movement and storage and of market and consuming centers. In parallel, commodity profile should be prepared for all major commodities outlining the market requirements in terms of quality, standards, labeling, packing, storage, transport, regulation, taxation, warehousing, forward and futures markets etc. This information has to be translated in local languages and uploaded onto the State level portals to facilities market the extension to farming community in local language through internet.

9.2.7 Marketing Extension, Training and Research

Agricultural/horticulture produce marketing is witnessing major changes owing to liberalization and globalization of markets. In this context, has to be market driven, more cost effective, competitive, innovative and responsive to high tech and I.T. applications. Training and extension system in agriculture marketing will have to sensitize and orient the beneficiaries to respond to these challenges. It is necessary to build capacity of each of the beneficiary group, namely, the farmers, market functionaries and other officials involved in the agricultural marketing activities. Knowledge has to be imparted at the grassroots level in areas such as market driven production program, post harvest management of agricultural and horticultural crops, availability of marketing finance, information on facilities for quality assurance and standards, grading, packaging, storage, transportation, contract farming, direct marketing, alternative markets including Forward and Futures markets, commodity exchanges, online market information system etc. Training and education modules will have to be prepared in these areas for reaching the region specific farmers in vernacular languages. The objective of imparting training to marketing functionaries and stake holders should be to create an ambiance of Good Marketing Practices in the country to promote the interests of farmers as well as consumers.

9.2.8 Contract Farming

Contract farming can be defined as a system for the production and supply of Agricultural/ Horticulture produce by Farmers / primary producers under advance contracts, the essence of such arrangements being a commitment to provide an agricultural commodity of a type, at

a specified time, specified price and at a specified quantity to a known Buyer. In fact, Contract Farming can be described as a halfway house between independent farm production and corporate/captive farming and can act as a step towards complete vertical integration depending on the given context. It basically involves four things – pre--agreed price, quality, quantity or acreage (minimum/maximum) and time.

Contract Farming is a partnership between farmers and sponsors (processing and/or marketing firms) for the production and supply of agriculture products under forward agreements frequently at pre-determined prices with provision of supply of transfer of technology, critical inputs, credit, and upgradation of marketing and management skills.

Contract Farming is becoming an increasingly important aspect of agribusiness, whether the products are purchased by multinationals, smaller companies, Government agencies, Farmer Cooperatives or individual entrepreneurs. The approach would appears to have a considerable potential in countries where small-scale Agriculture continues to be widespread, as in many cases small-scale farmers can no longer be competitive without access to the services provided by Contract Farming companies.

Contract Farming has been prevalent in various parts of the country for commercial crops like Sugarcane, Cotton, Tea, Coffee, etc. The concept, has, however, gained importance in recent times in the wake of the economic liberalization process. The main feature of Contract Farming is that grow select crops under a buy back agreement with an agency engaged in trading or processing. There are many success stories on Contract Farming such as Potato, Tomato and Chilli in Punjab, Oil Palm in Andhra Pradesh, seed production contracts for hybrids seed companies in Karnataka, which helped growers in realization of better returns for their produce.

9.3 PROGRESS OF REFORMS IN AGRICULTURAL MARKETS

The Essential Commodities Act had empowered Central and State Governments to impose restrictions on the storage and movement of commodities, thus restricting the scope of private investment in these markets. In consonance with the liberalized regime of commodity flows, some of the recent steps towards deregulation of domestic markets for agricultural commodities are as follows:

- Government has removed restrictions on investment in bulk handling and storage by private investors, including permitting 100% ownership by foreign investors.
- A single unified Food – Laws has been drafted and an Integrated Food Law (Food safety and Standard Bill, 2005) is now under consideration of Parliament.
- For promoting warehousing in the country, a Warehousing (Development and Regulation) Bill 2005 has been placed before the Parliament.

9.4 POLICY INTERVENTIONS

- The amendment to the APMC Act should be vigorously pursued and assistance under plan schemes for agriculture/ horticulture marketing should only be extended to States, which have carried out the amendments in the APMC Act in letter and spirit.
- All restrictions on storage and movement of all agriculture produce under the Essential Commodities Act should be removed.
- The warehouse receipt system should be introduced

- The Forward Contracts (Regulation Act) should be expeditiously amended. There should be rational riders on physical delivery in futures markets. At present, futures are allowed for six months. It should be extended at least to 12 months so that full crop marketing year and its seasonality is covered.
- Market fee needs to be converted into service charge and should be levied on produce which is brought to the market yard.
- Considering the inevitability of horizontal integration of markets and envisaged strengthening of agricultural production system with the markets, the subject 'Agriculture' should be shifted from State list to the concurrent list to facilitate fast tract changes in the legal and procedural framework related to agricultural sector.
- The National Institute of Agriculture Marketing (NIAM), Jaipur should be the nodal agency for implementation of training, extension and research programs in Agricultural Marketing. The Institute should coordinate research activities in collaboration with State Agricultural Universities, State Agricultural Marketing Boards, Directorate of Marketing, Ministry of Agriculture & Cooperation and International Agencies involved in promoting agricultural Marketing.

Besides the above, Policy interventions for Contract Farming are as follows:

- The Government may work out a farmer centric 'Code of Conduct' for contract farming arrangements, which should form the basis of all contract farming agreements and also encourage development of farmer's groups/organizations to negotiate with the purchasers and take care of the interests of the small farmers. Till such time a cautious approach is needed towards contract farming in India.
- While prompt settlement of disputes is crucial to Contract Farming arrangements, compulsory registration of Contract Farming agreements with the APMC may not be insisted upon.
- Indian agriculture must move from low value agriculture to high value agriculture. There is an urgent need to provide extensive training to the farmers and also creation of quality testing laboratories and other infrastructure for the purpose in rural areas. The concept of 'Farm-Schools' for lateral training of the farmers needs to be pursued.
- Private sector entrepreneurs are compelled to get multiple licenses in each marketing zones. Hence, single licensing system should be introduced for setting up of Private Markets and large number of Procurement Centers within one State.
- The companies should preferably have an end use for the produce under Contract Farming – either for processing, retailing or for export.
- Incentives should be given to the sponsoring companies for disseminating technical knowledge or introduction of new technology
- Contract Farming tenures should be permitted for a relatively long period of 3-5 years or more,
- Long period of contract for labour will facilitate long term investment of the companies in training and manpower development and lead to skill development.
- National and State level Contract Farming Policies should be framed.
- Different Models of Contract Farming should be allowed to evolve as per the situation, instead of straitjacketing the models into a particular fixed definition.
- Creation of dispute resolution mechanism which can quickly settle the disputes in a quasi-judicial manner.
- Proper insurance products appropriate for Contract Farming need to be developed.

- Like in Punjab and Maharashtra, other States Governments should also totally exempt levy of market fees in respect of commodities procured under the Contract Farming agreement.
- Elimination of red tape in import of varieties/ hybrids for Contract Farming.
- Tax incentives to food processors involved in Contract Farming for investment in rural infrastructure related to Contract Farming.

9.5 SUGGESTED MODIFICATIONS IN THE EXISTING SCHEMES/ PROPOSED AND NEW SCHEMES FOR THE XI FIVE YEAR PLAN

9.5.1 Upgradation of Village Haats (Perishable markets)

There are more than 27,294 village haats in the country, some of which lack basic amenities like pucca sheds and drinking water. These are largely managed by Panchayats and local bodies quite often through contractors. It is estimated that the basic amenities can be provided in these markets at an average cost of Rs.9000 per haat. Government needs to take up this scheme urgently for providing basic amenities in these haat's with a 100% grant.

9.5.2 Wholesale Markets

Although Rs.150 crores has been kept for setting up of wholesale markets under the NHM, it has not made any significant headway as yet. The scheme needs to be amended and privatization of wholesale markets and participatory management models should be encouraged.

It is estimated that an investment of Rs.12, 500 crores is required for the development of providing essential infrastructure in wholesale markets over the next five years. It is observed that this cannot be generated from public sources. Hence, efforts should be made to mobilize private investments in marketing infrastructure.

There are about 7,557 wholesale markets in the country having 2,428 Principal markets and 5,129 sub-yards. Most of them lack critical infrastructure. It is estimated that an amount of about 12,230 crores is required. The current scheme of assistance under the NHM has failed to take off. The scale of assistance has therefore, to be substantially stepped up and a participatory management model should be encouraged to ensure efficiency. It is therefore, suggested that farmer interest groups and private sector should be invited to invest in these wholesale markets as a joint venture through a transparent bidding system. The wholesale markets in the State may be set up in the private sector with the State Government playing the role of a facilitator/promoter and regulator.

9.5.3 Collection Centers Near to the Farms

To create primary processing centres for a cluster of villages with minimum infrastructure of drying yards, small storage facility, cleaning and grading equipment, cold storage, if required and basic food safety testing/soil health testing facilities. Considering the number of villages in the country in the form of clusters, 50,000 primary processing centers can be proposed to be created after actual assessment depending on the production potential of the area. Each center is estimated to cost Rs.15 lakhs.

9.5.4 Specialized Cold Storages

Cold storages with facility of built in pre-cooling, high humidity and controlled atmosphere for storage of produce for a longer period are essential for effective marketing of the perishable horticultural produce. Other components like **ripening chambers** close to market places and display cabinets at retail outlets. Linkages for conversion of fresh produce into other marketable forms. Medium to small cold storages (multi-product & multi-chamber) as transit godowns are also essential.

9.5.5 Integrated Pack Houses

Integrated pack houses catering to farms in respect of regions around 5,000-10,000 hectare for washing, sorting, grading, packing, cold storing etc.

9.5.6 E-trading

For direct marketing through kiosks in the market yard need to be established across the country

9.5.7 Improved Telecommunication

Only 59% of villages are covered (2001), 3.5% tele-density against world average of 16, target is 15% by 2015. Efficient communication is the key to marketing. Therefore there is an urgent need to establish a strong network of communication in the rural and urban markets for effective information flow.

9.5.8 Improved Rural Connectivity

Only 47.83% of villages covered till mid 90s. Av. road length is 4 km. To connect each village with main road. Investment requirement is Rs 74000 cr.

9.5.9 Physical Facilities in Wholesale Regulated Markets

The proposed markets require auction platforms, shops and godowns etc; Rs 3000 crore during the next 5 years to develop 1,000 such wholesale markets @ 3 crore of central assistance per market is envisaged.

9.5.10 Specialised Markets

The National Horticulture Mission launched in May 2005 as a major initiative to bring about diversification in agriculture and augment income of farmers through cultivation of high value crops seeks to double the horticultural production by 2011-12. The facilities and infrastructure facilities available in the markets are far from satisfactory keeping in view the specific needs of the perishable commodities. There is, therefore, need for developing specialized markets for fruit, vegetables, flowers, etc. It has been assessed by the Expert Committee on Strengthening and Developing of Agricultural Marketing that there are at least 241 such places in the country where fruit and vegetables markets should be developed. The investment requirement for fruit and vegetables markets alone in the country is estimated at Rs.964 crores.

9.5.11 Farmer's Markets

Apni Mandis in different states need to be established in every district at least. Considering the useful role, direct marketing has played in the interest of both producers and consumers, it is required to be promoted in all the States/UTs. It is, therefore, suggested that financial assistance to set up **1000 farmers' markets** in all the districts of the country. It would require financial assistance of **Rs.500.00 crores @ Rs.50.00 lakhs per market during XI Plan period.**

9.5.12 Flower Markets

Flower markets need improvements immediately to protect the losses in handling and transportation. At least our modern state- of -art flower market is required to be developed near major metropolitan cities. It is proposed to take up such markets at five locations with an estimated cost of Rs. 10 crores for each markt. The total requirement of investment will be Rs. 50 crores.

9.5.13 Medicinal and Aromatic Plants

Proper market infrastructure for medicinal and aromatic plants is required in the states of Kerala, Chattishgarh, MP, Uttarancahl and North Eastern States. About 500 such markets

are required to be developed in these States. Each such market may cost around Rs. 1 crore. The total investment required will be Rs. 500 crores.

9.5.14 Spices

The major spice producing States are Andhra Pradesh, Kerala, Gujarat, Rajasthan, Maharashtra, West Bengal, Karnataka, Tamil Nadu, Orissa and Madhya Pradesh. North-Eastern Region and Nicobar Islands have also been identified as potential areas for spice cultivation. The 500 markets mentioned for medicinal plants would cover spices also

9.5.15 Organized Retailing

It would be desirable to promote organized retail chains for fruits and vegetables in urban centers through promotion of entrepreneurship amongst the educated unemployed youth in urban areas to cater to the urban consumers' daily need necessities in better organized hygienic and efficient manner. Such organized retail chains should be equipped with cool chambers and other facilities to maintain the freshness of the products as well as to minimize deterioration.

9.6 INFRASTRUCTURE PROPOSED

9.6.1 Rural Periodic Market

For upgradation of infrastructure in 27294 rural periodic market investment requirement is Rs. 2000 crores @ 50 lakhs per market.

9.6.2 Cold Storages

Presently 300 Million tonnes of fruits and vegetables are likely to become 400 MT during the next 5 years. Considering about 60% (including 10% cushion) of the production goes in cold storages, a total cold storage capacity of 240 lakh tonnes would be required during the next 5 years. The additional requirement will be 45 lakh tonnes (240-195=45). This is macro level assessment. There are certain saturated pockets while other pockets lack in cold storage capacity. A micro level study will be necessary to identify such pockets. The financial requirement for construction of additional cold storage capacity of 45 lakh tonnes @ Rs.4000/- per tonnes would come to **Rs.1800 crores**.

9.6.3 Reefer Vans/ Containers

Till 2012, 3000 units with a capacity of 8 tonnes each; Investment requirement is Rs.600 crore(As per Expert Committee Report,2001)

9.6.4 Cleaning, Grading and Packaging

Grading facility available in less than one-third of the markets, about 1093 grading units in a total of 7557 regulated markets.

9.6.5 Agri Export Zones

Already 60 AEZs have been notified in different states for specific commodities including fruits, vegetables, flowers, spices, vanilla, tea, coriander, cumin, sesame seed, cashewnuts, potato. The estimated investment varies from Rs 3.5 crores to Rs 212.65 crores which will be shared by the centre, state governments and private entrepreneurs in varying proportions. The farmers will benefit from AEZs only if they organize into groups and are linked with players in AEZs directly or through contract farming arrangements.

9.6.6 Terminal Markets

To compete in the global markets, it is necessary to develop terminal markets already in existence in major metropolitan cities during XI Plan. Thirty terminal markets in cities with more than 5 lakh populations serving as important export centers may be set up in with private sector participation with an outlay of Rs.50 crores for each terminal market.

9.6.7 Centres for Perishable Cargo (CPC)

The major problems faced by the Indian exporters of perishable products relate to the inefficient handling of the perishable commodities at the cargo centres resulting in poor quality of products reaching the international markets. The APEDA has established six CPCs at Bangalore, New Delhi, Chennai, Thiruvananthapuram, Hyderabad, and Mumbai with varying capacities. The total handling capacity at these six CPCs is 2.16 lakh tonnes per annum. The operating and ground handling agencies have been designated for each CPC. The prescribed charges for users vary from Rs 0.35 per kg to Rs 2.29 per kg. In addition, APEDA has signed MoUs for setting up of CPCs at Cochin, Ahmedabad, Amritsar, Kolkata, Bogdogra, Lucknow, and Goa. As an interim measure, APEDA has provided (or is in the process of providing) walk-in type cold rooms at Kolkata, Agartala, Guwahati, Lucknow, Coimbatore, and Ahmedabad. Processing and value addition:- Now 7% value addition and 2% processing; Target 35% Va. Addi. and 10% processing; investment of Rs1,50,000 cr.(As per MOFI.)

9.6.8 Market Information System

A number of initiatives have been taken. However, under the present dispensation, market news system is able to provide only a broad overview to the farmers due to several defects in the system. The price quotations are not backed by grades and the information is available with considerable lag. This information is not linked to local grade standards. Quite often, a range of prices is made available, which is of little use to farmers. There is also a serious misconception about the buying and selling price, which are distinctly different. However, developments in information technology have opened new opportunities for dissemination of real time information across the country, which needs to be tapped for wider dissemination of market information.

CHAPTER X

EXPORTS, IMPORTS AND WTO

10.1 EXPORTS

10.1.1 Status of Agriculture Exports

The exports of agricultural products which were valued at Rs.77,600 million at the beginning of the VIII Plan have virtually doubled to Rs.1,50,000 million by 1996-97, the end of VIII Plan. The exports of agricultural products have further risen to Rs.2, 22,030 million by 2001-02, the end of IX Plan. India's export of agriculture and allied products including plantations are of the order of Rs. 3,64,647 million during 2005-06. Export of these products has grown at a Cumulative Annual Growth Rate (CAGR) of 12.22% in the first four years of the X Five Year Plan. During 2004-05, export of these products accounted for 10% of the total exports from India, ranking 22nd in the world with a market share of 1.16%.

The export performance of agri and allied products including plantations as per the data available from the DGCIS during the first four years of the X Plan as compared with the year 2001-02 which is the end year of the IX Plan are given in the following Table 10.1.

Table 10.1 Status of agriculture exports value: Rs. in crores

Commodities	2001-02	2002-03	2003-04	2004-05	2005-06
PLANTATIONS	**2831.05**	**2831.32**	**3070.15**	**3134.72**	**3667.45**
Tea	1719.22	1652.07	1637.35	1840.30	1632.09
Coffee	1094.92	993.98	1085.92	1069.08	1577.07
Rubber	16.91	185.27	346.88	225.34	458.29
AGRI&ALLIED PRDTS	**19388.81**	**22848.97**	**24844.48**	**28276.93**	**32797.32**
Cereal	**4620.27**	**7682.17**	**6956.68**	**9022.57**	**8244.35**
Rice	3174.14	5831.24	4167.98	6768.92	7074.35
Wheat	1330.21	1759.87	2391.15	1459.82	557.12
Others	115.92	91.06	397.55	793.83	512.88
Pulses	369.13	345.02	328.60	602.57	1102.62
Tobacco	**807.70**	**1022.89**	**1096.47**	**1254.61**	**1330.11**
Unmanufactured	582.05	733.52	801.41	940.07	1027.70
Manufactured	225.66	289.37	295.06	314.54	302.41
Spices	**1496.97**	**1655.49**	**1544.18**	**1883.18**	**2218.09**
Nuts & Seeds	**2654.95**	**2690.68**	**3003.45**	**3809.84**	**3864.37**
Cashew incl. CNSL	1793.93	2061.50	1704.84	2489.12	2569.75
Sesame & Niger seed	610.08	450.88	754.30	773.69	794.09
Groundnut	250.94	178.30	544.30	547.02	500.53
Oil Meals	2262.93	1487.35	3348.41	3177.60	4826.07
Guargum Meal	403.09	486.64	507.90	689.48	1042.19
Castor Oil	625.94	609.81	656.06	1077.98	934.41
Shellac	72.99	89.85	179.74	164.87	161.18
Sugar & Mollasses	1781.85	1814.54	1235.97	155.05	584.38
Fresh & Processed Prdts	**2490.06**	**2929.00**	**3485.06**	**3430.94**	**4154.15**
Fresh Fruits & Veg.	992.35	1090.11	1737.95	1725.25	2012.16
Fruits/Vegetable seeds	62.19	97.96	53.61	66.04	89.87
Processed and misc. processed items	1435.52	1740.93	1693.50	1639.65	2052.11
Floriculture products	127.43	180.77	250.47	222.92	304.69
Meat & Preparations	1193.28	1377.19	1714.41	1905.27	2647.50
Poultry & Dairy Product	356.25	358.52	415.15	740.75	1112.07
Spirit & Beverages	125.96	119.06	121.92	139.31	271.14
Grand Total	**22,219.86**	**25,680.29**	**27,914.63**	**31,410.65**	**36,464.77**

10.1.2 Status of Horticultural Exports

10.1.2.1 Global position and India's share

India is one of the large producers of horticulture crops in the world. Horticultural crops occupy about 8% of gross cropped area and account for 30% of agricultural GDP. However, the presence of India as an exporter of horticulture products is insignificant. India's share in global horticulture trade was a mere 0.5% in 2004 as per a recent World Bank study ($ 575 million compared with a global trade of $ 108 billion).

Fresh fruits and vegetables comprise almost 35% of the world trade in horticulture, out of which, almost two-third is accounted for by four items, namely, citrus, banana, apple and grape. The other important items are mangoes, papaya and kiwi. Among the vegetables, which account for about 22% in the world trade in horticulture, the major items are tomato, onion, potato, bean, pea, mushroom, asparagus and capsicum.

Processed fruits and vegetables account for about 20% and 17% of the world horticultural trade, respectively. Among the processed fruits, 41% trade is of fruit juices and 12% of dried fruits. Similarly, among processed vegetables, the major items are mushrooms, gherkins and frozen pre-cut vegetables.

Floriculture trade is approx. 6.3 billion US Dollars, of which cut flowers are about 86%.

Since major trade policy and exchange rate reforms were initiated in the early 1990s India has experienced significant growth in its horticulture export trade. Since 1994, fruit and vegetable exports have grown at about 8% per year in real terms the segments with the fastest growth are processed vegetables and processed fruits which had growth rate of 10 and 11% per annum respectively.

While the basket of India's fresh and processed horticultural export products is very diverse, only a few products account for a large share of total earning. Five commodities namely fresh onions, mango pulp, processed gherkins, fresh grapes and fresh mangoes together account for about half of the total horticultural exports.

The growth in the last two decades in the world trade and India's position in horticulture is depicted in the Table 10.2.

Table 10.2 World exports in horticulture (1984–2004) US$ Millions

	1984		1994		2004	
	World	**India**	**World**	**India**	**World**	**India**
Fresh fruit	8,862.19	15.73	21,869.37	29.49	37,457.04	64.57
Processed Fruit	6,108.68	23.40	13,177.71	36.96	21,623.76	110.09
Fresh/Dried Vegetables	6,164.79	66.58	13,763.42	92.89	23,686.36	181.99
Processed Vegetables	4,523.70	15.85	11,437.42	53.77	18,888.57	179.17
Fresh Cut Flowers	1,109.86	-	3,248.11	0.49	5,497.20	9.63
Dried Cut Flowers	20.36	0.02	168.93	5.07	183.57	5.19
Fresh & Dried Plants	133.32	1.23	519.24	9.26	967.52	24.58
Total	**26,922.79**	**122.81**	**64,184.20**	**227.93**	**108,304.02**	**575.23**

Source : World Bank

10.1.2.2 Status of Indian horticulture exports

India is exporting fresh fruits, vegetables, processed products of fruits and vegetables, cut & dried flowers, medicinal and aromatic plants, seeds, spices, cashew kernels and their products, tea and coffee. The total value of export of these commodities increased from Rs.29723 million in 1991-92 to 64,450 in 2001-02 to 124175 million in 2005-06**.** Horticulture produce and products account for about 35 per cent of the total value of exports of agricultural commodities from India during 2005-06. Of these, export of cashew leads all

horticultural commodities followed by spices, tea and coffee. During past one decade the maximum increase in exports was observed for floriculture (Table 10.3).

Table 10.3 Status of Indian horticulture exports

Commodities	1995-96	2005-06		2011-12
	Value (Rs in Crores)	Value (Rs in Crores)	% Increase over 1995-96	Projected Value (Rs in Crores
Fruit & Veg Seeds	43.08	92.87	115.58	149.57
Floriculture	60.14	301.44	401.23	485.47
Fresh Fruits	229.93	1120.68	387.40	1804.87
Fresh Vegetables	301.19	919.8	205.39	1481.35
Processed Fruits & Veg.	491.57	1093.24	122.40	1760.67
Coconut & its products	211.56	552.09	160.96	889.15
Arecanut	3.6	9.46	162.78	15.24
Cocoa	8.86	24.8	179.91	39.94
Cashew	1240.5	2593.35	109.06	4176.62
Spices	804.44	2115.92	163.03	3407.71
Tea	1244.52	1730.7	39.07	2787.31
Rubber	278.44	274.51	-1.41	442.1
Coffee	1527.16	1588.66	4.03	2558.55
Total	**6444.99**	**12417.52**	**92.67**	**19998.54**

i) Fresh fruits

India accounts for about 6% of global fruit production and exports a wide variety of horticultural products, only a handful of commodities or products account for the bulk of this trade. India is one of the largest producer of mango, banana, grape, litchi etc. With the vast majority of its output being consumed domestically, India's share of global exports is only 0.3% for fruits. However, fresh fruits make up around 11% of India's horticultural exports. Grapes and mangoes account for close to 60% of India's exports of fresh fruits.

India is the pre-eminent producer of fresh mango in the world. With an average annual production over the past three years of 10.7 million MTs, India accounts for 40% of world production. The leading mango producing states are UP, AP, Bihar, Karnataka, Tamil Nadu, Maharashtra. India's role in global mango trade is quite modest as it accounts for about 5% of world exports. As a major exporter, it is ranked sixth behind Mexico, Brazil, Pakistan, Peru and the Philippines even though the combined production of these five major exporters is less than half of that of India.

The grape production in India is of the order of 1.2 million MTs. It has increased by about 70% in the past 10 years and the current production represents about 2% of the global grape production. Grapes are a highly seasonal crop and there is a potential window in the European market between March and April, at the end of the main southern hemisphere production season, in South Africa and Chile and before Egypt and turkey enter the market. India is one of the few countries that can produce good quality fresh grape at this time of the year. Thompson Seedless is the main variety, which is exported. This variety is becoming more popular in Europe as the market increasingly prefers green and seedless grapes. Most of the Indian grapes are sold in Europe through the network of Supermarkets.

As in the case of mango, India is also the largest producer of Bananas in the world. With an average annual production of about 17 million MTs, during the last three years, India accounts for about 24% of the world production. Indian banana production is poly-clonal with over 200 cultivars of which about 40 are of commercial value. Only about 0.7% of banana production is exported which is mainly due to high domestic consumption and absence of the protocols for sea transportation.

Pomegranate is another fruit the momentum recently. One, which has contributed to this increase is the development of a new variety Bhagva by the Indian researchers which has an attractive colour appealing to the European market. Traditionally most of India's pomegranate exports have been to the Middle East countries but the interest in the European market has increased due to increasing health consciousness and the medicinal properties of this fruit. The current level of export is about 10,000 MTs out of a total production of about 50,000 MTs, Maharashtra being the main producing state.

ii) Fresh vegetables

India accounts for 11% of vegetable production in the world and it ranks second after China. The export of fresh vegetables including onions during 2005-06 was of the order of Rs 919.8 crores out of which Onions contributed to Rs 621 crores. Other major export products are Mushrooms, Green Peas, Egg Plants and Okra. Major markets for Indian vegetables including Bangladesh, Malaysia, UAE, Sri Lanka and Nepal.

iii) Processed fruits and vegetables

Major processed fruit exports include mango pulp which accounts for close to 50% of the value of this category as well as pickles and chutneys from various fruits including mangoes. Gherkins, dehydrated onion, and mixed frozen vegetables account for 60% of processed vegetable exports. In 2004, exports of processed fruits and vegetables accounted for 19% and 31% of total horticultural exports respectively. The major markets are Bangladesh, Sri Lanka, USA, UK and UAE besides other countries of the Middle East.

iv) Flowers cut and dried

The growth in floriculture in India has been phenomenal in the last decade or so. The area under flower cultivation has doubled from 53,000 hectares (1993-94) to 103,000 hectares (2001-02). This period also witnessed a new dimension in the floriculture business, when a large number of units set up in clusters around Bangalore, Pune, Delhi and Hyderabad started production of cut flowers primarily for export markets. This export-oriented sector after the initial burst of considerable success faced certain viability problems, particularly in North India where the cost of setting up such units was higher. This industry has now stabilized with about forty units in the 2 largest clusters of Bangalore and Pune having sustained fresh cut flower exports. The total area under organized floriculture (greenhouse based units) is currently estimated at around 500 hectares.

Today, we find a wider variety of flowers cultivated on a commercial basis including carnation, gerbera, lilium, orchids, anthurium and many others being marketed all over the country. The diversity of agro-climatic conditions available in India presents it with a capability to cultivate a large number of flowers

Although, the value of exports of floriculture products from India has shown very significant growth, from Rs.18.83 crores (1993-94) to Rs.210.00 crores (2004-05). The dried flowers and other plant parts contribute to about 70% of the exports in the floriculture segment. India is still a marginal player in the world floriculture trade indicating the strong potential that can be exploited in the sector.

Major markets for Indian floriculture products are USA, The Netherlands, UK, Germany and Japan.

v) Plants and seeds

India is also an exporter of seeds of fruits and vegetables. The export during the year 2004-05 has been of the order of Rs 63 crores. The major markets are USA, Pakistan, Japan, Bangladesh and The Netherlands.

vi) Medicinal and aromatic plants

According to the report of the World Health Organisation (WHO), a large population of the

world relies on the traditional systems of medicines, largely plant based to meet their primary health care needs. India at present exports herbal materials and medicines to the tune of Rs. 446 crores only while it has been estimated that this can be raised to Rs. 3,000 crores by 2005. The Chinese export based on plants including raw drugs, therapeutics and other is estimated to be around Rs.18,000 to 22,000 crores. In view of the innate Indian strengths which interalia include diverse eco-systems, technical and farming capacity and a strong manufacturing sector, the medicinal plants area can become a huge export opportunity after fulfilling domestic needs. part from requirement of medicinal plants for internal consumption, India exports crude drugs mainly to developed countries, viz. USA, Germany, France, Switzerland, UK and Japan, who share between them 75 to 80 percent of the total export of crude drugs from India. The principal herbal drugs that have been finding a good market in foreign countries are Aconite Aloe, Belladona, Acorus, Cinchona, Cassia tora, Dioscorea, Digitalis, Ephedra, Plantago (Isabgol), Cassia (Senna) etc.

vii) Spices

Indian spices accounts for more than 5% of the total agricultural export earnings in the country. More than 0.30 million (10-12% of the total spices production) tonnes of spices are exported annually to more than 150 countries around the world. World trade in spices is in the order of 7.50 lakh tonnes valued at 1650 million US $. According to Spices Board, India commands a formidable position in the World Spice Trade with 43% share in Volume and 31% in Value (2005-06). It is estimated that, with a variety of spices in its production list almost one half of the world demand is being met by Indian exports. The share of value added products is estimated at 66% of the total spices export. But most of this was low end value addition. There is both need and potential for increasing the relative share, more particularly in the case of value added spice exports.

In India, spices exports have been consistently moving up during the past years. Spices exports have registered substantial growth during the last fifteen years with an average annual growth rate of about 7%. It has increased from 109,636 tonnes valued at US $ 135 million in 1990-91 to 320,527 tonnes valued US $ 518 million in 2005-06 (Table 10.4).

Table 10.4 Export of spices from India

Year	Quantity (tonnes)	Value (Rs in Lakhs)
1991-92	142,104	38096.76
1996-97	225,295	123071.77
2001-02	243,203	194054.88
2005-06	320,527	229525.00

The major constraint faced by India in exporting spices is the fall in unit prices of spices in the international markets. This is due to the increased supply from newly emerged competitors like Vietnam, Thailand, China, Guatemala etc. These producers have no domestic market, which made them to push their entire produce to the international market, making the traditional exporters like India to bear the brunt. India though a major producer of spices can only export around 7% of its production due to the high domestic demand. The situation is gradually changing to make India one of the major importer of spices. In some traditional item like pepper, where India was once a major player, the situation is drastically changed to make India a major importer. Therefore the major constraints are the lack of surpluses at international competitive prices for export, quality issues, port congestions, lack of infrastructure and credit. The major interventions required are production of sufficient surpluses for export, improved quality standards, good manufacturing practices, export driven packaging and promotion and value addition.

In many traditional export items of the country competition is hardening from low cost economies of the South East Asia with high productivity and negligible domestic demand. They have created huge quantities of exportable surpluses in many spice varieties in which the country had near monopoly in the recent past. Relatively low levels of value addition

make Indian spice exports all the more vulnerable. These developments have taken place at a time when of many major economies were passing through difficult situation due to the turbulent politico – economic conditions resulting in a near stagnancy in world demand particularly for bulk exports. Notwithstanding, Indian spice exports grew at the rate of 5.96%.

viii) Arecanut

Arecanut is a commodity, which has a very limited export potential. The bulk of production of arecanut is consumed within the country. However a small quantity of arecanut is exported mainly meant for the Indian settlers abroad. Quantity of export was at a range of 330 MT to 823 MT during the period 1994-95 to 2000-01. But the export increased substantially during the last couple of years. Export from India was 1809 MT valued at Rs 1174 lakhs during 2003-04 and was 3695 MT valued at Rs 20.66 crores during 2004-05 (Table 10.5). The main countries to which arecanut is exported are Indonesia, UAE, Maldives, Nepal, Afghanistan, Pakistan etc.

Table 10.5 Export of arecanut from India

Year	Quantity (tonnes)	Value (Rs in lakhs)
1991-92	658	457.13
1996-97	513	419.08
2001-02	1483	728.90
2004-05	3695	2066.12

ix) Cashew

India has been exporting the cashew kernels since early part of 20th century. The country is at present exporting annually about 1.27 lakh tonne of cashew kernels worth over Rs. 2500/- crores. At present India produces annually about 5.4 lakh tonne of raw cashew nuts. However, India needs about 11 – 12 lakh tonne of raw cashew nuts per annum for feeding over 1700 cashew processing units. In order to meet the requirement of the processing industry, India imports annually about 5-6 lakh tonne of raw cashew nuts from African and other countries.

Over the years, both the export earnings as well as quality of kernels has been increasing. The established processing capacity of raw nuts is around 12 lakh tonne. However, domestic production is around 5.4 lakh tonne. Thus, presently India is importing raw nuts from African and other countries to the tune of 5.8 lakh tonne to meet the demand of cashew processing industries. Export earnings has been on the increase since 1955. India has earned an all time high export earnings of Rs. 2709 Crores during 2004-05 (Table 10.6).

Table 10.6 Trade analysis on cashew

Particulars	2004-05	2005-06
Processing units	1707 Nos.	1707 Nos.
Import of raw cashewnuts (quantity)	5.78 lakh tonne	5.65 lakh tonne
Import of raw cashewnuts (value)	Rs. 2191 Crores	Rs. 2163 Crores
Export of cashew kernel (quantity)	1.27 lakh tonne	1.14 lakh tonne
Export of cashew kernel (value)	Rs. 2709 Crores	Rs. 2515 Crores
Export of CNSL (quantity)	7474 tonne	6405 tonne
Export of CNSL (value)	Rs. 8 Crores	Rs. 7 Crores
Foreign exchange earning (Kernel + CNSL)	Rs. 2717 Crores	Rs. 2522 Crores
Net foreign exchange earning	Rs. 526 Crores	Rs. 359 Crores

Cashew industry provides employment to over 5.5 lakh workers annually, mostly women. Between 1980 and 1985, although export earnings increased, quantity of cashew kernels exported decreased. Since 1985, there is a steady growth in the quantity of cashew kernels exported. Inspite of the domestic production of over 5 lakh tonne and import of over 5.5 lakh tonne of raw cashewnuts, the total availability of raw cashewnuts is not able to keep pace

with the requirements of cashew industry. Since African countries have taken up for cashew processing themselves, availability of raw cashewnuts for importing by India may gradually decline or may all together stop. Hence, there is urgent need to increase the domestic raw cashewnut production and become self sufficient in raw cashewnut production. Availability of land area to expand cashew cultivation in India may not be much except in states like Chattisgarh or waste lands available to certain extent in coastal regions and some non-traditional areas. Hence, it is essential to increase productivity per unit area.

x) Cocoa

Though India has gained foreign exchange by way of export of cocoa products, cocoa beans are being imported. Cocoa Industry in India has expanded to a considerable extent in the current decade. At present there are more than 15 companies in the field. These industries have the capacity to process 30,000MT of which present availability is only 30%. In addition to utilizing the domestic products, import of dry beans to the level of 4000-6000MT along with other cocoa products are also taking place to cater the needs of the industry. During 2005-06, we have gained a foreign exchange of Rs.24.80 crores by exporting cocoa beans/cocoa products, whereas we have imported cocoa beans, paste, butter, powder etc from other cocoa growing countries at a cost of Rs.112.865 crores so as to meet the indigenous consumption and export.

xi) Coconut

There are a number of value added products and by-products of coconut which are traded globally Table 10.7.

Table 10.7. Coconut products exported globally *vis a vis* APCC countries

Products	Global exports			APCC exports			% share of APCC countries	
	1990	2004	Increase/decrease (%)	1990	2004	Increase/decrease (%)	1990	2004
Copra (000 MT)	284	237	-16.55	283	223	-21.20	99.65	94.09
Coconut oil (000 MT)	1,481	1,836	23.97	1,471	1,627	10.61	99.32	88.62
Copra meal (000 MT)	1,250	777	-37.84	1,116	642	-42.47	89.28	82.63
Desiccated coconut (MT)	151	260	72.19	150	224	49.33	99.34	86.15
Coco cream (MT)	Neg	22,000						
Coco powder (MT)	Neg	7,796						
Coco chemicals (MT)	17,389*	52,640	202.72	20,500*	52,640	156.78		100.00
Shell charcoal (MT)	55,472	57,600	3.84	55,472	41,567	-25.07	100.00	72.16
Activated carbon (MT)	22,147	1,10,500	398.94	19,544	71,657	266.64	88.25	64.85
Coir & Coir products (MT)	1,06,200	2,50,745*	41.94	1,05,557	3,08,374*	192.14		

* Figure needs verification ; Neg. = Negligible

The global exports of coconut products during the last 15 years show decrease in exports of copra, copra meal; marginal increase in coconut oil, desiccated coconut and shell charcoal while significant increase in coco chemicals, activated carbon and coir and coir products. Coco cream and coco powder have been a major addition in export of coconut products during this period.

The export trends in APCC countries are similar except that there is a decline in the exports of shell charcoal to the extent of 25.07%. The disturbing aspects of exports from APCC countries is their decreasing trend in almost all products during the last fifteen years.

While almost entire copra, desiccated coconut, shell charcoal, coco chemicals and coir products are exported from APCC countries, coconut oil, copra meal and activated carbon are also exported in significant quantities from outside the APCC region.

While the trends in total export value of coconut products and by-products have been by and large inconsistent, at the end of the last 5 years, the total exports have increased from Philippines and India, while other major exporters e.g. Indonesia, Sri Lanka, Malaysia and Thailand experienced decrease in value of exports (Table 3). Total value of coconut product exported from the 6 major APCC countries during 2004 was 1447.4 million US$ representing an increase of 4.69%. The value of exports per ha area in Philippines, Malaysia and Sri Lanka was more than US$ 200. However, it was very low in India (52 US$) probably because of the large acreage and poor productivity and in adequate value addition (Table 10.8).

Table 10.8 Export value of coconut products from major exporting countries

Country	2000 (US$ millions)	2004 (US $ millions)	Trends	Value (per ha US$)
Philippines	653.5	841.0	Increasing	269
Indonesia	401.2	341.5	Decreasing	92
Sri Lanka	164.0	101.1	Decreasing	229
India	71.6	97.9	Increasing	52
Malaysia	57.8	42.0	Decreasing	264
Thailand	34.5	23.9	Decreasing	73
Total	**1382.6**	**1447.4**	**Increasing**	

International trade, both import and export, plays a vital role in economic development of a country. The global competitiveness of a sector is truly reflected in the volume and value of trade achieved by a country in that sector. The trend of export and import of coconut products in India is not very encouraging. Even though India's export earnings from coconut and coconut products have been increasing at a compound growth rate of 12.40 per cent per annum, the rate of growth in the import of the products in the same period is 13.50 per cent per annum. Among the commodities in the export basket, coir and coir products account for the bulk of exports from this sector. Coconut oil and other coconut products make a very negligible contribution. This is mainly on account of the fact that the domestic prices of coconut products generally rule above the international price. Further, almost the entire production in the country is consumed in the domestic markets itself. However, since India, is a prominent coconut growing country with a production of 12833 million coconuts from 19.35 lakh hectares of coconut cultivation, there is a potential for exports, on account of the unique quality, aroma and flavour of Indian coconut. Indian coconut oil as toiletry oil through value addition has made its presence in the international market despite its higher price. Among the imported items, coconut oil, oilcake and desiccated coconut powder are the prominent commodities.

xii) Coffee

Coffee is the second largest traded commodity in the world next only to Petroleum. In India, coffee is predominantly an export-oriented commodity and over 70% of the coffee produced in the country is exported and the balance quantity is consumed within the country. There are 70 processing centres licensed by the Coffee Board and about 300 registered exporters. Consequent to liberalization, the marketing of coffee is carried out entirely by the private sector.

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There are 70 processing centers licensed by the Coffee Board and about 300 registered exporters. Consequent to liberalization, the marketing of coffee is carried out entirely by the private sector. India's domestic coffee consumption is mainly restricted to the four southern states of Tamil Nadu, Karnataka, Andhra Pradesh and Kerala and the per capita Another unique feature of Indian coffee industry is that, it produces both Robusta (65%) and Arabica (35%). The Indian coffee industry employs nearly 1 million people directly and indirectly. consumption is only 75 gm. The highest per capita consumption is in Tamil Nadu (450 gms)

The markets for Indian coffee are European Union and the major importing countries of Indian coffees are Italy, Germany, Spain, Belgium, Russia and others. Another unique feature of Indian coffee industry is that, it produces both Robusta (65%) and Arabica (35%). As export is function of production, commensurate to the increase in production from 1990 onwards, the coffee exports also rose steadily both in terms of volume and value during the last 15 years. In volume terms, the coffee exports peaked in 2,000 (2,53,524 tonnes) whereas in value terms, the highest foreign exchange earned was in 1998 (468.11 US $ Million), thanks to the highly remunerative international coffee prices prevailing during this year. Subsequently, there was drop in export volumes and value during the period between 2001 and 2004 consequent to the drop in production because of price crisis and adverse weather factors Table 10.9).

Table 10.9 Performance of coffee exports and domestic consumption

Year	Export Earnings	
	Quantity(tonnes)	Value(US$ Milln)
1991	103638	62.26
1992	108988	87.27
1993	126152	138.83
1994	151532	329.07
1995	149290	428.68
1996	186841	438.21
1997	161590	438.30
1998	209687	468.11
1999	218230	326.66
2000	253524	316.81
2001	223782	208.16
2002	213008	244.97
2003	222425	247.98
2004	228246	287.95
2005	203748	338.37

Table 10.10. Coffee export targets in XI Plan (Qty in MTs)

Year	
Export	2007-08
2,10,000	2008-09
2,20,000	2009-10
2,30,000	2010-11
2,40,000	2011-12
2,50,000	

Note: Export targets inclusive of re-exports of coffee. Overall AGR is 5%

xiii) Rubber

Rubber plantations occupy 0.4 percent of the gross cropped area in India, and accounts for 0.19 percent of the country's GDP. Rubber-based manufactured products sector is one of the few sectors for which India has positive trade balance. Exports of rubber products from the country during 2004-05 were Rupees 31,990 million whereas the imports were only Rupees 9260 million. In export of NR, though India is a new entrant, the country holds 1.1 percent of the global share compared to the global share of only 0.8 percent in the total merchandise exports of India. One of the noteworthy developments during the QR-free regime has been India emerging as an exporter of NR. Export of natural rubber from India rose from the low level of 6995 tonnes in 2001-02 to 55311 tonnes during 2002-03 and 75905 tonnes during 2003-04. Against a target of exporting 102,000 tonnes during the Tenth Plan, 177,385 tonnes was exported from the country during the first three years itself. During 2005-06, though the financial incentive for NR exports was withdrawn and the international prices remained unfavourable for about three months, 73,830 tonnes was exported Total export up to 2005-06 is 258,191 MT.

Table 10.11 shows the annual trend in imports and exports of NR and value thereof during the period from 1991-92 to 2005-06.

Table 10.11. Quantity and value of natural rubber exported

Year	Export	
	Quantity in tonne	Value In Rs. Crore
1991-92	5834	NA
1992-93	5999	NA
1993-94	186	0.05
1994-95	1961	8.07
1995-96	1130	6.67
1996-97	1598	7.98
1997-98	1415	5.12
1998-99	1840	5.59
1999-00	5989	16.20
2000-01	13356	37.36
2001-02	6995	16.91
2002-03	55311	185.27
2003-04	75905	346.88
2004-05	46150	225.34
2005-06	73830	458.29

In the present situation, though financial support for export of rubber is not proposed, promotional activities through interactive website specially designed for the purpose, visits of trade delegations to potential overseas markets, identification of potential buyers, etc. will be continued.

India produces a large quantity of rubber wood every year. However, value addition is negligible. The rubber wood processing industry in the country is in its infancy. Technology development and upgradation, quality assurance, market promotion etc are very essential in this field. Therefore, the XI plan proposals include schemes for providing assistance for strengthening the rubber wood processing industry and promotion of rubber wood as an eco-friendly timber.

xiv) Tea

Until FY 1987-88, tea was the most significant item of agricultural export from India accounting for 20.7% of agricultural exports. Disintegration of the then USSR and loss of other hard currency markets had adversely affected the Indian export over the last 20 years. India's world ranking as an exporter has come down from number one to number four, in the

face of stiff competition from Sri Lanka, Kenya, and China Presently, tea export constitutes about 0.5% of total commodity exports and about 5% of total agro-export.

The global export demand was estimated by FAO by taking into account the impact of the removal of QRs, which was an important obligation under the Agreement of Agriculture of WTO. According to FAO, Export demand was projected to reach 1600 million kg in 2005. Based on this estimate, Indian exports were targeted to gain a share of 16% of the total global exports. Thus the production and export targets at the initial stage were estimated as under Table 10.12.

Table 10.12. Production and export targets at the initial stage

Particular	2002-03	2003-04	2004-05	2005-06	2006-07
Domestic demand	693	714	735	757	780
Export	234	241	248	256	264
Total Production	927	955	983	1013	1044

Subsequently after taking into account the oversupply situation which had led to drastic fall in tea prices and consequent depression in the industry, it has become necessary to revise the targets as under Table 10.13.

Table 10.13 Revised targets **In million kgs**

	2002-03	2003-04	2004-05	2005-06	2006-07
Exports	184	170	180* (200)	190 (205)	205 (210)

Ministry of Commerce vide it communication No: T-35018/2/2004-Plant -A dated 28-5-2004 has directed that the export target for2004-05 may be fixed at 200 m.kg. Accordingly, targets for next two years have also been revised upwards.

Table 10.14. Exports from India during X Plan period

Year	Volume Million kg	Value Rs. Crores	Value US $ million	Unit Value Rs. per kg
2002-03	184.40	1665.04	344.05	90.30
2003-04	183.07	1636.99	363.78	89.42
2004-05	205.81	1924.71	429.10	93.52
2005-06	181.06	1631.60	369.17	90.11

Table 10.15. Imports during X Plan period

Year	Volume Million kg	Value Rs. Crores	Unit Value Rs. per kg
2002-03	22.49	105.32	46.83
2003-04	11.34 (8.30)	66.23	58.41
2004-05	32.53 (29.83)	145.15	44.61
2005-06	16.40 (16.40)	99.26	60.53

The present import duty on tea is 100%. WTO bound rate of duty on tea is 150%. The figures in brackets indicate the volume of tea used for re exports out of the total imports

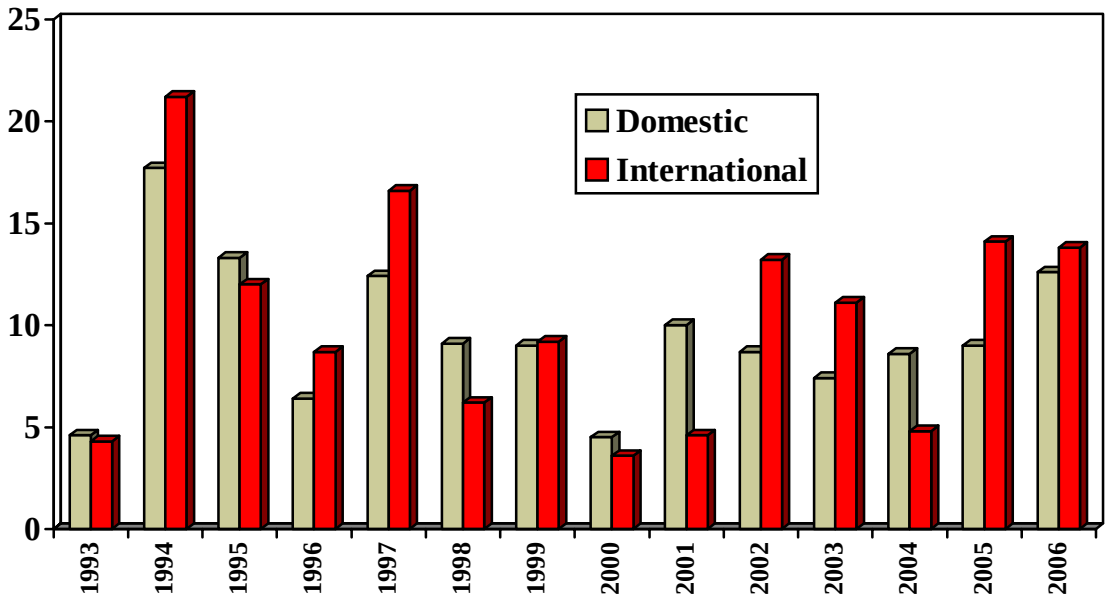


Fig. 10.1. Volatility in Domestic and International Markets (Coefficient of Variation)

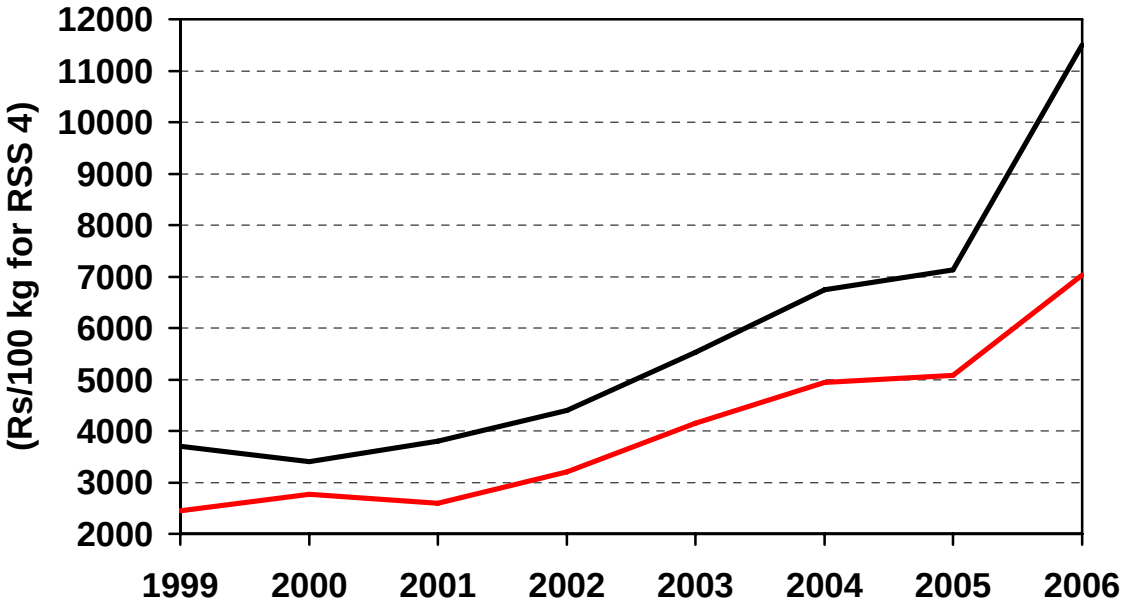


Fig. 10.2 Maximum and Minimum Prices in Domestic Market during each Year

10.1.2.3 Major importing countries

The major markets for Indian horticulture products are the West Asian countries and UK, Germany, The Netherlands in Europe. The top five destinations for various product groups are listed below in table 10.16:

Table 10.16. Major importing countries

Product Group	Major importing countries
Floriculture	USA, The Netherlands, UK, Germany, Japan
Fruits & Vegetable Seeds	USA, Pakistan, Japan, Bangladesh, The Netherlands
Fresh Onions	Bangladesh, Malaysia, UAE, Sri Lanka, Bahrain
Other fresh vegetables	UAE, Nepal, UK, Saudi Arabia, USA
Walnuts	Spain, Germany, UK, Egypt, The Netherlands
Fresh mangoes	Bangladesh, UAE, Saudi Arabia, UK, Nepal
Fresh Grapes	The Netherlands, UK, UAE, Bangladesh, Germany
Other fresh fruits	Bangladesh, UAE, Nepal, Saudi Arabia, The Netherlands
Dried & Preserved Veg	Bangladesh, Sri Lanka, USA, UK, UAE
Mango Pulp	Saudi Arabia, The Netherlands, Yemen, UAE, Kuwait
Pickles & Chutneys	Russia, USA, France, Belgium, Spain
Other processed fruits/Veg	USA, Israel, Saudi Arabia, UK, the Nethrlands

10.1.3 X Plan Programmes and Performance including Market Intelligence

10.1.3.1 Budgetary allocation and expenditure

Total outlay for the identified schemes under the Tenth Plan period as sanctioned by the Planning Commission was Rs.310 crores. As against this, Ministry of Commerce gave a total plan allocation of Rs.253 crores. Out of this, Rs 131.63 crores (representing 76% of the total plan outlay), has been disbursed till February 2006. It is expected that full outlay will be utilized during the plan period (Table 10.17). There was no separate allocation for the horticulture sector, though it is estimated that at least 75%-80% of the budget may have been spent directly for the horticulture sector.

Table 10.17 Scheme-wise assistance disbursement form 2002 to 2006 (Rs. in crores)

Scheme	Tenth Plan approved by the Govt.	Share in total outlay (%)	Expenditure					Share (%) in expenditure
			2002-03	2003-04	2004-05	2005-06	Total (2002-06)	
Infrastructure Development	95	37	16.71	20.91	18.1	21.78	77.5	43
Research and Development	23	9	0.94	1	2.75	0.23	4.92	3
Quality Development	15	6	3.18	3.99	6.32	7.9	21.39	12
Market Development	40	16	7.17	5.83	6.05	8.77	27.82	15
Transport Assistance	80	32	4.65	10.77	11.85	21.23	48.5	27
Total	**253**	**100**	**32.65**	**42.50**	**45.07**	**59.91**	**180.13**	**100**

10.1.3.2 Tenth Plan targets and achievements (year-wise and consolidated)

APEDA schemes have contributed in the growth of the exports of scheduled products by:

- Upgradation of quality systems
- Infrastructure development
- Market development
- Packaging improvement (*this scheme is now merged in the market development scheme*)
- Identification of new markets

The exports have increased from Rs. 9,212.87 crores in 2000-2001 to Rs. 17,918.17 crores during 2005-06. The average annual growth rate has been about 19%. A commodity-wise export growth has been given in the Table 10.18.

Table 10.18. Commodity-wise export growth

(Value in Rs Crore)

Products	Year			Growth in export (2002-2005)
	2002-2003	2003-2004	2004-2005	
Floriculture and seeds	266.83	303.15	273.93	2.66%
Fruits and vegetables	1,086.75	1,457.26	1,299.93	19.62%
Processed fruits and veg.	1,206.93	1,125.81	1,462.72	21.19%

10.1.3.3 Scheme wise analysis of the performance during X Plan

i) Scheme for infrastructure development

a) Objectives

Infrastructure Development scheme has been introduced to address the problems of infrastructure in the development of agricultural and processed food products. The main objectives were to develop post harvest infrastructure, common facilities for logistics and handling at exit points and environment management systems etc. Nearly Rs.775.00 million has been disbursed under Infrastructure Development Programme, which is 59 % of the total amount disbursed.

b) Main achievements

- Infrastructural financial assistance has been taken by 264 beneficiaries, accounting for 23.7% of the total beneficiaries. The infrastructural financial assistance has been mostly availed by manufacturer exporters.
- Under the scheme for Infrastructure development, APEDA has set up six Centres for Perishable Cargo (CPC's) at the international airports at Delhi, Mumbai, Hyderabad, Chennai, Thiruvananthapuram, Bangalore.
- APEDA has also provided financial assistance to set up common laboratory facilities (National Referral Laboratory) at the Following centres.
  - NRC for grapes, Pune - for testing pesticide residues in grapes for exports to EU.
  - Regional Research Laboratory, Jammu for Honey.
  - BCKV, West Bengal (proposed)
- To promote the export of floriculture products, APEDA is setting up three wholesale flower market-cum-auction centres at Bangalore, Noida and Mumbai

- APEDA has developed eleven pre-harvest/post harvest manuals/ protocols for grapes, potato, onion, etc. Export quality standards have been notified for 34 fruits and vegetables under the AGMARK Act.
- APEDA has also been financially assisting setting up of packhouse facilities, pre-cooling units, high humidity cold storages, mechanized handling facilities and reefer vans etc. for packing, grading, sorting, pre-cooling and cold storage of fresh grapes, mangoes, pomegranates, banana, flowers, other fruits and vegetables, etc.
- Manufacturing / processing base being located in production areas, there is a clear trend of infrastructure being developed in rural areas. For example, Nasik and Chitoor are the two regions, which have contributed highest to the list of beneficiaries for infrastructural financial assistance (Table 10.19).

Table 10.19. The infrastructure created in production zones

Product	Major centres of production	No. of beneficiaries
Grapes	Nasik	43
Mango pulp	Chitoor	43
Litchi	Muzzaffarpur	5

- In all product categories, the exporters have taken the financial assistance mainly for the most important infrastructure that would meet their specific requirement as given Table 10.20.

Table 10.20. Products and component-wise assistance

Product	Most important infrastructure	Beneficiaries (%)
Fresh fruits and vegetables	Packing house/pre –cool	95
Processed fruits and veg.	Pollution control	90

Among different product groups, fresh fruits and vegetables, and processed fruits and vegetables have availed maximum assistance as 39 and 35%, respectively. Processed foods and floricultural and seeds have also availed the reasonable assistance under Infrastructural Development.

- Majority of beneficiaries are satisfied with present range of components. Beneficiaries are able to develop integrated infrastructure to meet the export requirement.
- Similarly, the cost of many equipment and facilities has increased over the period but the quantum of assistance remains same over the period. Thus based on the ongoing prices the limits need to be increased.

c) Component-wise assistance

Financial assistance under various components of Infrastructure Development has been shown in Figure. Nearly, 30% beneficiaries have availed the assistance under environment / pollution control component for establishment of effluent treatment plant. Similarly, 28% of exporters availed the financial assistance for mechanized handling facilities and 27% for integrated packing house.

d) Assistance for purchasing specialized transport unit

Nearly 17% of the exporters have taken the assistance for purchasing of specialized transport units. These exporters are primarily exporting animal products, fresh fruits and vegetables, and floricultural products. There are certain beneficiaries who are handling larger amount of products for export and thus, assistance for single unit is not enough for them.

This component has greatly contributed to maintain cold chain for export of chilled and frozen fruits and vegetables, flowers, etc.

e) Setting up of integrated post-harvest handling system (packing house)

Packing house financial assistance has been availed mostly by fresh fruits, every kind of exporter be it a small, medium or large, has availed the packing house financial assistance. As on today, these packing houses are generally being used for exporting grapes. About 27.4% of the beneficiaries have taken the financial assistance for packing house. Among fresh fruit and vegetable exporters, the financial assistance for packing house is quite high at 75%. It is noted that in this area, the exporters, who are exporting only 8-10 containers of grapes, are taking packing house financial assistance. Mango, pomegranate, litchi, kinnow and apple are other commodities where packing houses have been established by exporters.

f) Setting up of sheds for intermediate storage

Nearly 24.7% of the exporters have availed the financial assistance for sheds for intermediate storage. Most of the exporters who have taken this assistance are exporting (rice and) mango pulp. Both these products account for 75% of the total beneficiaries in this segment.

g) Setting up of environment control system

Nearly 30% of the beneficiaries have taken the financial assistance in the environmental control system under Infrastructure Development component. Majority of beneficiaries under this component are from processed fruits and vegetables sector, specifically mango pulp exporters of Chitoor.

Under this component, mango pulp exporters are major beneficiaries who have taken financial assistance for setting up the pollution control system. The financial assistance has helped these small and medium units to achieve pollution control norms and meet the requirements not only that of the authorities but also importers who insist on sound environment practices by the exporting units (Table 10.21).

Table 10.21. Capacity utilization pattern of some of sampled infrastructures

Infrastructure	Capacity utilization	Products	Seasonality
Environmental Control System	6 months	Mango pulp	6 months
Pack House	Two-and-a-half months	Grape and other fresh fruits	Two-and-a-half months
Intermediate Storage	6 months	Rice, mango pulp etc	9 months
Pre-cooling Unit	Two-and-a-half months	Grapes and other fresh fruits	Two-and-a-half months

h) Benefits

It is observed that the units in almost all the product categories, in the immediate next year of taking the financial assistance, have achieved substantial growth in terms of revenue. Units in the fresh fruits and vegetables have achieved the maximum growth of 125% in terms of revenue. Units in this category have also been able to achieve 85% of the export target, which was set at the time of taking the financial assistance. In terms of growth, units in the floricultural products category have achieved a revenue growth of 100% and the export target achievement is 95%, which is the highest among all products (Table 10.22).

i) Adequacy of financial assistance

Most of the exporters are of the opinion that the present level of financial assistance is inadequate with the magnitude of the investment in creation of international level of infrastructure. More than 80% beneficiaries wanted increase is ceiling amount.

Table 10.22. Achievements of export targets

Infrastructure	Export target achievement (%)	Growth in revenue (%) @
Fresh fruits and vegetables	85	125
Cereal	64	30
Processed fruits and vegetables	80	90
Animal products	75	65
Floriculture	95	100
Other processed foods	55	25

ii) Scheme for market development

a) Objectives

Financial assistance under market development has been given mainly for the market promotion and promotion of image of the Indian produce in various international markets. Nearly Rs.278.20 million has been disbursed, which is 21% of the total amount disbursed.

b) Major achievements

- Market Development scheme has been availed by 611 beneficiaries, which accounts for 54.9% of the total beneficiaries under all schemes of APEDA. Assistance under this scheme has been availed equally by the manufacturer exporters as well as merchant exporters
- The maximum assistance has been availed by fresh fruits and vegetables (about 55%), followed by (cereals and then) processed fruits & vegetables.
- 5% assistance has been availed both by Floriculture and seeds and other processed foods

c) Component-wise performance

- Majority of the beneficiaries are satisfied with present components structure. There are three major components of market development under which APEDA is providing financial assistance for Packaging Developments, Feasibility Studies, Survey, Consultancy, Database Upgradation, Export Promotion and Market Development. Within these components, assistance has been sought by the beneficiaries only on use of packaging materials, conducting surveys and feasibility study, and brand publicity. Under the scheme for market development, 45% of the total beneficiaries have taken the assistance under packaging material. Out of these, majority (>75%) of the beneficiaries are availing the assistance for export of grape and are based at Nasik and Mumbai.
- Around 21% of the exporters have taken the assistance for supplying of materials, sample and product literatures
- The assistance for developing the packaging standards has been taken by 8% of the beneficiaries.
- Other beneficiaries include subsidy for market information and database, conducting feasibility studies and brand publicity through advertisements.

d) Main benefits

Packaging standards have been developed for majority of products. The packaging has been developed by Indian Institute of Packaging matching the standards of the competing as well as importing countries.

- Exporters are also encouraged to adopt packaging as per the standards developed by APEDA. Exporters of fruits and vegetables and floriculture are the major

beneficiaries of this exercise. Export of grape, pomegranate and vegetables by sea has been made possible with new strong cartons and have witnessed major growth in exports.

- New units are provided assistance to undertake feasibility studies to set up modern production facilities explore new markets and upgrade the production infrastructure. These units are also given assistance to send samples to their new contacts. Similarly most of the exporters have developed product literature through assistance that enables them to market effectively.

e) Adequacy of financial assistance

A number of exporters are of the view that in today's scenario financial assistance under the packaging material should be enhanced which will certainly help them in brand promotion of the products. Similarly, assistance for preparation of feasibility studies, surveys, and consultancy and database upgradation should be increased at substantial level since these are major tools to explore and understand the requirement of international markets for the Indian produce.

iii) Scheme for quality development

a) Objectives

- The scheme for Quality Development has been introduced to develop and ensure appropriate standard in exports and to meet the quality of the produce as per the international standards.
  - ✓ Setting up quality testing labs
  - ✓ Adoption of quality systems like HACCP, ISO, EurepGAP etc.
  - ✓ Testing of products to ensure importing countries requirements of product standards, pesticide residue levels etc.
- Nearly Rs. 213.90 million has been disbursed under this scheme for quality control development, which is 16% of the total amount disbursed.
- APEDA has accredited, recognized and upgraded laboratory facilities for testing of agro produce for exports. There are 6 laboratories upgraded and recognized in public sector and 7 private labs upgraded and recognized. APEDA has recognized 4 consultants and 1 certification agency for HACCP certification. HACCP standards have been implemented in over 125 manufacturing units of food products. Training programmes for analysts, Agmark and extension officers and farmers have been arranged.
- APEDA carries out the recognition of the exporter's units for certification of "Quality Produce of India" in the processing units of:
  - ➢ Fresh fruits and vegetables
  - ➢ Floriculture etc.

b) Major achievements

- A total of 204 beneficiaries (18.3 %) have availed financial assistance under the scheme for quality development. It has also been observed that majority of this has been availed by manufacturer exporters.
- Under the scheme of Quality Development, processed fruits & vegetables sectors have availed maximum assistance of 55 and 21%, respectively. Other sectors like fresh fruits and vegetables, other processed foods, and animal products have also availed reasonable assistance. However, there was not representation from floriculture and seed sector.
- An integrated system of pesticide residue management in grape has been

established, which has been instrumental in ensuring that Maximum Residue Level (MRL) meets the stringent requirement of EU and other importing countries.

c) Component-wise assistance availed

- Quality Development scheme has two broad categories comprising 'Promotion of Quality and Quality Control' and Organizational Building and HRD. Under 'Promotion of Quality and Quality Control', there are five components under which financial assistance of APEDA is available. Similarly under organisational building and HRD section, there are four components. Most of exporters are satisfied with the present basket of components. However, they are interested in slight modification and addition of new components under the present scenario.
- Nearly 50% of the beneficiaries have taken the assistance for setting up of laboratory. About 38% of the respondents have taken the subsidy to install quality standards/certification.
- Setting up of lab for mango pulp exporters is necessary, thus nearly 5% of the beneficiaries have taken the assistance for upgrading their labs.

d) Amount of subsidy availed (component-wise)

- The average subsidy taken on account of setting of the lab has been Rs 4.00 lakh, and the maximum subsidy allowed is Rs. 5.0 lakh. The average disbursement for the upgradation of lab is Rs. 2.4 lakh, while average disbursement for installing the quality management system has been Rs 1.1 lakh. Most of the exporters have taken this subsidy to install HACCP- based system.
- Exporters feel that since technology is changing very fast, upper bar to the subsidy should extend to Rs. 10 lakh for setting up a lab and there should be regular upgradation of the infrastructure for quality systems by adapting latest technologies.

iv) Scheme for research and development

a) Objectives

- Research and Development is an important tool to remain competitive in the market-driven international trade. APEDA has taken the initiative to provide financial assistance for various R&D projects having direct impact on export promotion of agricultural and processed food products.

b) Major achievements

- Nearly 3.1% of the total beneficiaries have availed the financial assistance under Research and Development scheme.
- APEDA has given 100% financial assistance to more than 63% R&D projects for public research and development institutions.
- The share of private sector in R&D efforts was 37%, in which APEDA's assistance was only 25% of the total cost of project up to a ceiling of Rs. 10.00 lakh only.
- 34 R&D projects have been sanctioned by APEDA to various public and private research and development institutions.
- It is observed that more than 86% R&D projects have been sanctioned from Division of Fresh Fruits and Vegetables, however, other division viz. Processed Foods & Vegetables and Floriculture were entirely un-represented.
- There are two components under scheme for Research and Development:
  - ✓ 100% assistance is available for research and developmental activities through public R & D institutions.

- ✓ Assistance is available for R&D efforts by exporters, trade associations and cooperative institutions.
- ✓ In addition to the above components, international R&D institutions can be engagement for quality research and better output.

- APEDA has awarded research & development projects for :
  - √ Rose onions (productivity)
  - √ Walnuts (Tissue Culture/vegetative)
  - √ Pests and Diseases Surveillance in potato
  - √ Laboratories for Development of protocols for VHT and CA
  - √ Litchies and Vegetables
  - √ Variety Improvement & Pre harvest management in grapes, another on grape production under poly house
  - √ Identification and eradication of mango stone weevil
  - √ Pests and Diseases management in gherkins
  - √ Development of varieties of white onion for dehydration

v) Scheme for transport assistance

The objective of the transport assistance scheme is to compensate the exporters against disadvantages faced in respect of sea and air-freight rates. This scheme assumed importance about ten years ago when it was introduced. The implementation of the scheme was evaluated twice by different consultants and it was recommended that the scheme needed to be continued. The last evaluation of this scheme was carried out by M/s A.F. Ferguson & Co., Mumbai in September, 2004 and it was decided to continue the scheme until March 2007.

The evaluation revealed that air-freight assistance has been a key factor in maintaining/enhancing competitiveness of Indian agri exports by bringing down the extent of disadvantage and helping growth in exports of eligible items. In case of fresh vegetables, where the air-freight cost is substantially higher (roughly 2-3 times the FOB value), the growth has been quite substantial (CAGR 22%). However, growth in fruits and flowers has been substantial (CAGR around 14%). In case of air-freight assistance, the greatest positive impact was in respect of processed fruits and vegetables, where the growth in exports went beyond 100% in certain cases.

The government had desired that the scheme might be re-evaluated for further continuation during the XI plan. A separate study has been commissioned for this purpose and the results of evaluation will be available not before December 2006. However, based on our experience during the implementation last ten years, it is expected that we might need to continue the scheme in the larger interest of exports. The only change that might come about could be in terms of the percentage of assistance.

10.1.3. 4 Interventions

The outcome of the study revealed that the existing schemes of Tenth Five Year Plan are required to be modified and new components/schemes to be introduced to facilitate the export growth of agricultural and processed foods sector by providing domestic support. Schemes of the financial assistance have been modified and formulated in such a way that can have maximum impact on the export of agricultural and processed food products without any reduction commitment under WTO obligation. Various components under agriculture and related activities are highly subsidized under Green Box ambit in USA and European Union as given in Annexure – IV. It includes various activities of research, training,

extension, advisory, inspection, market promotion and infrastructural services etc., hence free from any subsidy reduction commitments. The study revealed that present level of assistance of APEDA for export promotion under various schemes falls under Green Box ambit and should be vigorously utilized for export promotion.

10.1.3.5 Overall impact of financial assistance

i) Increase in turnover

Almost all the exporters, who have taken the financial assistance to create the infrastructure, have shown the impressive improvement in their export performance. The average increase in the turnover has been more than 50%. In many cases, exporters after setting up the infrastructure have started exporting to new territory or country. In fresh fruit and vegetable products category, the average growth in turnover after the financial assistance has been almost 100%. The objective of large exporters in taking the financial assistance is to improve the quality of existing deliveries, while the objective of smaller exporters is to increase the business.

Exports of the sampled beneficiaries have been rising annually after getting the financial assistance. During 2002-03, the average export turnover of exporting companies was Rs 82.2 lakh, while in 2005-06 it increased to Rs 224.2 lakh.

It is pertinent to mention here that this trend may not be fully assignable to the financial assistance facilities created with the same and many factors might have contributed to it. However, the fact clearly established two conclusions:

- The exporters who availed the assistance have made serious efforts to increase their exports
- There is positive correlation between the assistance and the export of the company.

ii) Role of financial assistance

Almost all of the beneficiaries are of the opinion that financial assistance given by APEDA is important to them and it helped them in setting up their business venture, creating infrastructure and market developmental programmes. It makes them feel that government is concerned about them and appreciates their efforts in earning foreign exchange for the country. Financial assistance had given them the financial cushion, strength and some manoeuvrability in terms of playing around with the price or to accommodate some losses incurred in the way. Nearly 70% of the exporters feel that it reduced their financial problems. Improvement in product quality and financial security are some of the other important benefits derived through the financial assistance as reported by the exporters.

iii) Constraints, strategies & recommendations to overcome the same

Major problems that come across while exporting fresh fruits and vegetables from India include low productivity as compared to international levels, lack of the use of new technologies for pre and post-harvest management of crops, stringent international quality standards and disconnect between production and marketing. A paradigm shift is required to bring in better balance between production and other sub-systems, viz., pre-harvest technologies, post harvest processing, quality management, export infrastructure, supply chain, market information and marketing strategies.

iv) Market orientation of production

(a) R&D for specific varieties and supply of planting material: Introduction of commercially successful varieties is required which are suitable for different end uses of fruits and vegetables to gain consumer acceptance. The development of industries for multiplication of seeds and planting material is necessary as planting material for desired varieties is generally in short supply.

(b) Inadequacy of basic knowledge about pre-harvest practices, which are crop and location specific in nature, needs to be addressed through intensive education of farmers. Knowledge about maturity indices and use of new harvesting tools and techniques are essential to ensure that comparative advantage of low cost production is not eroded in post production stages. For example, in the case of fruits, the level of firmness, the colour, and aroma play an important role in deciding about maturity conditions for harvest.

(c) One of the main post harvest management practices is use of cold chain to prolong shelf life and preserve quality of fruits and vegetables. While cold storages are established in few pack houses, market yards and some airports, the available capacity is substantially low particularly at the farm level. Specialized cold storage with high humidity and facilities for ethylene removal as part of cold chain for export of fresh fruits need to be set up and made available for use on commercial basis.

v) Quality including human, plant & animal health and safety issues

(a) Another major area of concern is strengthening the capabilities of Indian exporters for adherence to international quality standards. There is an urgent need to increase awareness and adherence to Good Agricultural Practices to meet the quality specifications of the international market. Growing food safety resulting in stringent phyto sanitary control measures restrict access of our produce to developed markets.

(b) Exporters are required to comply with the maximum pesticide residue levels for exporting their produce. Producers, therefore, would have to strictly follow at least Codex Standards to minimize rejections. Disinfestations protocols need to be established for various products in keeping with latest developments in the application and use of pesticides

(c) Japan, Australia and China have in the past banned imports of mangoes and grapes from India on account of presence of certain fruit flies. Australia desires to have complete details about pest management practices in India and a ban can only be lifted after signing of a MoU on mutual recognition of pest management practices. Japan on the other hand desires Vapour Heat Treatment (VHT) of fruits for disinfestations before these can be allowed to enter into their country. These issues require to be taken up vigorously during bilateral trade meetings.

vi) Supply chain with technologies for cost-effective transportation

(a) The high delivery costs significantly erode the production cost advantage enjoyed by Indian farmers. One of the key factors that determine the export potential of fresh fruits and vegetables sector is maintenance of the quality of the produce and increasing its shelf life. The facilities currently available are inadequate to meet the growing needs of storage of perishable products. Efforts need to be made to motivate the farmers to use refrigerated vehicles for transportation of fresh fruits and vegetables for which establishment of pre cooling facilities is required and farmers have to prepare their harvesting schedules after a tie-up with such facilities.

(b) Lack of cargo space and high airfreight rates: India has a unilateral open skies policy for air cargo. According to this policy, any operator, including foreign operator, can operate any number of flights by any type of aircraft to any airport having customs and immigration facilities without any bilateral agreement. The operators are also free to charge rates according to the demand and supply situation. But according to exporters, many airlines don't offer cargo space because of one way freight (to Europe and North America) and so only handful of airlines including Air India and Indian Airlines remain the major handlers of freight.

GOI's Committee report 'A Road Map for Civil Aviation Sector' identifies the following three major problems why air transport costs are so high in India. While fuel costs are

usually 10 – 15% of airline operating costs, in India, they are nearly 30%. This is because the average price of aviation turbine fuel (ATF) in India is nearly 190% higher than the international price. The excise and sales taxes constitute nearly 45% of the ATF price. The fact that only government-owned oil companies supply the ATF has lead to lack of competition in the fuel prices. Furthermore, according to the Committee report, the airport charges in India are 78% higher than international averages.

(c) Price competitiveness is essential in order to sustain the market. Transportation of mangoes by air is costlier by 10 times, as compared to sea, to most of our Asian markets, especially to the west Asian markets. Thus, export of fruits and vegetables in bulk by sea is the best alternative. However, in order to preserve quality and extended shelf, life during sea transportation there is need for development of protocols for management of different varieties of specific fruits and vegetables during voyage time through use of alternative techniques of refrigeration, controlled/modified atmosphere management.

(d) Besides developing refrigeration technology and protocols for sea transportation of fruits and vegetables, application of similar technologies / protocols of transportation by road / rail should also be developed since multi model transportation is required for most products in view of the production areas being away from the sea ports. Neighbouring countries like Pakistan, Bangladesh, Nepal, Bhutan, Myanmar and China could be targeted through inter-modal transportation system, with complementary roles to be played by road transport and carriage through railways.

(e) High international transportation costs coupled with high costs of storage and inland transportation impede the growth and development of the export of fruits and vegetables.

GoI's Committee report 'A Road Map for Civil Aviation Sector' identifies the following three major problems why air transport costs are so high in India. While fuel costs are usually 10 – 15% of airline operating costs, in India, they are nearly 30%. This is because the average price of aviation turbine fuel (ATF) in India is nearly 190% higher than the international price. The excise and sales taxes constitute nearly 45% of the ATF price. The fact that only government-owned oil companies supply the ATF has lead to lack of competition in the fuel prices. In addition, according to the Committee report, the airport charges in India are 78% higher than international average. Measures to reduce these costs need to be undertaken.

The situation in case of sea freight is also similar. Findings in a recent study conducted by the World Bank indicate that the share of transportation costs in the CIF price of Indian grapes in the Netherlands is 48% as compared to 18% in the case of grapes arriving from Chile. The delivery cost is USD 790 for one MT of grapes from India in the Netherlands markets as compared to USD 300 in case of Chile although Chile is twice as far from the Netherlands as India.

While the improvements in the supply chain infrastructure will show their positive impact in the long term, we need to evolve means to compensate the Indian exporters for the disadvantage they have due to high air/sea freight costs. The scale of compensation under the transport assistance scheme currently being implemented by APEDA is inadequate.

(f) From a cost perspective the biggest impediments to the competitiveness of the export of fruits and vegetables lie outside the horticulture sector rather than inside it. The average price at the farmgate for a typical horticulture produce was found to be only 12 – 15% of the price at which the product is retailed in the destination market. Therefore, a 20% improvement in yields would lead only to a 2 – 3% reduction in the

final price. On the other hand a 20% reduction in transportation cost alone will reduce final prices by as much as 8 – 10%.

(g) Good quality packaging materials suitable for global markets need to be made available starting at the farm level to prevent deterioration of fresh produce during journey upto pack houses.

(h) Cargo handling Facilities at Airport

Cargo handling and cold storage facilities suitable for perishables have been set up at some of the international airports. All domestic and international airports need to be equipped with temperature control facilities for handling and storage of the export cargo of perishable agro products particularly fruits and vegetables since the production is spread over different agro climatic zones located far away from exit points.

vii) Marketing

(a) Improvement in Market Channels

Both the Central Government and the Governments in the respective States to increase control over storage, marketing and distribution of agricultural commodities (including fruits and vegetables) during periods of shortages within the country enacted the laws such as Essential Commodities Act (1955), Agricultural Produce Marketing Act 1972 and the Prevention of Black Marketing and Maintenance of Supplies of Essential Commodities Act (1980). These Policies prevented free mobility of Agriculture Produce and thus segmented the Indian domestic market into many smaller markets. The supply chains developed under these legislations have been primarily local or regional in nature. Till recently almost nil infrastructure existed for handling and storage of perishable horticultural products. The restrictions of private domestic investment in APMC markets prevented emergence of large, organized, efficient supply chain for fruits and vegetables.

The scenario has started changing in last few years. It is understood that six States have already amended the APM Act to allow private investment in markets and direct buying of produce from the farmers by traders and processors. Improvement in domestic market channels would increase efficiency in the process of market transactions and maintain quality. Joint efforts by growers, wholesalers, exporters and processors would help improving efficiency in market channels and reduce the end user cost substantially.

(b) Direct to Retailer Strategy – Developing Linkages with the AEZs – Creation of Hubs.

Driven by competitive pressure caused by a maturing food industry in Europe and USA the retail industry has been witnessing the phenomenon of consolidation for quite some time now. The leading 30 retailers in Europe have a combined sale of USD 1050 billion which is 26% of the total European retail sales and 44% of the total European grocery retail sales. In US top 10 retailers contribute 60% of the food sales. These big retailers could be the key to getting sizable market share for our products. Most of the Indian exports presently pass through traditional food consolidators resulting in low price realization for our farmers and exporters. Hence, it would be a better strategy to organize some of our Indian Corporates, which are already into the agri food business, as big suppliers of fruits and vegetables supplying directly to the big retailers outside. The retailers are interested in sourcing goods from big Indian Corporates capable of offering large quantities of quality agri produce of a wide range. APEDA has been talking to some of the well known Indian Corporates in agri business. Such leveraging is capable of providing the necessary demand pull for growth of the agriculture sector through a quantum jump in exports.

(c) Setting up of marketing centers abroad including leasing and hiring storage/logistic facilities, hiring of personnel/consultant, etc.

Based on the potential of specific products such as fruits & vegetables, horticulture products including floriculture and cereal products, there is a need for creation of cold storages/warehouse in gateways to major markets like Dubai, Singapore, London, Moscow with 100% grant from APEDA.

The XI Plan proposals focus on mitigating the above constraints with the help of various schemes. The broad categories of the schemes remain unchanged but a number of components have been modified and a few new components have been added.

10.1.3.6 Eleventh Plan programmes

i) Thrust areas

The key action points for improving the export performance during the XI Plan are suggested as under :

(a) India needs to standardize pre and post harvest management system and harmonize them with the international standards. Technical experts should participate in all Codex and SPS/TBT related meetings and conferences.

(b) We need to invest in post-harvest and laboratory infrastructure, technology up-gradation, quality/food safety and training. We also need to re-orient our own extension machinery with an element of motivation.

(c) We need to implement `IndiaGAP' (the draft National Programme for Good Agricultural Practices, currently under consideration of the Govt.) in the country on a project mode as soon as possible. Here again, training at all levels will be a critical factor.

(d) It will be extremely important to introduce a new scheme to encourage value addition in agricultural products with the aim of converting India from being an exporter of bulk agri. products into an exporter of agri. products in consumer packs.

(e) Market intelligence activities and competence should be strengthened in India to meet the increasing global competition. If necessary, we should position experts in our mission at key locations.

(f) Invest vigorously in market promotion activities on a project basis, both on a generic basis and for brand building to enable exporters export ready-to-eat products in consumer packs for direct retail by retailers/ super-markets.

(g) Government should provide support to NABARD in a appropriate manner to enable NABARD to work out an arrangement with commercial banks so that finance to agri processing units is available at a concessional rate of interest (2-3%) which would cover crop loans for production under contract farming, project funding (capital and term loans) and export/packing credit, particularly in Agri Export Zones (AEZs). This will encourage viable investments in the AEZs. List of 54 AEZs notified so far covering horticulture crops is given in Annexure-I.

(h) Make available concession on premium on crop insurance in the AEZs, where contract farming arrangements are prevalent. This concession could be upto 50% of the premium amount.

(i) We also need to clearly define our own Food Safety Objectives and invest in scientific risk analysis activities to monitor imports.

(j) We need to improve the working of our quarantine, authorities, PFA, etc. Import clearance rules and procedures in India should be reviewed in line with the current international practices.

(k) We should effectively monitor production and marketing of pesticides in the country.

(l) Adequately improve technical resources in APEDA to foresee and meet the emerging quality needs.

On the basis of the evaluation of different financial assistance schemes of the tenth plan, the modifications in the existing components and introduction of new components along with the rationale of modifications / additions is presented below:

ii) Future projections

The value wise export targets for the five years of the XI Plan period are given in the Table 10.23.

Table 10.23. Future projections

Vaue : Rs Crores

Sl.No.	Commodities	07-08	08-09	09-10	10-11	11-12
1	Floriculture Products	381	437	502	580	665
2	Fruits/Veg Seeds	163	188	216	245	285
3	Fresh Fruits & Veg	2775	3190	3665	4115	4845
4	Proc /Misc Proc	2655	2837	3264	3758	4320

Programmes/sub programmes with budgetary allocation (Please highlight budget) required for horticulture programmes only.

Table 10.24. APEDA proposal to the government for the XI Plan period

(Rs. Crore)

Name of the Scheme	10th Plan (2002-07) Approved Outlay	Annual Plan (2005-06) Actual Expenditure	Annual Plan (2006-07) Anticipated Expenditure	10th Plan (2002-07) Accumulated Expenditure$	11th Plan (2007-12) Proposed Outlay	Annual Plan (2007-08) Proposed Outlay
1	2	3	4	5	6	7
Central Sector Schemes (ongoing Schemes)						
i) Sch. For infrastructure development	95.00	22.16	48.62	126.50	229.00	39.85
ii) Scheme for market development	40.00	7.76	0.41	37.56	170.30	15.00
iii) Scheme for quality development	15.00	8.43	9.36	31.28	150.00	15.00
iv) Scheme for research & development	23.00	0.26	10.75	5.36	0.70	0.15
v) Transport assistance scheme	80.00	21.23	23	71.50	200.00	30.00
Total	**253.00**	**59.84**	**92.14**	**272.20**	**750.00**	**100.00**

APEDA programmes do not have separate allocation for horticulture crops and other agriculture products. However, the expenditure related to horticulture products is about 75% of the total expenditure.

10.2 Imports

10.2.1 Status

The import value of all horticulture products in 2003 was of the order of USD 1.06 billion. There has been about three fold increase in the last one decade which is attributed mainly to the phase out of quantitative restrictions starting in the second half of the 1990s.Imports of fresh fruits, especially apples, have risen considerably by more than 245% per annum between 1997 and 2003, of course, on a small base. Growth has also been rapid for certain processed food products like apple juice and dried vegetables, though the single most dominant item in this category continues to be dried peas. The share of various commodities in total import is as under:

i)	Fresh grapes	2%
ii)	Peas fresh or chilled	8%
iii)	Potatoes fresh or chilled	2%
iv)	Other vegetables/fruits preserved	7%
v)	Apple juice unfermented	2%
vi)	Grape juice	1%
vii)	Dried vegetables nes	4%

India though a major producer of spices can only export around 7% of its production due to the high domestic demand. The situation is gradually changing to make India one of the major importer of spices. In some traditional item like pepper, where India was once a major player, the situation is drastically changed to make India a major importer.

The established processing capacity of raw nuts is around 12 lakh tonne. However, domestic production is around 5.4 lakh tonne. Thus, presently India is importing raw nuts from African and other countries to the tune of 5.8 lakh tonne to meet the demand of cashew processing industries.

Table 10.11. Quantity and value of natural rubber imports

Year	Import	
	Quantity in tonne	Value In Rs. Crore
1991-92	15070	29.54
1992-93	17884	46.65
1993-94	19940	54.88
1994-95	8093	27.21
1995-96	51635	278.44
1996-97	19770	100.44
1997-98	32070	121.66
1998-99	29534	91.17
1999-00	20213	57.32
2000-01	8970	30.38
2001-02	49769	144.46
2002-03	26217	99.30
2003-04	44199	220.14
2004-05	72835	429.11
2005-06	45285	274.51

Imports of NR into the country surged during the first quarter of 2005-06 because the domestic prices during the period were higher than the international prices. But, by the end of June, the domestic prices came below the international prices and the gap between the two progressively widened. However, imports continued against contracts made during the

first quarter when international prices were lower than the domestic prices. Import of NR up to 2005-06 was 238,305 tonnes. India had been a net importer of rubber and only negligible quantities of rubber used to be exported. In accordance with the policies of WTO mandated regime, rubber and rubber products could be imported without restrictions. To neutralize the impact of possible imports of rubber and rubber products, it is essential to promote export of rubber. It is proposed to support export promotion activities to establish the presence of India in the international rubber market.

10.2.2 Impact of imports on domestic and export market

The imports, in case of some items has increased in last few years for example the apples. The trade has reported that about 1000 containers of apples were imported for Diwali gifts in 2006. However, import penetration remains insignificant in terms of the share in total consumption. For fresh fruits, it is less than 0.1% of domestic production, and is also negligible for most fresh vegetables.

Import volumes for some products have risen at times when world prices are stable or rising. For example, in the case of dried peas, periods of high imports have been associated with higher prices. Similarly, for both apples and grapes, the fastest growing items in the fresh fruits category, unit prices have been higher on the average in the post – 2000 period than in the preceding decade. From this, it seems clear that increasing import volumes are more reflective of demand conditions in India, than changes in international supply.

10.2.3 Measures to counteract the effects

The import of horticulture commodities into India do not face any reasonable SPS restrictions. We would need to strengthen our quarantine and health and safety standards monitoring systems and institutions.

Most developed countries deny access to Indian horticultural products, under the garb of SPS measures, or at least delay access to the extent possible. Quarantine procedures in India are not strictly implemented and there is a need for our authorities to be pro-active. For example, the apples and other fruits which are being imported in India need to be test checked to ensure that they are free from pests and diseases and do not pose any threat to the domestic systems of production.

A system for surveillance of the imported consignments and sample testing of the same needs to be brought into place and monitoring on a regular basis is urgently required so that imports do not continue to increase due to laxity of quarantine monitoring. A system for pests risk analysis needs to be put in place so that the risk of entry of new pests and diseases is dealt with appropriately.

10.3 WTO

10.3.1 Present status

One of the most important issues currently being deliberated upon in the WTO relates to the provision of Special Products and Special Safeguard mechanisms. G-33, a group of developing countries, of which India is also a member, in the Doha Round of WTO, are negotiating provisions for declaring a few tariff lines important to them as Special Products (SPs). Some SPs will not attract any cuts in the bound tariffs while other SPs would attract bound tariff cuts which are lower than the tiered-tariff reduction formula cuts. This is expected to be a safeguard mechanism for the developing countries

Another safeguard mechanism termed as Special Safeguard Mechanisms is also being negotiated by the developing countries under which they will be authorized to protect against the import of those agriculture products which are critical for the livelihood and food security and rural development. The indicators for designation of Special Products and Special Safeguard Mechanism are under discussion.

10.3.2 Factors Affecting Exports

10.3.2.1 Artificially low prices in global trade due to export subsidies and domestic support by the developed countries

The biggest challenge which Indian exporters of agro and food products face in the international markets pertains to low prices as an influence of the excessive export subsidies and domestic support extended by the developed countries to their farmers. We can hardly survive the price war unleashed by the subsidy rich farmers of the USA and the EU. Negotiations under WTO, so far, have not made much headway in persuading the rich nations to stop giving subsidy to their farmers in different forms

There has to be a balance between the three pillars of the negotiations. If tariffs were to go down it is essential that developed countries reduce export subsidies and domestic support implying reduction in production and increase in possibilities of import of foodstuffs by them from developing countries most of which are low cost producers.

10.3.2.2 SPS and TBT issues

The Agreement on Application of SPS Measures contain detailed provisions on transparency, harmonization and standardization. However, the very high level of standards set by some developed countries make it amply clear that developing countries with their current level of industrial expertise would find it difficult to achieve these levels. Many of these standards, are set not on the basis of adequate scientific justification but are driven by commercial considerations. Hence, they tend to operate as non-tariff barriers affecting trade performance of developing countries. Standards set by private bodies have been started in many Western European countries which include parameters relating to social and environmental factors also

Maximum Residue Limits (MRLs) for pesticides in gherkins and grapes are not harmonized by European Communities with Codex standards. In some of the products, the MRLs are not harmonized even within different member countries of EU. This lack of harmonization results into a technical barrier for Indian produce.

The approval by Japan of Vapour Heat Treatment protocols for control of pests in Indian mangoes has taken a very long time. Though, the protocols were developed by India quite sometime back, the Indian mangoes could reach Japanese market only in July 2006. Similarly the equivalence procedure for fruits and vegetables with China are in progress but at a very low pace. The matter regarding upgradation of India's status to GBR level-I (signifying no risk of BSE) by European Commission has been pending for several years. APEDA has taken these issues relating to specific products with respective member countries during bilateral discussions. However, the experience on pace of such deliberations leaves much to be desired.

We have been suggesting that SPS Agreement should be amended to bring in more discipline in this regard. In case a higher level of protection is considered necessary within an existing standard, Member(s) concerned should bring it before the respective international standards setting organisation viz Codex/OIE/IPPC for revision in the original standard (or) a separate standard/measure be permitted for the concerned Member on clearance by Codex/OIE/IPPC as a special case.

10.4 BUDGET REQUIREMENT

The budget requirement for the promotion of exports through APEDA is Rs 750 crores. However, budget for the various boards have been given separately with the various boards e.g. Tea Board, Coffee Board, Rubber Board and Spice Board.

CHAPER XI
TECHNOLOGY TRANSFER

11.1 INTRODUCTION

Horticulture sector has gone through a glorious path in recent years as evident from its significant contributions in availability of fruits and vegetables round the year even at the remotest corners of the country as well as in socio-economic betterment of horticultural crop producers and related stakeholders. Increase in acreage and production of horticultural crops namely fruits, vegetables, spices, floriculture, medicinal and aromatic plants, plantation crops, etc has been spectacular.

The importance of horticulture in improving the productivity of land, generating employment, improving economic conditions of the farmers and entrepreneurs, enhancing exports and above all, providing nutritional security to the people, is widely acknowledged. Being low volume and high value enterprise and having immense commercial potential, horticulture is appropriately considered as sunrise area, which engages the attention of all shades of people i.e. farmers, entrepreneurs, sharecroppers, traders, scientists, planners and development agents. However, the major concern is to how best to harness the fullest potential of horticulture for employment and income generation as well as livelihood and nutritional security of the people, especially the poorer farming communities – small and marginal farmers including tribal farmers and farmwomen and the agricultural labourers. Horticulture being highly remunerative is expected to contribute substantially in this context.

11.2. STATUS OF EXTENSION SYSTEM AND PROGRAMMES

Agriculture includes all land-based activities like (i) cereal crops, (ii) horticulture, (iii) livestock production, (iv) fisheries and (v) allied areas. Literature many times refers to ‘agriculture’ as the cereal crops only rather inadvertently. Correct connotations are important for better communication, linkages and relationship. Therefore, agriculture is not only cereal crops.

Extension has played a key role in promoting scientific and commercial cultivation of agricultural crops. However, the role specificity of Extension system in promotion of horticulture remained limited because of skewed primacy to food grain crops. Nevertheless, since the fourth Five Year Plan (1970s), horticulture has been recognized as a potential sector.

The fatigue in agriculture, suicides of the farmers, the lowest growth rate in agriculture around 1.5 percent, and the opening the gate for wheat import, show the crisis we are facing. Similarly lowest per unit production of major horticultural crops as a result of non exploitation of technology developed by Agricultural Research Services is likely to continue unless our horticulture **extension system and strategy is drastically changed structurally, strengthened professionally** and **financed adequately**.

11.2.1 Agricultural Extension System: Organizational Perspective

Unfortunately, we do not have as yet a **National Agricultural Extension System** in the country. To many, this may sound unbecoming, but this is what it is. In the USA, in 1914 as per Smith Liver Act, the **Cooperative Extension Work** was established and till date this system remains the same, though, many extension projects and designs came and went. In India, we went by **extension projects (C.D., AES, IADP, IAAP, HYVP &T&V),** one after another for agricultural development, not by a lasting and stable extension system. After T&V of the World Bank was withdrawn in 1993, virtually we have no extension system; it has been left loose in the hands of states by and large. Most of the earlier projects were foreign

supported. Thus, we never developed a strong teeth of our own and hence this growing crisis today.

Structurally, we have Directorate of Agricultural Extension (DAE) in the Ministry of Agriculture (MOA), Government of India; and the Division of Agricultural Extension Education (DAEE) in the ICAR; both are Subordinate Offices. After T&V extension project of the World Bank in the Ministry, ATMA (Agricultural Technology Management Agency) was launched as an experiment under the NATP of the ICAR supported by the World Bank in seven States and 24 Districts in 2001; this was devoted to decentralized planning involving all stakeholders – an integration process. Only in 2005, it has been expanded to major states (not Union Territories) only in 252 districts. ATMA is a district level integrating and management extension mechanism, and not a total extension system.

Similarly, in the National Agricultural Research Systems (NARS) of the ICAR, obviously there is priority to research, Agricultural Education and very limited priority to Agricultural Extension. The ICAR rightly justifies this, because in the ICAR, extension education is a first-line (pilot) effort with only limited area jurisdiction, whereas the DAE of the MOA is the main extension system for the country as a whole.

11.2.2 Conceptual Clarity

There are **conceptual differences** between those two extension mechanisms – one in the Ministry of Agriculture and the other in the ICAR. **Extension is basically an educational design better known as extension education**. This being a basic and universal phenomenon, it is applied in all transfer of technology (TOT) projects/programmes, may that be agricultural or industrial. It is named accordingly**:** Agricultural Extension (to be accurate – Agricultural Extension Education) or Veterinary Extension or Veterinary Extension Education. However, the extension being promoted in the ICAR system including SAUs (State Agricultural Universities) is, unwittingly, termed as **extension education**, whereas the extension is being done by the MOA and the States is termed as **extension services**, the latter denotes the mechanical manner of transferring technologies, not the educational approach. Rightly, it can also be called **extension education services**. The services concept thus has also percolated to the State Extension programmes, which are almost devoid of educational and training role for the farmers, ultimately adversely affecting the whole extension system in the country. Due to these two Subordinate Offices, the present extension system has no voice and teeth of its own. This is a serious concern directly affecting the agricultural productivity and production. If this basic malady is not corrected, the present plight will continue undated. It is alarming!

11.2.3. Extension Programmes

Mahatma Gandhi talked of **Antodya**– reaching first the poorest of the poor, but we did not do it owing to two reasons: (i) influence and maneuvers of the rich farmers; and (ii) soft options and convenience of the extension personnel in approaching the well–to–do farmers. Thus the small and marginal farmers as well as agricultural labourers were virtually by-passed. Hence rich continues to be richer at the cost of the poorer farming communities; in fact we have **poverty among the rich people**–**hunger and greed for wealth false ego and vanity; this artificial poor class is dangerous for the society**. Majority of the farming families belong to small & marginal groups nearly 70 per cent.

The **Land to Lab programme** and the **SC/ST Operational Research Project** of the ICAR were very successful for poorer sections of the farming communities, but they could not be continued for long. The **KVKs**, besides functioning for the last 30 years, continue to be a **Plan Scheme– they die or survive every five years**. The KVKs are successful rural institutions–and must be converted into **non-plan** after their successful working for initial 10 years. The **Trainers Training Centres (8)** with the specialized ICAR research institutes have unfortunately been lately closed, when training is a strong mechanism for Transfer of

Technology (TOT) the world over. There are 543 KVKs in the country today, and they are likely to be around 600– one in each district (588 rural districts now). The management of such a big scheme should be the concern of the ICAR/ GOI. It would demand an **independent set–up to administer it effectively and efficiently**. Lately **NGOs** have been discouraged in running the KVKs, (when the ICAR had taken the leadership in this direction vis-à-vis other Departments and Ministries), because now they must have their own land (25-50 acres) which should be mortgaged to the ICAR for the KVKs, Even lands (50 acres or so) being leased by the State Govt. to good NGOs/private Institutions have been ignored in this respect. It has been easier to dump KVKs in the SAUs– all eggs in the similar baskets. Even core resources available to KVKs by the ICAR are not totally available to the KVKs — they are being diverted by major institutions for salaries etc.; and the KVKs are also becoming government institutions depending totally on ICAR resources, whereas they should generate additional resources from their own farms, national or international demonstrations units, and outside agencies through productive projects. These require serious considerations; the leadership in ICAR extension should back-up such move by the KVKs.

The Ministry of Agriculture has been promoting extension schemes such as mini-kit scheme, Font Line Demonstrations, Watershed Development programmes, Extension Education Institutes, Framers Taining Centers, Women in Agriculture, Farm Information and Communication, Mission-Oilseeds and Horticulture, Intensive Development of Vegetables (IDV), Training and visit of farmers, etc,.

After T&V virtually there is no extension system. ATMA– a planning and integrating mechanism at the district level is under experimentation and also under gradual expansion.

The extension system should seek mechanisms for integrating horticultural programmes with agricultural extension activities; this is a big management issue – also a serious linkage problem. Horticulture is growing very fast in the country – almost half the states now have a separate Department of Horticulture – some are a large set-up and others are growing according to their scope, resources and commitment. For instance, Karnataka is one such state where horticulture in all its perspectives (fruits, vegetables, floriculture, plantation crops, spices etc.) has been given a priority place in scheme of agricultural development. In their horticultural set-up, there are 1186 staff from state to villages, though, nearly 50 percent are vacant (561). The budget allocation for Department of Horticulture for 2006-07 is Rs. 6056.59 lakh. Similarly Maharashtra State has very strong horticultural programmes; other States are at varying state of development. The need of a proper extension system for this sector therefore deserves priority attention.

11.3 Small and Marginal Farmers and Women in Horticulture

India in its strides for agricultural development witnessed a chain of revolutions and continues to strive for rainbow revolution; however, the small and marginal farmers remained elusive of the projected benefits. That they produce proportionately more than their share in land both for subsistence and for the market in spite of natural, institutional, social and policy aberrations, is their strength. Low horticultural information dissemination index as compared to field crops, poor extension contact, pro-large farmers extension approach, inappropriateness of technology to their production system, low capital base, unorganized populace, and socio -psychological characteristics like risk taking ability, entrepreneurial orientation, achievement motivation etc have been the major factors for impeding technological change in small and marginal production systems.

The Horticulture Mission has made explicit their intention for development of small and marginal farmers with provision of financial assistance in promotion of schemes for hi-tech horticulture including protected cultivation, organic farming, etc. Area expansion under horticultural crops, establishment of small nurseries, progeny and herbal gardens, transfer of technology through training, front line demonstration, publicity, training of trainers, human

resource development, establishment of training centers, promotion of small farmers agri-business consortium (SFAC) are the initiatives for the benefit of small and marginal farmers.

However, schemes alone cannot make significant dent. Missionary zeal and commitment to serve the poor are essential for effective implementation of the schemes and ushering change in the system, and unfortunately these traits are not common.

At present in many spheres of horticulture promotion schemes, the guidelines for financial assistance are specified in a blanket manner for farmers. As a result large and influential farmers appropriate the major share. Hence to attain the avowed goal of developing small farmers, specific guidelines for their financial assistance should be specified.

11.3.1 Women in Agriculture/Horticulture

Despite their hard work and productive contribution in farming, women remain the most vulnerable section in the society. They play vital role in seed selection; planting; nursery management; grading, packing and processing of horticultural produce but in want of gender mainstreaming, they remained out of pale of technological advancements and development process.

On overall basis women constitute more than two thirds work force in agriculture and allied sectors. However, spurt in the number of women professionals in agriculture is only a recent phenomenon. With the rapidly changing agricultural scenario against the backdrop of globalization of agriculture, contribution of professional women in development on the one hand and emancipation of rural women on the other hand assumes a greater significance. In this emerging scenario highlighting swing towards more and more openness for the rural women, role of women extension workers in terms of their number and quality of technology transfer mechanisms becomes of paramount significance (Katyal, 1998).

A study on Women in Agriculture brought out the following facts (Rao *et al.* 1998).

i. Out of the 14,27,071 graduates (agricultural 73,133), 2,09,413 were women (14.7%); only 806 (1.1%) were in agriculture;

ii. Both men and women perceived work as gender neutral attaching more importance to competence – 14.9% were from rural and 85.1% from urban schools – the former was recommended for enhancements;

iii. Above 72% women graduates were employed, 6.6 % unemployed, and 20.8% were students – unemployment in agriculture was low in comparison to other professions;

iv. As to supervisory officers, 61.6% were neutral to gender; 22.9% preferred male supervisors, 15.6 preferred women supervisory;

v. Prejudice against women in jobs, and non-flexibility in working hours were cited as problems especially in private sectors; and

vi. Urban women graduates were reluctant to serve in rural areas, more rural women should be encouraged for joining agricultural stream.

According to 1981 Census, there were 253.72 million women in the rural areas in India and most of them were engaged in agriculture and agro-based activities such as livestock, forestry, fishery etc. Women accounted for more than 76% of the marginal workers and about 16% of the main workers. Among main workers as well as marginal workers, more women seemed to belong to the category of agricultural laborers than to cultivators. Although farmwomen play a significant role in Indian agriculture, they have not been given the importance they deserve in agricultural research, education and extension. They are often labeled as “invisible worker”, as their achievements have not been adequately recognized and appreciated. About 18% of the farm families are reported to be headed by

females. According to some accounts, about 30-45 per cent of rural families are said to be managed by females as a result of male migration to urban Centres in search of employment.

Women have been ignored and neglected since long so much so that they accepted their role as directed by men chauvinists without any grudge or reservation. In 1970s, the U.N. raised the gender issues focused on women in order to empower them for gender equality and gender equity. Women's day, week, year, five year or decade have been organized the world over. Four International Conferences were organized by the UN starting from Mexico, Copenhagen, Nairobi and Beijing within two decades on this vital subject.

Some of the development in this respect is worth noting: (i) 'Women and Development' Chapter in the Sixth Five Year Plan (1980-85), several international meets and Conferences through the International Research Institute (IRRI), Philippines on women in Rice-based farming system; (ii) the Extension Division of the ICAR in collaboration with IRRI organized the first International Conference on Women in Agriculture (1998) at New Delhi inaugurated by the then Hon'ble Prime Minister of India, Shri Rajiv Gandhi. A few basic things emerged out of this Conference: (i) a review book on women studies (Prasad, et Al. 1998); (ii) birth of International Federation for women in Agriculture; (iii) breaking the myth that agricultural research was gender neutral; (iv) Chief Guest remarks that women are mainly responsible for their backwardness – they must come up and raise their rightful voice for their rights and privileges provided in the Indian constitutions; (v) a remark that "when both men and women are working for women empowerment, we are bound to succeed; and (vi) 'Women in Agriculture Day' is celebrated in India by all agricultural institutions on 4th December every year – the day of closing the Conference and emergence of International Federation for women.

The National Commission for Women was established by an Act of Parliament in 1990. A landmark decision of the Government of India came in 1993 when the 73rd and 74th Constitutional Amendment guaranteed women a minimum one-third representation in all local bodies in the rural and urban areas and also reservation of one-third posts of Chairman for Women. The decision of the Government to give due attachment to and place for women empowerment in all sectors/ministries has been showing results.

11.3.2 Progressive Involvement of Women in Horticulture: Status and Prospects

Achievements notwithstanding, women still comprise the largest section of population living in absolute poverty and they represent the poorest of the poor sections of our society. Gender discrimination today, though amongst the most subtle, is one of the most all pervading forms of deprivation. A most telling demographic symptom of such deprivation is the persistence of an adverse sex ratio which declined from 934 females per 1000 males in 1981 to 927 females per 1000 males in 1991. Gender violence, both societal as well as domestic, continues unabated (Ministry of Human Resource Development, 1995).

There are a number of horticultural activities like ornamental nursery, fruit and vegetable nursery, kitchen gardening, fruit and vegetable processing, vegetable and flower marketing in which women are engaged to a considerable extent. Horticulture is also attracting women entrepreneurs, especially in big cities. Fruits, vegetables and flowers also offer much scope for export and additional employment for farmwomen.

As a result of research efforts several new technologies appropriate for farmwomen have been developed. Modern techniques of raising grafted fruit plants in polythene bags using detached vegetative propagation methods are more elegant and conducive for adoption by farmwomen. Tissue culture technique has been developed in several fruit plants like papaya, banana, grapes, etc. and ornamental plants like orchids. Hybrid seed production, which requires a great amount of patience and delicate handling, is another area suitable for

women. Similarly, mushroom cultivation, apiculture, sericulture, etc. hold much promise for farmwomen. Improved technology in traditional activities like preparation of dehydrated products, preserves, pickles, jams, juices, squash, etc. can improve efficiency and income.

11.4 CONSTRAINTS IN TECHNOLOGY DISSEMINATION

- Lack of robust extension system after the withdrawal of Training and Visit system in the country
- Horticulture extension is extremely weak due to lack of extension professionalism as well as lack of manpower adequately trained in extension science placed in horticultural technology transfer.
- Needed highly trained manpower for hi-tech horticulture
- Low information dissemination index of the major sources of information
- Lack of linkage, coherency and coordination among different extension agencies
- Inoptimal harness and sporadic deployment of information technology for diffusion of horticultural technology, weather forecasting based pest management strategy, market trend update, assessment of demand of produce, recording arrival and sale volume of produce.
- Lack of regular training programs for the field functionaries to keep the abreast of technological advancements.
- Lack of training centers for capacity building of farmers in advanced /modern practices, entrepreneurship development, marketing skills, financial management, quality standards and biosafety measures for export, IPR issues, etc.
- Lack of mobility among the grassroots functionaries of line department
- Low budgetary provision for extension of horticultural technology
- Lack of policy and infrastructure support for small farmers and womenfolk in terms of subsidy, credit, market integration, etc hinders the promotion of hi-tech horticulture

11.5 STRATEGIES FOR REVITALIZING TRANSFER OF TECHNOLOGY SYSTEM IN HORTICULTURE

The need of the hour is rejuvenation of policy interventions and their emphatic translation to boost up the production and trade of horticultural produce. Policy interventions for effecting a change need to focus upon the holistic issues related to technology development; its effective, efficient and speedy dissemination and optimum utilization for remunerative horti-business.

11.5.1 Farmer Participatory Research for Development of Appropriate Technology

- Emphasizing On-farm research to address the problems, needs and aspiration of growers as well as development of location-specific, appropriate and compatible technologies.
- The technology generation and assessment must be carried out along stakeholders-centered, sustainability as well as market-oriented criteria.
- Fostering farmer-scientist partnership

11.5.2 Technology Dissemination Strategy

As the farmers are to gear up to commercial cultivation and compete with global partners, they will be required to handle more complex information as well as technical know-how and do-how emanating from research system.

11.5.2.1 Broadening the role and domain of extension

- The extension system will also have to ***move beyond its communication role of transferring prescriptive information to an educational role*** with greater emphasis upon increasing farmers' technical skills and understanding of new technology, especially scientific principles that could enable farmers make better use of prescriptive information.
- Now the extension system needs to disseminate a broad array of information related to production, protection, post harvest management, credit, storage, packaging, improved transportation system, marketing in traditional and non-traditional areas at home as well as abroad.

11.5.2.2 Improving research-extension-clientele linkages

11.5.2.3 Strengthening public extension services

Though there is influx of multiple players (private agencies, corporate houses, NGOs, trust and authenticity among the clientele group simply because their concern is free of profit motive. Also the biggest advantage is the researches back up to maintain credibility.

i. It is high time to revitalize the extension machineries of SAUs and State Department of Horticulture. KVKs., Extension Education Institutes (EEI), State Agricultural Management Extension Training Institutes (SAMETIs) and other extension infrastructure should be strengthened.

ii. Provision of vehicle for mobility; incentives; decentralized management; creation of single window delivery outlets; intranet connectivity among the different departments of essential services; commodity programme develoment; implementation, monitoring and evaluation unit; mobile exhibition and video show vans, etc must become integral part.

iii. The public extension system needs recasting as learning organization.

11.5.2.4 Promoting pluralistic extension system in public –private partnership mode

Farmers groups, Corporate houses, NGOs, Voluntary Organizations, input dealers and other private agencies should be encouraged to disseminate routine information and provide extension services. If farmers are willing to have paid extension service in specialized areas, provision need to be made for such export oriented farmers.

Capacity building of extension functionaries to infuse proactiveness, professionalism, responsiveness, accountability, missionary zeal and sound managerial abilities to handle the WTO related farming constraints and challenges, the entire functionaries require to be trained in newer and relevant areas of behavioural dynamics like motivation and attitudinal orientation, entrepreneurship development, group formation and functioning, skills in conflict management among growers; use of media mix and computer aided communication aids (internet); video-conferencing; help-line; enterprise management; agri-business management skills; WTO and implication to horticulture; participatory need assessment technique; innovative techniques in production, protection and post harvest management; quality standards for export etc.

11.5.2.5 Information management

- Mechanism for information support to farmers needs to be streamlined. Organization of horticultural fairs and exhibitions at state, regional, national and international levels, production and relay of audio-video films and development of extension literature in local language need to be emphasized.
- Exploitation of booming mass media channels to reach the unreached and improve their Dissemination Index (DI).
- Face-to-face contact programme has its own importance and incomparable impact in technology dissemination. They must be used for follow-up and convincing campaign for major changes in production system of farmers.
- Farm School on All India Radio (AIR) can be replicated effectively in horticulture at wider scale.
- Community radio could be promoted for information sharing among the horticulture farmers in cluster villages.

11.5.2.6 Information technology enabled extension services

Development of commodity specific decision support system (DSS) and Expert system, On-line market info-portal could bring about improvement in precision decision-making by the growers and lead to betterment in production and trade of horticultural produce.

11.5.2.7 Intensification of field extension programmes

Besides conventional methods of demonstrations, exhibition, excursions, growers-scientists interface, field-visits, commodity shows and competitions at block, district, state and national levels and innovative approaches of FARMERS' FIELD SCHOOL, FARMER-to-FARMER communication and rewarding the pioneer adopters in public gathering may be effective in dissemination of knowledge and infusion of competitive spirit among the growers.

11.5.2.8 Strengthening contract farming institutions

Dependency upon private sectors, contracting firms and companies is becoming inevitable for small-scale farmers to facilitate accelerated capital inflow, technology and essential service delivery and assured market for quality crop production. However, appropriate structural arrangements should be initiated to develop an institutionalized mechanism for designing, organizing and operationalizing the contract system in the watchful eyes of the government and public institutions keeping in view the long –term implications. Structural arrangements should ensure fair deal in arbitration and dispute resolution, and for justice it should be the domain of the government. At the same time it is highly essential to educate the novice partner- the farmers about the dynamics of contract and corporate world.

11.5.2.9 Distance learning programme on horticulture

Capacity building of farmers, entrepreneurs and other potential end users could be facilitated with education and training through distance learning system for practicing horticulture with latest technical know-how and do-how.

11.5.2.10 Marketing extension

Besides the task of promoting quality production through organic means, marketing has assumed greater significance in the light of new international trading regime under WTO. Public extension system will need to address the issues related to marketing of produce to keep horticulture economically viable and remunerative options. Market surveillance; export quality standards, terms of global trade, export ventures in partnership with exporters, linkage with APEDA, NHB, and Export Houses should be strengthened.

11.6 CAPACITY BUILDING FOR TECHNOLOGY UTILIZATION

Technology utilization behaviour of growers reflects that they are complacent with traditional techniques. An aggressive spirit towards commercialization of horticultural crops production and processing with modern production, post harvest and marketing management techniques need to be infused among the growers.

i. **Development of Growers Association/Group**: Growers should be encouraged to operate in groups and their associations should be facilitated in commodity belts to derive manifold benefits like assertion of their voice for getting the due schemes, subsidy, inputs and infrastructure support from the government as well as guard them against exploitation and better their bargaining power with the *aarthias, mandis*, traders, input agencies, and contracting corporate bodies.

ii. **Gender empowerment** with the process of mainstreaming women in farming has set in but the pace needs acceleration particularly in horticulture. Legal issues related to provision for leasing lands by women for horticulture, availability of loans and credit to women head, and other issues related to generation and dissemination of drudgery reducing technologies; adequate training in production, post harvest handling, processing, value addition as well as marketing; educational excursion and exposition; and increasing the strength of female extension workers need greater emphasis.

iii. **Behavioral trainings** need to be strengthened to bring about motivation and entrepreneurial orientation among the farmers, as they have to brace up the emerging challenges of market and trade.

11.7 SPECIFIC RECOMMENDATIONS

i. Reviving and strengthening of extension system with institutional reforms to provide a organizational structure with functional linkages with concerned partners and adequate research back up.

ii. The ratio of male and female extension workers and the clientele group should be increased to improve frequency of the extension contact and information acquisition by farmers.

iii. KVKs need to be strengthened with manpower, physical facilities and adequate budgetary provision to provide leadership to state line departments and other development agencies in deployment of horticultural interventions at grass roots.

iv. There has to effective linkage with streamlined regular training and visit programme among the functionaries of Directorate of Extension of SAUs, nearby ICAR Institutes, State Department of Horticulture, KVKs, NGOs and other development agencies.

v. Enhancement of field extension activities and farmers capacity building programmes

vi. Emphasizing the **role of extension** as educational, training and motivational character rather as service provider.

vii. Recruitment of staff with B.Sc or M.Sc. (Horticulture) with adequate training in extension methodology

viii. Induction as well as refresher training curriculum must emphasize upon capacity building in extension methodology.

ix. The national organizational set up should provide enough space and freedom for extension to perform with accountability.

   a. The proposed model suggests at the Central level, an autonomous Council for Technology Transfer (CATT) under the Ministry of Agriculture in order to tackle extension work with more responsibility, accountability and Authority by merging

the two Sub-ordinate Offices of extension education: (i) Directorate of extension of the Ministry of Agriculture (MOA), and the Division of Extension of the ICAR (See Annexure-V for details), so that the Extension Education system should have its strong “teeth” as well as “voice”. Under this council there should be sub divisions dealing with Field Crops, Horticultural Crops, Animal Husbandry and Fisheries

b. At present, all agricultural sub-sectors/departments are having their parallel extension staff and wing at all the administrative levels — Centre, State, District and Block; there are no functional linkages and relationships to the disadvantage of duplication of efforts, no synergy and added expenditure. The administrative units/departments should also be functionally integrated at the all levels: D.G. of the proposed CATT at the Centre, APC/Director at the state, Joint Director at the district/region and the Deputy Director/BAO at the Block.

c. At the Block, there will be subject-matter supervisors and Block Extension Officers; at the Panchayat/Village levels there will be Para-Extension Workers (locals) – one male and one female for three Panchayats.

d. The knowledge Extension Centre is suggested at the Block level to be linked with the KVKs and ATICs at the SAU/Research Institute levels.

x. Front-line horticulture extension project should be launched by ICAR to address the national issues

xi. Horticultural infrastructure especially, food processing centers cold storage, warehousing facility, transportation, nurseries & planting materials, organized marketing – domestic & export, require augmentation as a support to horticultural extension education programmes.

xii. A holistic strategy to development especially for, fruits and vegetables on the pattern of AMUL/NDDB (Anand, Gujarat) or agro-industrial complexes of Bulgaria may be launched. The strategy may be worked out where involvement of Business Houses and Corporate Sectors may be important. To start with, the targets of such an approach may be (a) organic farming, (b) protected farming (c) precision-farming and, (d) contract farming.

a. Emphasis has to laid upon **Human Resource Development** to promote technology –led horticulture (see next chapter)

b. Besides academic degree programmes in horticulture, there is a dearth of scientists in hi-tech horticulture. Keeping in new the vast scope of horticultural productions, there is an urgent need for a **Central Institute of** Hi-Tech **Horticulture** with active linkages with foreign advanced Centres/Institutions of Hi-Tech Horticulture.

c. Besides Farm Advisory extension services for the farmers, the role of in-service training and entrepreneurship development have been very crucial. Therefore, all the SAUs and the ICAR Research Institutes are recommended to establish an **Advanced Training and Entrepreneurship Development** in agriculture; the 21 horticultural institutes may take the lead in this respect.

xiii. **Horticultural Inputs in KVKs:** The KVKs (now nearly 550) are the excellent network for the transfer of technology in all agricultural Sub-Sectors including horticulture. However, there is a very, limited support in KVKs to horticulture by way of only one base level position of scientist. It is recommended, therefore, to support KVKs by one Senior Scientist (Hort.) and two *Malis* each. Also the KVKs must have a good horticultural demonstration unit on the Campus including a plant nursing and seed farms for vegetables. Adequate operational costs will be equally essential.

xiv. **NARP – Zonal/Regional Research:** For generating location specific and appropriate farm technologies, Zonal/Regional Research Stations were established (120) under **NARP** scheme. Today these are not as effective because of the dearth of adequate funds. They may be supported in respect of the horticultural components. Appropriate technologies, based on agro-climatic and socio-economic considerations for effective extension education programmes are not only essential but also imperative.

xv. For small and marginal farmers, ICAR led previous front-line extension projects like the **Lab to Land** programme and **Operational Research Project (ORP)** were extremely successful. In horticulture, there is a lot of scope for these programmes for the small and marginal farmers and the agricultural labourers. These programmes should be revived in horticulture. They may be implemented by the KVKs and other Research and Development Centers. Self-Help Group (SHGs) may be promoted as a sustainable base for development.

xvi. **The Front-Line Demonstrations (FLDs) and Mini Kit programmes:** National Demonstrations of Front-line Demonstrations are common in cereal crops since long; we may launch/strengthen this programme in field horticultural crops especially vegetables.

xvii. **Horticultural interventions under Training and Visit programme like t**he Intensive Development of Vegetables (IDV) should further be strengthened for all horticultural crops. Besides, this scheme should also include the Training and Visit of the horticultural progressive farmers to relevant foreign countries.

xviii. **Community nursery and Farmers to Farmers seed promotion** and production of vegetable seeds should be promoted

xix. **The National Horticulture Mission (NHM)** should lay greater emphasis upon Horticultural Extension Education component including Participatory Farmers Demonstrations, periodic and regularized Training & Field Visits at the farmers' fields, entrepreneurship development, empowering women with greater focus upon small and marginal farmers.

xx. **Farm Women** need to be empowered through vocational training, entrepreneurship development and Self-Help Group (SHG) formation and micro-financing

xxi. **Budget for Horticultural Extension**

- Considering the essentiality of extension as a policy guideline, one third of the total budget ear–marked for horticulture should be provided for horticultural extension purpose.
- Center must play a decisive role in funding the states to strengthen the horticultural infrastructure in the states.
- Zero–based budgeting must be done by a specially created expert group or groups discipline-wise by the Planning Commission.

11.8 BUDGET REQUIREMENT

Considering the essentiality of extension as a policy guideline, one fourth of the total budget ear–marked for horticulture should be provided for horticultural extension purpose. Center must play a decisive role in funding the states to strengthen the horticultural infrastructure in the states. An expert group or discipline-wise groups created by the Planning Commission must do zero–.based budgeting in consultation with concerned departments. A humble budget needed for activating horticultural extension is proposed in Table 11.1.

Table-11.1 Budget outlay

S. No.	Items	Budget (Rs. in Crores)
1.	Strengthening KVKs (550) in terms of (a) staff component (one S_2 & two maalies), (b) demonstration units, (c) vegetables seed farm, (d) front-line demonstrations, and (e) vocational training & entrepreneurship development.	100.00
2.	In-service trainings, entrepreneurship development & initial support, and management training to small horticultural enterprises for SMFs.	100.00
3.	Empowering women through vocational training, entrepreneurs development, promoting self-help groups (SHGs)	50.00
4.	Lab to Land Programme and Operational Research Projects for small and marginal farmers on the enhanced support of the original ICAR schemes.	50.00
5.	HRD for extension education cadre in horticulture.	50.00
6.	Extension Support to selected NGOs devoted to horticultural development.	50.00
7.	Establishing Advanced Centres in all the 21 horticultural institutes/centres utilizing only core staff and deploying the Subject-matter Scientists of the respective institutions.	50.00
8.	Central Institute of hi-tech horticultural Research and Extension with linkages with advanced foreign Centres of Excellence.	50.00
9.	Foreign Educational visits of the Progressive and awarded horticulture-based farmers and farmwomen.	50.00
10.	Promotion of (i) Precision farming, (ii) protected farming (iii) contract farming and (iv) organic farming on holistic mode like AMUL/NDDB (Gujarat).	200.00
11.	Together with NHM and enhanced programmes of horticulture in the XI Plan, Horticultural Management – Governance and implementation through specialized horticultural (i) management training and (ii) strong supervision of the field programmes by the Expert horticultural & extension groups.	100.00
12.	Revolving funds for introducing holistic horticultural strategies on AMUL/NDDB model – Precision farming, agro-industrial complex, organic farming etc.	100.00
	Total	**1000.00**

CHAPTER XII

HUMAN RESOURCE DEVELOPMENT IN HORTICULTURE

12.1 HUMAN RESOURCE DEVELOPMENT

Horticulture in India has been identified as one of the most promising sectors with growth rate of above 6.00 percent. The production of fruit crops has risen to 49.2 million tones (2004-05) from 28.6 million tones (1991-92). Similarly the production of total horticulture crops has reached to169.8 million tones (2004-05) from 96.6 million tones (1991-92). Similar trends of growth has been observed in sectors like floriculture. The overall growth trend in horticulture sector has given boost to export securing Rs.3036.59 crores (2004-05) as compared to Rs.592 millions in (1992). The outlay for agricultural sector for the 11th plan is Rs.4800 crores. Keeping in view the growth pattern, around 50 per cent fund may be allocated to horticulture sector.

Horticulture has been considered as the priority area for investment in dry land and hilly regions of the country, where commercial agriculture is not remunerative. The growth of horticulture sector also provides support to employment and income generation and thus better livelihood to the farmers. Many new commodity interests groups and farmers federations have come up to develop this untapped source of economy.

The policy of economic reforms and WTO regime has created a new scenario for agri business including horticulture sector with the opportunities for import and export of horticulture produce. At the same time the cost competitiveness has put forth the demand to go in for high-tech horticulture, which requires a vibrant band of trained and skilled manpower to handle the production, post-harvest management and value addition of horticulture produce. The product quality desired at international standards necessitates a rejuvenation of age-old domestic horticulture production system and for effecting any change development of human potential is of paramount importance. Strategic need is to develop policy guidelines, institutional framework and conducive climate for facilitating capacity building of manpower engaged in horticulture.

12.1.1 Present Status and Review of HRD Programmes During the X Plan

The launch of National Horticulture Mission was one of the lead steps towards a planned approach for development of horticulture sector with focus on cluster approach in all the states of the country except the North Eastern States, Himachal Pradesh, Jammu and Kashmir and Uttaranchal, where separate technology mission for integrated development of horticulture exists. The mission document has included human resource development as one of the key activity for implementing other sub components under the changing global business environment in context of horticulture production, post harvest management, marketing and value addition Emphasis is given on capacity building of various stake holders in the sector viz., farmers, field level workers, officials and entrepreneurs.

For human resource development following training programmes were planned for implementation for selected states as per the focus of horticulture crops. Most of the on - going programmes under the X Plan (mentioned below) were merged in to **Macro Mode Management** scheme of National Horticulture Mission.

12.1.1. 1. Gardener Programme - of six months duration started during the 1999-2000 of IX Plant and continued to X Plan to develop basic gardening skills of participants with educational qualification class as 8th pass.

12.1.1.2. Vocational Training course for Horticulture Supervisor – an annual programme to develop a pool of skilled management resource in practical horticulture with educational qualifications for class of 10+2.

12.1.1.3. Specialized Entrepreneur in Horticulture - an annual programme to develop a pool of skilled management resource in new horticultural technology, bio-technology, plant protection, post harvest management and book keeping with educational qualifications of class 10+2.

12.1.1.4. The new Programmes Initiated during the X Plan– of three months duration to be organized two times in a year.

- Protected Cultivation of Vegetables & Flowers (PVF)
- Hybrid Seed Production of Vegetables and Flower Crops (HVF)
- Mass Propagation of Horticultural Crops (MPH)
- Post harvest Management & Value addition in Horticultural Crops (PVA)
- Production & Processing Technologies of Medicinal & Aromatic Plants (TAP)
- Transfer of Technology through T&V System for Orchardists (TOT)
- Advance Training for Field Functionaries and Trainers (ATS)
- Financial Assistance to the Trainees of Specialized Entrepreneurs (FAT)

12.1.2 Objectives of Mission

- To provide holistic growth to the horticulture sector through an area based regionally differentiated strategies, which include research, technology promotion, extension, post harvest management, processing and marketing, in consonance with comparative advantage of each state / region and its diverse agro-climatic features;
- To enhance horticulture production, improve nutritional security and income support to farm households;
- To establish convergence and synergy among multiple on-going and planned programmes for horticulture development;
- To promote, develop and disseminate technologies, through a seamless blend of traditional wisdom and modern scientific knowledge;
- To create opportunities for employment generation for skilled and unskilled persons, especially unemployed youth.

To achieve above objectives, the mission has formulated a seven-point strategy, which includes " **promoting capacity building and human resource development at all levels**".

Presently, horticulture development programmes are being implemented through a number of schemes viz., National Horticulture Board (NHB) programmes, Coconut Development Programmes, Technology Mission for Integrated Development of Horticulture in North Eastern States (TMNE), Human Resource Development (HRD) in Horticulture, Integrated Development of Horticulture in Tribal and Hilly Areas and Horticulture Programmes under the Macro Management Scheme. Of these, the schemes on HRD and Tribal Areas and Programmes under Macro Management will be subsumed under National Horticulture Mission (NHM). The Macro Management scheme provides flexibility to the states to allow new interventions within 10 percent of the total allocation for the States, which will be maintained in the NHM. The NHB programmes are entrepreneur-drive and the Board would continue to implement its programmes. The NHB will also provide a launching pad for the Mission, by way of pooling experts and housing the Technical Support Group. Technology Mission in North Eastern States (TMNE) programmes, which are focused for the development of the North Eastern and Himalayan States, will continue as a separate scheme. The Coconut Development Board (CDB), which has been created through an Act of

Parliament for overseeing the development of coconut in the country, would continue to independently implement coconut development programmes.

Under the National Horticulture Mission, training and demonstrations are integral part of human resource development efforts for farmers' field level workers, officers and entrepreneurs.

12.1.3 Programmes for the Farmers

Farmers are the backbone of rural economy of India. Considering the poor level of literacy and lack of latest information due to poor extension contact and mass media exposure among the vast majority of farmers as well as thinning technology dissemination systems in the country, it is proposed that greater emphasis should be laid upon training of farmers to empower them demanding and adopting the high yielding varieties of crops and to develop their skills in modern farming systems and techniques through demonstrations, field visits and exhibitions as well as to assist them in accessing quality inputs and assured credit. Major areas of training for farmers identified included:

- Production technology for different vegetables and fruits crops, spices, aromatic plants, etc.,
- Production technology for high plantation crop geometry,
- Training programmes on IPM and IPNM for different horticulture and plantation crops
- Training programmes on Micro Irrigation, use of liquid fertilizer, soil treatment etc.
- Training Programmes on marketing and packaging of horticulture produce, preservation of fruits and vegetables and export
- Training programme on good agricultural practices
- Training programme on Organic farming, production of seed material,
- Training programmes on bee keeping, entrepreneurship development, and post harvest management etc.

The above programmes are general illustrations, however in consultation with farmers groups and commodity producers associations the respective states should identify programmes for capacity building as per actual need of the farmers/clients. The activities will be carried out both by government as well as private sector and NGOs. Similarly, seven-day exposure tours must be organized for the farmers by the state departments under horticulture mission. The programmes are implemented in all the states for the fruits and vegetable crops grown in particular states.

12.1.3.1. Objective

- To provide the farmers necessary skills and knowledge of modern practices to increase the production and productivity of horticulture crops.
- Orient and train the farmers about high yielding fruit and vegetable crops

12.1.3.2 Eligibility—The horticulture farmers

12.1.3.3. Financial Outlay

Cost norms for the farmers training are kept @ Rs.1500/- per farmer. Besides training the farmers will be taken for field visit out side the state for training and orientation about the new varieties and crops and assistance of Rs.2500/- per participant is kept for a period of seven days including travel time.

12.1.3.4. Suggestions

- Besides capacity building of the farmers the activities related with formation of

commodity based groups and farmers organization should be encouraged to bring synergy.

- The voluntary sector organizations viz., Agri-Horti Societies in cities and Producers Associations of Horticulture Produce, eg. Mahagrape, Maha Mango etc., should be involved to utilize the faculty resources for training..
- A suggestion was given that vocational programmes for farmers may be developed through distance learning mode, and user friendly computer based learning system.
- Integrated training programmes for the farmers with focus on export of horticulture products, value addition and quality improvement.

12.1.4. Programmes For Gardeners

The Gardeners comes under grass root functionaries and up-gradation of their knowledge and skills is as important as of other stakeholders and functionaries. The gap between demand and supply of trained gardeners is found to be ever widening. States Departments of Horticulture are facing this constraint since its bifurcation from parent Agriculture Departments. It needs long term planning and sincere execution of HRD plans by the State Governments, whose large share of earning comes from this sector. The Horticulture division of ministry of Agriculture, Govt. of India introduced a central sector scheme on Human Resource Development in Horticulture during the year (1999-2000) of 9th five year plan (FYP) with total outlay of Rs. 5 crores. A six months long training programme was launched with financial outlay of Rs.45.48 lakhs The scheme was continued during 10th FYP.

12.1.4.1 Programme for Gardeners in XI plan

The training programmes will be of six-month duration. In order to attract candidates to join the programme and retain their interest, a monthly stipend will be provided in the form of boarding and lodging charges in the concerned institute. The programme will be residential. On successful completion of training programme the candidates will be awarded a ***CERTIFICATE*** in Horticulture. Each institute will train about 50 gardeners annually. The programme will be organized by Krishi Vigyan Kendras (KVKs) and State Agriculture University (SAU). The departmental staff will be trained under various ongoing programmes.

12.1.4.2. Objective

To develop basic gardening skills for horticulture crops.

12.1.4.3 Eligibility

The qualification of candidates for gardener training will be Class VIII (Middle) standard. Fresher seeking career in Gardening and persons involved in gardening to earn their livelihood will be considered.

12.1.4.4 Suggestions

- The members of the sub group expressed the view that that all the Krishi Vigyan Kendras are not fully equipped with faculty and infra structure support, hence only few selected KVK's in cluster zones of horticulture may be used besides other training institutes of government / NGO sector.
- The training organizer at KVK should not be below rank of professor to handle the issues strongly. The area of coverage under KVK should be raised.
- Similarly the training support system for horticulture sector in certain Directorate of Extension under SAU's is also weak hence need is felt to strengthen the faculty and infra structure support in SAU's.
- The qualification for attending training programme for gardeners may be raised to X standard instead of VIII standard.

12.1.4.5 Financial Outlay

The indicative cost for organizing training programme will be Rs. 13.50 lakhs, as per following break-up.

Table 12.1 Indicated cost for organizing training programme for gardeners

Sl. No.	Item	Cost (lakh Rs.)
1.	Stipend @ Rs.800.00 p.m. for six months for 50 trainees	2.400
2.	Course material	0.125
3.	One time grant to institute for infrastructure support	6.000
4.	Operational Support	5.000
	Total	**13.525**

12.1.5. Programmes For The Officers

Though the qualification for entry at officers level in the state department is graduation, however their knowledge and skills need to be upgraded and refreshed time to time. It has become essential in the light of changing business scenario after privatization, globalization and new challenges after WTO. For training these officials The National Training Institutes of the government of India, National Research Centers, Directorate of Research for specific Commodities, Advance training and research institutes of Indian Council of Agricultural Research (ICAR), State Agricultural Universities, State level training institutes may be actively involved.

12.1.5.1 Objectives

- To develop orientation skills for guidance to the farmers, development of trainers in the modern technological advances in the Horticulture at various ICAR institutes and other premier institutes of excellence such as Indian Institute of foreign trade, New Delhi, Administrative staff College of India, Hyderabad, National Institute of agricultural Extension management, Hyderabad , National institute of Agricultural Marketing, Jaipur, Indian Institute of Plantation management, Bangalore and Indian institutes of Management for training.

  The regional and middle level institutions viz. Extension Education Institutes (EEIs), State Agricultural Management and extension training institutes (SAMETIs) and other specialized institutes for specific crops will be identified by the state departments for training of middle level officers.

- To develop a pool of skilled officers and trainers at state level.

12.1.5.2 Eligibility

Trainers at the level of Project Officers, District Horticulture officers, Agriculture officers and Extension Workers educators professionals

12.1.5.3 Orientation and Training Areas

Members identified certain traditional training programme and suggested few new areas for training in Horticulture sector, however the state departments may identify any new area for training and organize training programme for officers.

- Boosting organic farming and training in process of producing Certified organic products.
- Training of Laboratory analysts.
- INM/IPM training
- Promotion of new Technologies After prolonged discussion on this subject the

members were of consensus that the programme may be continued during 11th plan period for training of supervisors at the institutions mentioned above.

- Use of Plastics in Horticulture
- Bio-technology-leaf, soil & water analysis
- Landscaping and gardening
- Production and processing of medicinal and aromatic crops
- Mass propagation of Horticulture crops
- Post harvest and value addition
- Hybrid seed production for vegetables
- Course on marketing intelligence for horticulture produce
- Course on Floriculture
- Courses related with marketing aspects
- Course on Project Management
- Courses on human resource Management
- Training on Group formation and their maintenance
- Production and processing Technologies - Fruit crops - Vegetable crops - Spice Cops - Medicinal and aromatic plant crop -Floriculture

12.1.5.4 Financial Outlay

The actual cost for this is limited to Rs.50000/- per participant, which includes travel cost and training material at the institute.

12.1.5.5 Suggestions

- Till now in most of the states the extension activities and training programmes in horticulture sector were taken care by the department of agriculture. Keeping in view the growth rate of horticulture sector at 6%, a need is felt to make special efforts for human resource development in horticulture sector.
- Besides capacity building in technical areas, equal importance is required to be given to management issues, marketing, post harvest, value addition and personal development at all the levels.
- Presently a few selected states have developed exclusive training infrastructure in their states for Horticulture sector. Need has been felt to develop a state level training institution for the horticulture with focus on developing technical and management skills. These institutes may also be given responsibility for applied research, special studies, consultancy and documentation in emerging fields like post harvest management, e-marketing, storage, horticulture processing and implications of WTO in horticulture sector.
- The members identified certain new areas for development of trainers viz., training on data collection at district / state level, documentation and productivity mapping through GIS etc.
- Need has been felt for training need assessment at field level for the personnel at middle and grass root level in view of change in business environment.
- Effort should be made to establish linkages of these institutes with all other national level crop related institutes, management institutes, state agricultural institutes for

exchange of information, faculty and thoughts.

- The support of national level institutes like MANAGE- Hyderabad, NIAM-Jaipur, VAMNICOM-Pune and newly developed Institute of HRD for Horticulture-New Delhi under the Ministry of Agriculture, Govt. of India should be taken to develop thematic and business modules for training of senior level officials in government and entrepreneurs in private sector.
- Efforts should be made to encourage manpower development in horticulture sector through motivation of students to join horticulture courses from metric level. New certificate / diploma programme should be initiated for vocational training in horticulture sector.
- The available capacity of private sector, NGOs (with a selected criteria) and growers associations should be used for training and capacity building efforts in horticulture sector.
- In order to speed up the working of system in horticulture sector the use of ICT should be encouraged.

12.1.6 Programme For Supervisors in The XI Plan

12.1.6.1 Background

The rise in growth rate of horticulture sector during the X Plan period has also increased the gap between demand and supply of trained manpower. The Horticulture Departments in states are facing this constraint since its bifurcation from parent Agriculture Departments. Though this bifurcation might have created administrative convenience at central and state level, but the lack of knowledge and skills to carry out different technical and management operations and activities are biggest threats to sustain the pace of development visible now and projected in coming years. The Horticulture division of ministry of Agriculture, Govt. of India introduced a central sector scheme on Human Resource Development in Horticulture during the year (1999-2000) of IX Plan with total outlay of Rs. 5 crores. The scheme was continued during X Plan.

12.1.6.2 Programme for Supervisors in XI plan

The training programmes will be of one-year duration. In order to attract candidates to join the programme and retain their interest, a monthly stipend will be provided in the form of boarding and lodging charges in the concerned institute. The programme will be residential. On successful completion of training programme the candidates will be awarded a DIPLOMA in Horticulture. Each institute will train at least 25 supervisors annually. The programme to be organized by State Agriculture University (SAU) / ICAR Institutes and state horticulture training institutes

12.1.6.3 Eligibility

The qualification of candidates for supervisory training will be Higher secondary. Persons working in State Department of Horticulture or Horticulture Enterprises and the freshers seeking career in Horticulture Industry, field operations Horticultural development are eligible.

12.1.6.4 Objective

To develop a pool of trained manpower to serve the firms engaged in horticulture development.

12.1.6.5 Suggestions

- Besides the proposal in National Horticulture Mission, the ongoing schemes of the government of India, NABARD and MANAGE - Agri clinic and Agri business (ACBC)

scheme for entrepreneur development may also be continued for horticulture sector.

12.1.6.6 Financial Outlay

The indicative cost for organizing training programme will be Rs. 18.00 lakhs, as per following break-up.

Table 12.2 Indicated cost for organizing training programme for supervisors

Sl. No.	Item	Cost (lakh Rs.)
1.	Stipend @ Rs.1000.00 p.m. for one year for 25 trainees	3.000
2.	Course material	0.125
3.	One time grant to institute for infrastructure support	10.000
4.	Operational Support	5.000
	Total	**18.125**

12.1.7. Focus Of The Programme For Entrepreneurs

12.1.7.1 Background

The rise in growth rate of horticulture sector has come up due to participation of private sector, participation of corporate business group in retail business and interest of multinationals in horti-business operations. Horticulture is blossoming into a full fledged industry comprising production, input supply system, post harvest and processing system and output marketing system as integrated in one system known as Agri-business / horti-business. The needs of farmers are unending due to their dependency on season, good monsoon, information, finances, inputs, technology and market etc. and the public sector is unable to provide manpower and services to the farming community in rural, tribal and other difficult areas. The gap between demand and supply of technically qualified manpower is widening. To fill this gap the Horticulture division of ministry of Agriculture, Govt. of India introduced a central sector scheme on Human Resource Development in Horticulture during the year (1999-2000) of IX Plan with total outlay of Rs. 5 crores. The scheme was continued during X Plan to develop specialized entrepreneurs in Horticulture..

12.1.7.2 Programme for Entrepreneurs in XI Plan

The training programmes will be of three months duration. In order to attract candidates to join the programme and retain their interest, a monthly stipend will be provided in the form of boarding and lodging charges in the concerned institute. The programme will be residential. On successful completion of training programme the candidates will be awarded a ***CERTIFICATE*** in Horticulture. Each institute will train at least 20 entrepreneurs annually. The prgramme will be organized by State Agricultural University (SAU) / ICAR Institutes and state horticulture training institutes

12.1.7.3 Objective

To provide a pool of technically competent and qualified manpower to serve the horticulture sector as entrepreneurs**.**

12.1.7.4 Eligibility

The qualification of candidates for entrepreneurs training will be higher secondary. Fresher seeking career in Horticulture sector as entrepreneurs will be eligible.

12.1.7.5 Suggestions

- Besides the on-going programmes on entrepreneurship development, the other ongoing scheme of Govt of India, NABARD and MANAGE- Agri clinic and Agri business (ACBC) may also be considered for entrepreneurs development in Horticulture.

12.1.7.6 Financial Outlay

The indicative cost for organizing training programme will be around Rs. 16.00 lakhs, as per following break-up.

Table 12.3 Indicated cost for organizing training programme for entrepreneurs

Sl. No.	Item	Cost (lakh Rs.)
1.	Stipend @ Rs.1000.00 p.m. for three months for 20 trainees	0.600
2.	Course material	0.125
3.	One time grant to institute for infrastructure support	10.000
4.	Operational Support	5.000
	Total	**15.725**

12.2. HORTICULTURE INFORMATION SYSTEM AND DATABASE

Setting-up of a “Horticulture Information System” (HIS) through a network using Information and Communication technology from District level linked to state Horticulture department and at national level with Ministry of Agriculture as focal agency to coordinate, organize, analyze and consolidate the data.

It is proposed to have horticulture information service centre at district level to collect data and linked it with State and Central organizations to collate the data. The data collection work can be got done through assignment of contract and the staff/ personnel assigned the contract should be well trained. An uniform methodology should be evolved by various agencies in all the states regarding process for collection of data, use of same format, so that the data will be collected in uniformity for its completeness, updating reliability and validity at all levels. For this purpose special training be given to officials on data collection at district / state level.

It is proposed to establish a **“National Institute of Horticultural Management and Data base”** devoted for over all development of Horticulture Sector be established to act as think tank. The proposed institute will provide necessary support to state level Horticulture Missions in implementing the schemes and State Horticulture training institutes.

Besides providing academic inputs and training at apex level, the proposed institution will undertake research and consultancy assignment on policy issues specially related to WTO and international business, data collection and its analysis, project development and implementation, applied research, field studies and documentation about the horticulture production, productivity – mapping, quality management, marketing, international business and post harvest management.

The institute on one hand will act as think tank for overall development of horticulture, at the same time it will support in implementation of programmes under horticulture mission, and act as nodal institute for State Horticulture Training and Development Institutes. The institute may be assigned mandate for maintaining central database, documentation, training need assessment, preparation of training modules, repository of skills in areas like post harvest management, entrepreneur development and agro processing. The institute will have statutory linkages with national level institutes, State Agricultural Universities (SAU) ,ICAR institutes and International institutes.

The training infrastructure for Horticulture available in states should be further strengthened and cover training in both technical and management aspect of various operations, data base, high-tech horticulture, post harvest management and value addition. These institutes will act as think tank for State Horticulture Mission.

The state level training institutes should be upgraded to widen the horizon and undertake other activities like research, consultancy, project preparation and documentation etc. besides training. To bring professional touch, services of academicians, consultants and

experts may be taken, besides departmental officials.

Gap between demand and supply of trained manpower has been a major constrain in blossoming of this sector with full potential. Majority of states focussing on horticulture production has developed training institutes at state level as well as at regional level for capacity building of farmers and officials at middle and grass root level. The faculty members of the institutions are normally drawn from serving officials of the department and majority of training programmes are technical in nature. In the light of overall development of horticulture sector, the officers may also be trained in areas such as management viz. marketing, export and foreign trade, quality management, human resource management, data collection, Information & Communication Technology etc."

The faculty of the institute should be developed under separate cadre. Besides the regular faculty, provision should be made for exchange of faculty with national and international institutions, inviting visiting

A plan for professional development of the departmental Officials serving as trainers in state level institutes should be prepared by the state department and they should be governed under a separate cadre as academicians, so that this resource can be utilized optimally for the development of horticulture sector. Provision should be made for the appointment on deputation, as well as exchange of academicians/experts as faculty from other institutions. Besides the regular faculty, provision should be made for engagement of consultant for short term projects and other assignments or as visiting faculty.

The state level training and development institutions may also be given the responsibility for database, training need assessment, preparation of training modules, repository of skills in areas like post harvest management, entrepreneur development and agro processing, subject related to WTO and management etc. The institutes should be allowed and encouraged to have statutory linkages with national level institutes, agricultural universities and ICAR institutes for exchange of knowledge and resource persons.

To attract technically qualified manpower, motivation of students to join horticulture courses after matric level and new vocational courses awarding certificate/diploma in the field of Horticulture need to be introduced by the Universities.

The gap in demand and supply for technically qualified manpower at graduation and above level continues even after introduction of Horticulture as discipline at graduation level in 14 SAUs and at post graduation level in 32 SAUs producing 470 graduates and 540 post-graduates respectively every year. After careful survey of demand and supply the number of seats for horticulture sector at graduate and post graduate level may be increased. The Horticulture mission document for XI plan has already included training programmes to meet the demand at grass root level through entrepreneurs and supervisory training, leading to certificate and diploma in the field of horticulture. To meet the demand of qualified manpower for other business operations in horticulture, around 25 State Agricultural Universities are running post harvest management programme with facility of pilot plants for effective research and application. Two IIMs, Ahemdabad & Lucknow, at least three national level institutes viz. MANAGE- Hyderabad, VAMNICOM-Pune and IIPM, Bangalore, besides few private management institutions and a large number of state agricultural universities run management programmes in Agri-bussiness management to fill the gap of qualified manpower.

In view of changing business scenario the adequate focus on strengthening farmers should be given by formation of 'commodity based groups'/ 'Farmers organizations'.

The ongoing scheme of Extension Division, Ministry of Agriculture, Government of India, is under implementation in 252 districts of the country using a model known as 'ATMA" for decentralized planning incorporating activities of various line/related departments as per the needs of farmers at district level. (preparing and implementing a district plan called "Strategic Research & Extension Plan") .The scheme encourage formation of 'commodity based

groups' of farmers for implementing various activities. The states may use this platform for implementing activities of Horticulture mission at district level.

12.2.1. Institutional Programmes

Besides above proposals two institutes viz. Agricultural and Processed Food Products Development Authority (APEDA) and SPICES BOARD has specifically proposed activities for Capacity building .

12.2.1.1 Agricultural and Processed Food Products Development Authority (APEDA)

- Training programmes on Organic Certification for state 'Seed certification agencies'.
- Training for Laboratory Analysts
- Integrated training to farmers with focus on Export of Horticultural produce.
- Residue control Workshops for milk and milk products industry to control residue of pesticides and drugs.
- Development of Organic Certification Bodies for states

12.2.1.1 Spices Board

The training programmes proposed by Spices Board are

- Training of officials of Marketing department to meet the challenges of fast changing global marketing scenario.
- Training on officials on Post Harvest quality improvement
- Training of officials abroad for improving production, processing and marketing.
- Training/ Awareness programmes for farmers/growers.

Besides above, the Spice Board proposed for modernization of offices at Cochin, Mumbai, Bodinayakanur and Sakalespur, to provide modern IT equipments, conferencing facilities and E-sagu (electronically assisted extension system). For construction of three new labs and other construction activities the board has submitted proposal for Rs. 970.00 lakhs and Rs.620.00 lakhs for HRD activities with a total of Rs. 11590.00 lakhs for the period 2007-12.

12.3 RECOMMENDATIONS

Following major recommendations for inclusion in plan proposal are drawn from the views expressed by the members during discussion and consensus given on various issues by the distinguished members on the subcomponent of "Human Resource Development" and "Data base". In addition proposals related with human resource development and database in horticulture sector are also included in draft report.

- The training programmes for Farmers, Gardeners, Supervisors and Entrepreneurs proposed under 'Human resource development' by National Horticulture Mission for X Plan may be continued during XI Plan for capacity building of all stake holders.
- In view of upward growth of horticulture sector during X Plan period, besides training of various stakeholders in technical areas and subject matter, equal emphasis on capacity building will be given in management aspect of various operations, data base, high-tech horticulture, post harvest management and value addition.
- It is proposed to establish a "National Institute of Horticultural Management and Data base" devoted for over all development of Horticulture Sector be established to act as think tank. The proposed institute will provide necessary support to state level Horticulture Missions in implementing the schemes and State Horticulture training

institutes.

- The training infrastructure for Horticulture available in states should further be strengthened and emphasize upon training in management aspect of various operations, data base, high-tech horticulture, post harvest management and value addition. These institutes will act as think-tank for State Horticulture Mission.
- The state level training institutes should be upgraded to widen the horizon and undertake other activities like research, consultancy, project preparation and documentation etc. besides training. To bring professional touch, services of academicians, consultants and experts may be taken, besides departmental officials.
- Due to lack of infrastructure and qualified trainers at grass root level the training and other capacity building efforts are found to be inadequate. Hence the private sector (Infrastructure & Consultants), N.G.O.s and Commodity based farmers' organizations, Agri-horti Societies should be involved for training and capacity building, besides the public sector institutions, K.V.K.s etc.
- In view of changing business scenario the adequate focus on formation of 'commodity based groups' and'' Farmers organizations'.
- To attract technically qualified manpower, motivation of students to join horticulture courses after matric level and new vocational courses awarding certificate/diploma in the field of Horticulture need to be introduced by the Universities.
- Similarly for encouraging entrepreneurship development in Horticulture, the benefits/incentives of ongoing schemes of Horticulture Mission should be popularized and the ongoing scheme of Govt of India, NABARD and MANAGE- Agri clinic and Agri business (ACBC) may also be considered for entrepreneurs hip development in Horticulture.

CHAPTER XIII
HORTICULTURAL DATABASE

13.1 INTRODUCTION

Horticulture is an important segment of agriculture sector, which, in turn, is one of the major components of national economy along with manufacturing, and services sectors. Therefore, the quality of relevant data inputs is extremely important in the context of realistic and effective policy planning process. It is rather ironical that despite unambiguous importance of horticulture data recognized and articulated repeatedly in different fora, there has been no systematic policy or conscious effort to address the underlying issues to improve either its reliability or quality. It is, thus, extremely important to seriously consider various issues and problems confronting horticulture data sector through appropriate policy intervention and support during the XI Plan so as to establish reliable horticulture database without further delay.

The major constraint the available data suffers is the methodological and operational problems. Multiple agencies are involved in producing horticulture data that often varies. Even the data from the same agencies differs too.

Absence of proper validation mechanism is a serious constraint to restrict the possibility of checking inter-temporal or inter-agency inconsistencies, which obviously aggravates the problem. Consequently, it becomes very difficult to make correct assessment of horticulture growth, its commodities and products demand or effectively monitoring and evaluating the progress of implementation or achievements of policy objectives. Lack of authentic data restricts scope to identify real opportunities for undertaking much needed crop diversification programmes, besides exacerbating problems in making optimum allocation and use of resources to accomplish systematic progress and development of horticulture sector.

It is not just the basic data like area, production or productivity but the whole gamut of related data like storage, market arrivals, prices, exports and so on that is required to be collected and compiled to develop integrated data base which has become extremely important in the present era of globalization and integration of markets. It is difficult to ignore the consequences of shortages or hike in prices that can precipitate serious crisis both on economic and political front. Availability of proper data can, indeed, help in issuing advance warning about impending crisis to facilitate taking advance action. Authentic data is also required to conduct comprehensive analytical studies to understand and assess the potential demand in foreign markets, commodity preferences, quality parameters, domestic production capacity vis-à-vis the internal demand, incentives to promote horticulture exports etc.

It will be necessary to assign high priority to reverse the process of neglect that has undermined the development of horticulture database so far. In addition to envisaging critical policy support for data development activities at par with other development activities, adequate administrative, technical and financial support, will be most crucial and inevitable to drive the process of data development. Unless this is consciously enforced, it will be difficult to expect improvements in the quality and reliability of horticulture data. That would mean the present smoke-screen will not only continue to blur the view of actual horticulture scenario, but it might cause misdirection of resources to hamper realization of full potential or opportunities available in the horticulture sector. Failure to act sooner can prove disastrous, especially because there are competing priorities and the resources have to be allocated accordingly for development of other sectors of the economy.

13.2 PRESENT STATUS OF HORTICULTURAL DATA

National Horticulture Board (NHB) is the main source of data on fruits, vegetables potato, spices, flowers and plantation crops as collected from State Horticulture departments. It compiles, checks, does necessary revision and publishes this data on area, production, productivity, prices etc. Similar data is also collected under a scheme called Crop Estimation Survey for Fruits and Vegetables, which is in operation in some States and financed by the Ministry of Agriculture, for selected crops. Directorate of Economics and Statistics (DES) in the Ministry of Agriculture also collect such data for some crops. Further, some data such as area covered under different crops (operational holdings) is also available through Agriculture Census at 5-year interval.

The data is collected from the State Horticulture departments, which follow some method based on previous data, expert observations and ground assessment to arrive at the basic data. The NHB data is relatively more comprehensive and updated as compared to available from other sources, in addition to being consistent for almost all the states over the years. As such, this data is, generally, used so far for various purposes including GDP estimates. Inspite of that, it has problems and need to be reviewed to make necessary corrections for establishing proper authenticity.

Data is also collected under Crop Estimation Survey of Fruits & Vegetables (CES-F&V)-a component of Improvement of Agricultural Statistics Scheme. However, this scheme is implemented only in 11 States and the number of fruit and vegetable crops covered within the purview of this scheme are also limited. Thus, the coverage is incomplete both in terms of states as also the crops. Also, the data is generally outdated which poses problems in consolidating compilation and proper use. With regard to methodology prescribed under CES-F&V, it is a based on multi stage stratified sampling techniques designed to produce objective data. However, the procedure is rather cumbersome in actual operation and is likely to have fair chances of non-sampling as well as sampling errors.

The National Statistical Commission (NSC) also recommended that the methodology adopted under CES-F&V should be reviewed and alternative methodology for estimating production of horticulture crops should be developed taking into account information flowing from other sources. In other words, notwithstanding the objectivity of the procedure laid down in case of CES-F&V, there are serious problems in this case too, and it does not serve the purpose in its present form.

Directorate of Economics and Statistics (DES) releases estimates of area, production and yield in respect of principal crops and selected important horticulture crops. For area estimation, a prescribed method based on categorization of States is used which includes use of land records maintained by revenue agencies and the area statistics built up on the basis of sample surveys as envisaged under the scheme called Establishment of an Agency for Reporting of Agricultural Statistics (EARAS). The yield rate is another important component to arrive at production estimates. The yield estimates are obtained through analysis of Crop Cutting Experiments (CCE) conducted under scientifically designed General Crop Estimation Surveys (GCES).

In addition, a lot of other ancillary data such as prices, market arrivals, cold storage stocks of horticulture commodities etc. are collected by different agencies. But there again, the problem of variations exists which is often unexplained and continues to haunt the horticulture planners to take a considered and wholesome view of the actual situation.

It is noticed that the cropping pattern is generally skewed with crops grown in a cluster of districts rather than spread over the entire State(s). Availability of district level data is, therefore, very important in the context of crop diversification planning. Similarly, no base-line data is available though it is the basic requirement for assessing the growth pattern, for monitoring the progress of implementation and evaluating the impact of schemes such as NHM.

Notwithstanding multiple agencies engaged in collection of horticulture data, incurring huge cost and time, the horticulture data is still inadequate and incomplete and it is also difficult to assess the extent of incompleteness due to absence of any sound methodology to estimate production in respect of non-response cases or assess the contribution through other significant components of horticulture production such as production in the kitchen gardens, on common (property resource) land, Roadside plantations and in nurseries, the data not being captured systematically. Consequently, ad-hoc methods are being used to arrive at area and production estimates.

Variations, revisions and time lag in the data are serious constraints, which not only pose problems in ascertaining the actual position but also affect the credibility of horticulture data causing suspicion and distrust among users. It has, therefore, become very relevant in the modern context, to provide reliable data, timely in users, friendly form. The data does not appear to be adequate to present true picture of the Horticulture sector. The problem is compounded due to absence of any effective validation mechanism or method that could establish reliability factor of individual data sets. Consequently, ad-hoc methods may have been adopted to check consistency of data.

Apart from impinging data reliability factor, the inadequacy of data is likely to create problem in attempting evaluation of the integrated performance of the horticulture sector which has become relevant due to inherent linkages between activities relating to production and the availability of produce in the market for consumption.

13.3 RELIABILITY OF DATA

Reliability of data is one of the most crucial requirements. The problem is fairly acute owing to significant variations observed in the data provided by different agencies. Even temporal inconsistencies exist in the data obtained from the same source due to periodic revision of data, which though may not be completely unavoidable on account of well-known factors but the problem actually arises in the event of abnormal fluctuations. In the absence of appropriate validation mechanism, it is often difficult to validate reconcile variation or the inconsistencies in data or determine its reliability as is the case in respect of similar data produced by other agencies. This could be due to the fact that information on crops grown in kitchen gardens, on common (property resource) land, roadside etc. is incomplete, outdated and ad-hoc methods used for data estimation.

Variations in data are not only prominent in respect of area, production and productivity but also in the data on prices, market arrivals and the cold storage stocks of horticulture commodities. It appears that neither the coverage is uniform nor the data is adequate to present complete picture of the Horticulture sector.

There are several other problems like data of area under mixed crops or estimating production in such cases. It is not clear how the data is collected and whether there is any uniform methodology being followed by different States. The National Statistical Commission also expressed concern about the deficiencies in the horticulture data and recommended development of suitable methodology to estimate the production.

In other words, the existing horticulture database is not only inadequate but there is also a problem of scarcity of data often constrained by delays in availability. Not only does it lead to a serious problem in its effective use but adversely affect the reliability of data often causing confusion, distrust and doubt about its quality.

13.4 CONSTRAINTS FOR DATA COLLECTION AND COMPILATION

The constraints for data collection and compilation encountered in the horticulture sector are neither typical nor peculiar because it transcends to the entire data sector of the country. The characteristic of this neglect is:

- Poor data establishment and data culture in the country, which is also the primary importance of data is realized nor prestige of the staff maintained who are responsible reason to cause several constraints.
- Neither the for data collection and compilation.
- Lowest priorities within and the government departments, and often poor support from fellow government departments or outside agencies not only demoralize them and reduce their scope to function effectively but it also leads to loss in technical ability and kills the initiative to innovate.
- Data collection also suffers because the vacancy rates are usually higher in statistical offices which in a number of cases are just small units within the main government departments. For example, there is no proper data set-up in the Horticulture departments, in most of the cases, to support dedicated data collection and compilation activities.
- Lack of means including basic resource difficulties; impinge on the efficiency of compilation, scrutiny, analysis or dissemination of data. Obviously, it affects both timeliness and the reliability.
- Problems at administrative, financial, technical and infrastructural and restrict development of proper horticulture data system. I)

    i) The administrative constraints include lack of suitable authority in the absence of mandatory provision, to collect data that requires willingness and meaningful participation and coordination of others, systematic erosion of role, relevance and prestige of data collection personnel leading to their de-moralization and de-motivation.

    ii) Financial constraints include absence of dedicated or exclusive funding, in most cases, for activities related to data development and management unlike specific allocations made for different activities or components such as rejuvenation, post harvest management, protected cultivation etc. under NHM. This means the present financial support or funding mechanism for development of horticulture data base is merely a kind of secondary support, at best, which is bound to cause the data development activities to suffer the most in situations involving scarcity of funds or whenever the economy measures have to be enforced.

    iii) Technical constraints also include lack of well-established methodology, improper or ineffective application of methods and procedures, inadequate training and HRD development and dwindling willingness to innovate.

    iv) Infrastructural constraints include higher vacancies, resource difficulties involving constraints on acquisition of necessary equipment required for modernization of office.

13.5 REMEDIAL MEASURES

Undoubtedly, the quality and reliability of data and its timely availability is most important. It is also important that the data system should be more responsive, effective and flexible to deliver desired information, timely and in desired format, especially in the emerging development scenario. Therefore, important measures are:

- Necessary capacity and capabilities for data system for which necessary policy intervention will be most crucial including providing sufficient financial support for acquisition of necessary equipment and creating basic infrastructure.
- Review the present policy and approach to ensure that the above objectives are fulfilled. In recognition of the crucial role of data in planning as well as in monitoring of the schemes to justify investments in the horticulture, data gathering mechanism

has to be strengthened and empowered by way of vesting suitable administrative authority to enable proper data collection and getting active cooperation of all concerned so as to motivate the data personnel in the system.

- Suitable directives may have to be issued to consider all concerned with the horticulture development as data partners having equal responsibility to cooperate and provide basic data.
- Adequate financial support is critical to allow effective functioning and accomplishing the task. It is important to earmark exclusive funding in order to prevent the possibility of diversion of funds for other purposes. Absence of such a measure can cause cuts in the event of economy measures, which can adversely affect coverage.
- On the technical front, lack of well-established methodology, improper or ineffective application of methods and procedures, inadequate training and HRD development, is the major areas of concern, which have to be addressed systematically.
- Acquisition of necessary equipment required for modernization of office, making necessary policy in place and other support required to address the important issues.
- The most immediate priority is to reverse the process of neglect and degeneration of the data sector that has happened so far. It has to be done sooner than later, to realize the objectives of producing reliable, credible and timely data that has assumed a greater significance and become more relevant today than ever before
- It is essential to find ways to recover the shape and shine of the data establishment in the era of modern information age in order to enable the data system to deliver what is required in the context of handling the complexities of modern planning in the emerging dynamic development scenario of which horticulture is not only an integral part but also it imbibes great promise to emerge as a very important sector of the economy.

It is, indeed, a paradox that notwithstanding the crucial role, relevance and importance of data in the modern information age, the data sector should suffer in a country like India, which is known to have advanced statistical system and is a leader in the Information Technology.

13.6 PROPOSALS FOR XI PLAN

Horticulture is a fast emerging sector imbibing a huge development potential. Its growth will have a decisive impact on stimulating agriculture sector that is crucial for our country. It is, therefore, important to understand, inter-alia, the current status of horticulture in the country to be able to undertake forward planning for full exploitation of its potential.

Data is the soul of any planning and is a most fundamental tool for making realistic assessment of the policy objectives and ascertaining how far the investment is justified. It is the backbone for providing correct understanding about the situation for taking necessary remedial steps. While correct data is crucial and required to set right policy direction, wrong data can result in policy drift causing misplacement of priorities. It should be understood that a little conscious investment in horticulture data development can protect the huge investment being made in other horticulture development activities, especially in the backdrop of several other competing priorities for resources to be invested in the economy for development purposes. Accordingly, it is extremely important to address and tackle the issue of systematic development of comprehensive horticulture database during XI Plan. Appropriate policy thrust along with adequate administrative, financial and technical support should be considered vigorously being critical to pursue the expected inevitable task.

By virtue of its pivotal role and importance, there should be an explicit policy direction to treat horticulture data development as a primary development activity at par with other development activities being pursued or envisaged under various horticulture development

programmes and schemes. As a matter of policy, horticulture data development must be envisaged as a distinct yet integral activity within the ambit of horticulture development domain so as to ensure that horticulture data system is not neglected any more and a comprehensive horticulture data system can be developed with certain priority in concurrence with other development activities. It will be important to periodically monitor the status of progress of development of horticulture data system as in the case of other development activities, so adequate steps could be taken well in time to develop a more robust horticulture data system that will have necessary capacity to deliver requisite reliable data timely. It is recommended that Horticulture Data Development activity should be made mandatory and incorporated in all development schemes as a pre-condition for approval of the particular scheme.

So there has to be a greater involvement of data sector professionals in the Core group activities related to horticulture development planning so that the data needs could be properly defined and incorporated in the horticulture data base.

Since there are no proper or systematic horticulture data establishments in the country- either at district, State or Central levels, having necessary wherewithal to conduct their business effectively- be it data collection, compilation, analysis, dissemination or coordination with other agencies, the over-dependence on States- the primary source of various horticulture data, in the event of lack of any data validation mechanism in existence has only compounded the problem of reliable data collection. In other words, the efforts to generate horticulture data so far could be described as ad-hoc rather than systematic. The setting up of extensive network of proper horticulture data establishments called **Horticulture Information Systems (HIS)** Units in all the districts and at State level, preferably under the purview of State Horticulture Departments therefore gains importance. In addition, there should be an apex Unit at the Center in the Ministry of Agriculture to coordinate, organize, consolidate, analyze data obtained from the States and disseminate the same that could be treated as official data for the benefit of various users and for reference purposes. The proposed network of horticulture data establishments should have collective role and responsibility to plan, collect, compile and coordinate horticulture data required for various policy planning purposes on area, production, productivity, import, export of different horticultural commodities. Besides, it should also incorporate other ancillary data such as commodity prices, storage capacities, stocks, market arrivals, employment generation-direct and indirect, cost of cultivation and economy of farming, marketing facilities, institutional support including training or technical support available for the farmers etc., to develop more robust horticulture data system.

HIS will need adequate institutional support including setting up modern offices amenable for making extensive use of IT, especially as a wide variety of horticulture data will have to be collected and integrated- both horizontally and vertically, at various levels. It has to be recognized that there are a lot of areas and bottlenecks in the current scenario dominated by manual data feeding which is a matter of immediate concern being responsible for causing delays in compilation, consolidation and transmission of data in the hierarchy. This type of situation, especially, in case of data management is hardly acceptable in the present dynamic circumstances. Therefore, it is important and indeed a matter of priority to embark on a modern data system involving on-line data flow and incorporating effective checks and balances to ensure consistent and timely availability of data. This system will not only allow uninterrupted and instantaneous on-line electronic data updating, consolidation, integration and transfer but it will also save a lot of recurring cost on postage, printing, photocopying, communication, fax etc. Obviously, necessary equipment will have to be provided in addition to establishing proper networking and designing and developing customized software. Moreover, the existing staff capacity will have to be strengthened by considering adequate training for up gradation of data collection and management skills of existing staff in addition to deploying additional trained staff through contract placements.

The effectiveness of this electronic system is, of course, dependent on the timely availability of basic reliable data. It is, therefore, important to ensure that HISs should get distinct identity and authority to discharge their expected functions effectively.

13.6.1 Mandate

To identify and designate Nodal agencies in all the States to coordinate data collection, compilation and scrutiny, at district level data, for further consolidation to derive State level data. Considering the role and importance of horticulture departments, revenue departments and DES in the States, it may be desirable to establish Data Consortium comprising of experts from these and other research agencies to develop concurrence on the data to produce more authentic data. The Nodal agency may coordinate with the Data Consortium to ensure that the inter-agency and inter-temporal data inconsistency can be avoided. Proper data validation mechanism should be developed in each State to ensure desired data consistency before the data is forwarded, in the prescribed format, by the nodal officer to the central agency as per the prescribed calendar of dates.

It may be necessary, therefore, to develop suitable data layers through rational data planning and management to meet various data requirements. The existing data collection system need to be studied particularly in such States which account for a major chunk of production and contributing important crops, with a view to refining existing methodology or developing alternative methodology to generate reliable horticulture data. The methodology must address issue of capturing data on uncovered components of production and estimate production in respect of non-response cases in order to generate more comprehensive and representative data. Adoption of uniform methodology is considered an important step towards achieving conceptual homogeneity for producing comparable data across the country.

For this district level productivity maps/profile should be prepared to identify potential areas for plantation of horticulture crops. Similarly, periodic studies should be conducted to assess supply-demand position to facilitate forward production planning. Notwithstanding above, it is imperative to initially conduct **Horticulture Census** with the objective of generating reliable **base-line** horticulture data, particularly at district level, that is currently non-existent. There is also an urgent need to collect authentic district level data classified by different components. It will be necessary to involve farmers/panchayat members, on contract basis, for obtaining their cooperation in data collection process which is considered crucial by virtue of their local knowledge and intelligence that has sustained them for ages are important to evaluate the impact of various programmes.

13.6.2 Objectives

- To fill up serious data gaps in horticulture data that continues to haunt the policy planners in making correct assessment about the current status of horticulture and its growth in the country.
- To generate reliable horticulture data to attempt effective forward production planning and determining prospective investment policies to exploit huge horticulture potential, besides regulating marketing, transportation and distribution of horticulture commodities and products in the emerging dynamic scenario.
- For developing more robust and responsive data system to meet the emerging data needs periodic workshops and conferences would be conducted to accomplish the task.
- To study international data collection methodologies and practices, especially in some developed countries and/or equally placed countries in the context of planning, development and management of our horticulture data system, which will help in building greater compatibility and comparability with the international data.

13.6.3 Budget

While adequate administrative support may be obtained under the Collection of Statistics Act 1953 envisaging suitable amendments, it will be necessary to simultaneously consider dedicated funding exclusively for the purpose of data development activities. It will be important to earmark, say a minimum of 5% of the total budget or funds, to prevent neglect or dilution that has been witnessed so far, especially whenever any economy measures have to be enforced. Availability of committed administrative and financial support will be crucial for time-bound development of much needed effective horticulture data in the country to facilitate monitoring of the progress of achievement of objectives and justification of huge investment being made in the horticulture sector in the country. For sponsoring comprehensive study on the data collection system by the expert agencies, adequate funds have to be earmarked.

The tentative estimated financial requirements for setting up a network of HISs at districts, States and Center is **Rs 300 crores** during XI Plan.

For horticulture census = Rs. 250 crore

For studying methodology by expert agencies = Rs. 30 crores

CHAPTER XIV

RISK MANAGEMENT, CREDIT AND PUBLIC PRIVATE INVESTMENT

14.1 RISK MANAGEMENT

In agriculture controllable risks like pests, diseases, weeds, and seed material can be managed with the use of technology, effective monitoring and appropriate usage of inputs. However, the challenge lies in providing risk management solutions for uncontrollable risks like rainfall — it's deficit, excess and distribution, extreme temperature conditions, hail incidences, extreme wind speeds, humidity variations etc. In order to minimize the loss several solutions have been inculcated in the financial system.

14.1.1 Crop Insurance

The National Agricultural Insurance Scheme (NAIS) was introduced in the country from the 1999-2000 Rabi season, replacing the Comprehensive Crop Insurance Scheme (CCIS) which was in operation in the country since 1985. The scheme is being implemented by the General Insurance Corporation (GIC) on behalf of the Ministry of Agriculture.

The salient features of the scheme are as follows-

- To protect the farmers against losses suffered by them due to crop failure on account of natural calamities, such as, drought, flood, hailstorm, cyclone, fire, pest/ diseases etc. so as to restore their credit worthiness for the ensuing season.
- The new scheme is available to all farmers regardless of their land holding or indebtedness.
- It envisages coverage of all food crops (Cereals, Millets and Pulses), Oilseeds and annual horticultural/commercial crops, in respect of which past yield data is available for adequate number of years. Among ST the annual commercial/horticultural crops, eleven crops, namely, Sugarcane, Potato, Cotton, Ginger, Onion, Turmeric, Chilies, Jute, Tapioca, annual Banana and Pineapple are presently covered. All other annual horticultural and commercial crops will be covered in the third year subject to the condition of availability of past yield data.
- The new scheme operates on the basis of an area approach i.e. defined areas for each notified crop for widespread calamities and on an individual basis for localized calamities, such as, hailstorm, landslide, cyclone and flood.
- The premium rates are 3.5 per cent (of sum insured or actuarial rates which ever is less) for Bajra & oilseeds, 2.5 per cent for other Kharif crops; 1.5 per cent for Wheat, and 2 per cent for other Rabi crops. In the case of annual commercial/horticultural crops, actuarial rates are being charged. A 50 per cent subsidy in the premium is given to small and marginal farmers.

At present the scheme is being implemented by 21 States/UTs. These States/ UTs are Andhra Pradesh, Assam, Bihar, Chhattisgarh, Goa, Gujarat, Himachal Pradesh, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Meghalaya, Orissa, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal, Andaman & Nicobar Islands and Pondicherry.

In order to strengthen confidence in the existing seed breeders/growers and to provide financial security to seed breeders/growers in the event of failure of seed crops, the Government of India has introduced a Pilot Seed Crop Insurance Scheme from the Rabi 1999- 2000 season. The States of Andhra Pradesh, Gujarat, Haryana, Karnataka, Madhya

Pradesh, Maharashtra, Orissa, Punjab, Rajasthan and Uttar Pradesh are covered under the Scheme.

14.1.2 Weather insurance

The weather-index based insurance covers the likelihood for diminished agricultural output/yield resulting from a shortfall of any of the pre-defined weather parameter for a specific geographical location and time period, subject to a maximum of the Sum Insured. It seeks to address the issues in the traditional crop insurance schemes. It is made available against the uncontrollable factors, essentially to mitigate the weather risks. The Metrological Department keeps detailed, daily records of the weather parameters such as rainfall, temperature, humidity and other weather conditions. The co-relation between the deviations in weather conditions and the effects of the same on crop yield can be effortlessly ascertained by statistical methods.

Further as the payout is determined on weather conditions for a defined period of time, and not on the actual loss on the field, there are no gray areas on whether a payout has to be made by the insurance company and how much need to be paid. Thus, there is no incidence of adverse selection or moral hazard. It entails low administrative expenses and pays out claims in a few weeks time after the period of insurance.

Weather insurance is a well-known tool for agriculture insurance in other developed economies and has been used successfully by various developmental organizations in various developing economies as well. With the launch of this product, farmers in India can protect themselves against extreme changes in weather patterns.

The success of the weather-based insurance in India would require substantial investment of resources to analyze the data and develop models across the various products and regions for the various weather parameters. Further, there is a need for awareness and education about the product across the range of stakeholders. The weather-based insurance has the potential for providing a sustainable solution for Indian agricultural industry.

14.1.3 Insurance of Perennial Horticulture Crops

Improving production and productivity of fruits and plantation crops is a priority area and the cultivated area under these crops is steadily increasing. These perennial horticultural crops are presently not covered by NAIS and there is a demand for inclusion of these crops under the scheme.

The possible insurance interventions in case of crops are-

- Loss assessment based on Individual farm/ orchard insurance, covering non-preventable risks and natural calamities
- Area Yield insurance based on ‘homogenous area’ approach, similar to NAIS scheme
- Weather based insurance on area approach basis

14.1.4 Commodity Exchanges

Farmers are exposed to the risk of price fluctuation in commodity prices. In order to safeguard the interest of the farmers commodity exchanges were established. National Commodity & Derivatives Exchange Limited (NCDEX) and Multi Commodity Exchange Ltd. They are two of the major players in the market. NCDEX is a professionally managed online multi commodity exchange dealing in Cashew, Castor, seed Chana, Chilli, Coffee, Cotton Seed, Oilcake, Crude Palm Oil, Groundnut (in shell), Guar gum, Guar Seeds, Gur, Rice , Cotton, Soybean Meal, Yellow Red Maize, Yellow Peas, Wheat, Urad (Black Matpe), Turmeric, Tur and other agricultural products.

MCX is an independent and de-mutulised multi commodity exchange. The broad category of

products traded in this exchange are Bullion, Oil and Oil seeds spices, metal , fibre, pulses, cereal, energy plantation and other products.

These markets have been experiencing a strong growth, through the introduction of nationwide electronic trading and market access, as was done in the equity market during 1994-1996. Through this, turnover has rose sharply from a level of Rs.0.67 lakh crore in 2002-03 to a level of Rs.13.87 lakh crore in 2005.

14.1.5 Pledge Financing

Another concept in commodity market is a practice that enables the usage of inventories of graded produce as collateral for accessing credit from the organized credit market, thus enabling the Farmer to hold inventory of graded produce under favorable storage conditions, without having to dispose of the produce at adverse prices in regulated markets. It also advances grading of farm produce to the farm gate and enables identity preserved storage closer to the farms.

14.1.6 Warehouse Receipts

Warehouse Receipts are documents issued by Warehouses to depositors against the commodities deposited in the warehouses, for which the warehouse is the bailee. Warehouse Receipts may be either non-negotiable or negotiable. These documents are transferred by endorsement and delivery. Either the original depositor or the holder in due course (transferee) can claim the commodities from the warehouse. Warehouse Receipts in physical form suffer all the disadvantages of the paper form of title documents.

At the time of harvesting, farmers usually sell a substantial quantity of produce at lower prices. However, price tends to rise as the season progresses. If farmers keep their goods in warehouses and use them as collateral to avail credit facility, they would be better placed to take advantage of the benefits of higher price and meet their immediate credit requirements (banks generally have such a scheme).

14.1.7 Policy Interventions

- Integrated micro-product to cover life, health, non-life assets of SF/MF at reasonable costs
- Group premia approach at village/ panchayat level to be considered
- The products should be more farmer friendly, speedy settlements of claims
- Premium to be shared by Central and State Governments with farmers and banks concerned.
- MFIs may be utilized to tie up with formal insurance companies for increasing outreach of micro insurance products
- NDRF to be created through annual contributions of nationalized banks, RBI, NABARD, SBI etc., from out of their profits, contributions from State/Central governments and small annual cess from loanee farmers.

14.1.8 Suggested Schemes

Risk Management

High Premium costs of insurance	No scheme exists at present	Small and marginal farmers should be given subsidy up to 50 % of the premium charged.
Natural calamities	No scheme exists at present	In case of 1st natural calamity farmers should be exempted

		from interest on the loan In case of 2 successive years farmers should be given 1/3rd of the principle due to be considered if interest has already been paid by the borrowers If natural calamity occurs consecutively for the 3rd year SF/MF/TF to be given full relief in the form of waiver of entire amount due
Insurance of perennial horticulture crops	No scheme exist at present	Weather based insurance cover is proposed to be designed

14.2 CREDIT

14.2.1 Introduction

Taking into consideration around 20 per cent contribution of Agriculture to total Gross Domestic Product, a minimum 5 to 6 per cent of the total GDP should be invested in the Agriculture and allied activities per annum against the present actual investment of only 1.3 percent of the total GDP. To reach towards this figure, we must immediately bring a substantial jump in investment in agriculture and allied activities.

If policy framework is enabled with minimal fiscal incentives, they can result in attracting the much-needed private investments in the rural and agriculture based economy. Besides this, the share of public investment in the sector also needs to be increased which has been observed to be reducing over the years. Any public or private investment in agriculture and rural sector will have a multiplier effect in the rural economy.

14.2.2 Projection of Credit during XI Plan Period

14.2.2.1 Review of ground level credit flow

The total ground level credit flow for plantation and horticulture and allied activities during the period 2000-01 to 2004-05 is furnished in Table 14.1. It may be observed that the flow of ground level credit to plantation and horticulture sector registered a positive growth and increased from Rs. 1,420 crore in 2000-01 to Rs. 3,314 crore in 2004-05. During the above mentioned period, the flow of ground level credit increased at a CAGR of 23.6%. The annual growth rate of credit during the first three years of the X Plan fluctuated from 20.4% recorded in 2003-04 to 33.7% reported in 2002-03.

Table 14.1 Ground level credit flow for plantation & horticulture for the past five years
(Rs. Crore)

Particulars/ Year	2000-01	2001-02	AGR	2002-03	AGR	2003-04	AGR	2004-05	AGR	CAGR
Short term	666	810	21.6	912	12.6	1100	20.6	1437	30.6	21.2
Long term	754	765	1.46	1195	56.2	1436	20.2	1877	30.7	25.61
Total	**1420**	**1575**	**10.9**	**2107**	**33.7**	**2536**	**20.4**	**3314**	**30.7**	**23.6**

AGR: Annual Growth Rate
CAGR: Compounded Annual Growth Rate

14.2.2.2 Review of Agency Wise Ground Level Credit Flow

Analysis of GLC for P&H and allied activities(Table 14.2) during 2000-01 to 2004-05 showed that the share of commercial banks increased significantly from 46 to 58 % whereas the share of RRBs has remained almost stagnant at 8 to 9% while that of cooperative banks

declined from 46% to 33%. The declining share of GLC from cooperative banks may be attributed to the fact that their performance in the overall agricultural credit has also not been good and they have proportionately lost their market share in the sector.

Table 14.2 Agency wise GLC flow under plantation and horticulture (ST& LT loans)

(Rs. Crore)

Agency	2000-01	% share	2001-02	% share	2002-03	% share	2003-04	% share	2004-05
Coop Banks	650	45.77	674	42.79	749	35.55	845	33.32	993
RRBs	111	7.2	129	8.19	180	8.54	221	8.71	308
CBs	659	46.41	772	49.02	1178	55.91	1470	57.97	2013
Total	**1420**	**100**	**1575**	**100**	**2107**	**100**	**2536**	**100**	**3314**

14.2.2.3. Review of flow of refinance to P&H and allied activities under investment credit

The annual growth rate of refinance exhibited a fluctuating trend i.e., 4%, (-14%), (-6%) and 37% respectively during 2002-03, 2003-04, 2004-05 and 2005-06 respectively. The fluctuation in the refinance disbursement is attributed to the varying liquidity position of the client institutions during different years.

14.2.2.4. Estimated ground level credit flow for the period 2005-06 to 2006-07 for P&H sector

The ground level credit for P&H sector for 2005-06 and 2006-07 have been projected based on the CAGR of the GLC for the period from 2000-01 to 2004-05 and is presented in Table 14.3.

Table 14.3 GLC estimates for 2005-06 and 2006-07 based on CAGR for 2000-01 to 2004-05

(Rs. Crore)

Particulars/ Year	2004-05	2005-06	2006-07
Short Term	1437	1739	2104
Long Term	1877	2365	2980
Total	**3314**	**4100**	**5084**

14.2.3 Crop / Activity Wise Credit Requirements for P& H Sector

It is reported by bankers that the major share in the plantation and horticulture sector is flowing to more or less organised sectors which include plantation and major fruit crops and the share of minor fruit crops is minimal. In the absence of any available authentic data on crop wise disbursement of ground level credit under P&H sector, during the X Plan period, the crop/ activity wise credit requirement has been worked out taking into account the correlation between the ratio of ground level credit to NABARD refinance availed during the period 2002-03 to 2005-06, the GoI policies and thrust areas. The projections are presented in Table 14.4.

The crop/ activity wise credit requirement for the XI Five Year Plan has been worked out on the following assumptions

- The short term credit requirements have been worked out based on an annual growth rate of 25%.
- The long term credit requirements have been worked out based on an annual growth rate of 27%.

A higher growth rate has been assumed under long term credit, between the final year of the X Five Year Plan and the base year of the XI Five Year Plan since thrust areas like Post Harvest Technology, Agri Export Zone, Organic Farming and Contract Farming have not been reflected in the earlier projections.

Table 14.4 Crop/activity-wise year-wise credit requirements for plantation and horticulture sector – XI Plan

(Rs. crore)

Sl. No.	Crop/Activity	2007-08	2008-09	2009-10	2010-11	2011-12	Total
	Fruits						
1.	Grape	303.82	349.41	454.41	522.35	679.05	2,308.88
2.	Citrus	42.84	71.34	114.51	228.23	291.97	748.89
3.	Mango	220.07	316.00	370.77	442.05	552.56	1,901.45
4.	Pineapple	21.27	27.65	35.95	46.73	60.75	192.36
5.	Others	135.63	176.32	247.44	350.46	482.40	1,392.25
	Sub total	**723.63**	**940.72**	**1,222.92**	**1,589.82**	**2,066.73**	**6,543.82**
	Plantation & Horticulture						
1.	Coconut	87.39	113.61	147.69	192.00	249.60	790.29
2.	Tea	318.45	426.94	570.56	706.90	918.97	2,941.80
3.	Coffee	164.98	211.48	278.73	373.80	557.08	1,586.06
4.	Rubber	114.21	148.47	193.01	250.91	326.19	1,032.81
	SPICES						
5.	Cardamom	41.15	53.50	69.55	90.41	117.53	372.15
6.	Pepper	68.28	88.76	115.39	150.01	195.01	617.45
	Medicinal & Aromatic Crops						
7.	Arecanut	42.26	50.71	60.85	62.76	70.53	287.11
8.	Betelvine	114.25	142.89	171.47	205.76	246.91	881.28
9.	Others	65.97	85.76	111.49	144.93	188.41	596.54
	Sub total	**1,016.94**	**1,322.11**	**1,718.74**	**2,177.48**	**2,870.22**	**9,105.05**
	Floriculture	623.91	811.08	1,054.41	1,370.73	1,781.95	5,642.09
	Perennial Vegetables	289.61	376.49	489.44	636.27	827.15	2,618.95
	Other crops	277.43	360.66	468.86	609.51	792.37	2,508.83
	Sericulture	12.00	15.60	20.28	26.36	34.27	108.51
	Tissue Culture/Nursery	45.62	59.31	77.10	100.23	130.30	412.57
	Mushroom	153.82	199.97	259.96	337.94	439.33	1,391.01
	Medicinal & Aromatic Plants	166.76	216.79	281.93	366.38	476.30	1,509.07
	Bee keeping	0.60	0.78	1.01	1.32	1.71	5.42
	Sub total (F to J)	378.81	492.45	640.18	832.24	1,081.91	3,425.58
	Post Harvest Tech. – LS	100.00	130.00	169.00	219.70	285.61	904.31
	Agri Export Zone (PH)-LS	300.00	350.00	400.00	450.00	500.00	2,000.00
	Organic Farming-LS	400.00	500.00	600.00	7.00	800.00	3,000.00
	Contract Farming –LS	500.00	650.00	800.00	950.00	1,100.00	4,000.00
Total Long Term Credit		4,610.33	5,933.52	7,563.54	9,535.75	12,105.95	39,749.09
Total Short term Credit		2,630.00	3,288.00	4,109.00	5,137.00	6,421.00	21,585.00
Grand Total Credit		**7,240.33**	**9,221.52**	**11,672.54**	**14,672.75**	**18,526.95**	**61,334.09**

14.2.4 Policy Interventions

To attract private investment, FDI in agriculture produce retailing / post harvest activities and other specialized services like model nurseries, enhanced seed production and R&D should be allowed. The bank interest rates for horticultural crops production and marketing activities need to be lowered to 7% on the lines of crop loans where all crop loans for cultivation of agricultural crops upto Rs. 3.00 lakh are provided with a subvention of 2% by Government of India and the interest rate to borrower is 7%. The Govt. research facility should be opened to Pvt. Enterprises, on payment basis, for developing management & processing protocols as

per industry requirement. The provisions of IT act on income generation from specialized activities like green houses be reviewed and widened in scope to include hydroponics, NFT, aeroponics, etc. and other novel technologies in production, post harvest management, processing and marketing.

- There is need for bringing uniformity in the State level tax structure in agricultural commodities for improving the market efficiencies. Taxes and fees on raw agricultural commodities should be rationalised, with a limit ceiling of 4 per cent. In principle, raw agricultural commodities should attract zero tax (including purchase tax, mandi tax, commission of agents, and so on, which in Punjab today accounts for about 11 per cent on wheat). This can be done by allowing grain companies/traders to buy directly from farmers without going through commission agents, and abolishing purchase/sales tax.
- Octroi and Entry Tax should be abolished wherever applicable. This would help the growth of the agro-processing industry. Uniform Value Added Tax (VAT) in agriculture should be introduced in the following manner:
  - On processed products of a perishable nature – 0 per cent
  - Other processed foods (excluding tobacco & alcoholic beverages) – 4 per cent
- There is also need to abolish or reduce fees, cess, taxes, duties etc. on procurement of agricultural or horticultural produce procured through any registered contract-farming programme. This would promote direct procurement, improve quality of produce and lead to reduction in the load on the State and Central procurement systems.
- The Ministry of Finance should consider tax incentives like excise, sales tax exemption for bio fuels and industry equipment used for converting agri substitutes into usable grade bio -fuels.
- Provide capital subsidies to processing industries along with subsidized interest rates for setting up bio fuel plants and provide tax/duty concession for the bio-diesel producers.
- Import duty free of water soluble fertilizers for horticulture production
- Develop new structures like pure returns model where both the government and the private participation have equity investment and they work on commercial principles.
- Treat 150 per cent of investment by private sector in agri-infrastructure chain as deduction of expenditure like in the case of R & D.
- Treat 150 per cent of investment by private sector in wasteland reclamation as deduction of expenditure like in the case of R & D.

14.2.5 Credit Related Initiatives

14.2.5.1 Target for plantation and horticulture under priority sector

As per Reserve Bank of India guidelines out of total net bank credit 18% is earmarked for agriculture (including direct and indirect agriculture). In absence of any sectorial allocations, commercial banks are not putting desired emphasis for enhancing the credit flow for the Plantation and Horticulture Sector. With greater emphasis now being given for diversification of agriculture and more in Plantation and Horticulture Sector, in particular, the RBI may consider to earmark a sub target within the Agriculture Sector say 4% out of the 18% of Agriculture Sector exclusively for Plantation and Horticulture Sectors. This allocation has been suggested keeping in view the projected credit flow of Rs. 2.00 lakh crore under Agriculture during 2006-07. The performance of the banks under this head may be monitored by the RBI periodically as is done for the priority sector lending.

14.2.5.2 Credit linked subsidy

The National Horticulture Mission, which is under operation for last 2 years and will remain operational during the XI Plan, envisaged a substantial amount of subsidy for the farmers/entrepreneurs for promotions and development of horticulture activities. However, major chunk of this subsidy mandatorily should be credit linked and thereby involve all the financial institutions which in turn will reduce the pressure on budgetary allocations and enhance the flow of institutional credit in this sector.

14.2.5.3 Minor fruit crops

Special attention needs to be given for promotion and development of minor fruit crops specially those having medicinal properties like Aonla, Jamun, Kokum, Bael, Starfruit, Terminalia belvica, T. Chebula etc. These crops having a long gestation period may require additional support over other established crops. Allocation of higher subsidy for these crops may be considered.

14.2.5.4 Mature watershed

Over the years through various watershed development programmes, number of watersheds have reached the maturity stage. Many of these watersheds are managed by the Watershed Committees. With the improvement of soil and water conditions in the watershed area, part of the area could be dedicated for Horticulture development and the Watershed Committee could be used as a conduit for extending financial support through the banks either as financial intermediaries or as a license vendor.

14.2.5.5 Support to growers' associations and NGOs

These are a good number of Crop Specific Growers' Associations who are intimately involved in promotion and development of specific horticultural crops like Grape Growers' Association, Mango Growers' Association, Pomegranate Growers' Association, Orange Growers' Association, etc. These Associations are providing production and marketing related services to the members. The financial institutions may use these associations as financial intermediaries for extending credit to the members of these associations. This will reduce the cost of supervision of the banks on one hand and like to improve the recovery position of the banks. Similarly, there are a number of good NGOs who are also involved in promotion of SHGs and Farmers' Clubs (promoted by banks with the support of NABARD). These NGOs can also be given appropriate license and may as act as a license vendor for the financial institutions and can be used as financial intermediary for extending for the farming community and recovery of Farmers' Loans.

14.2.5.6 Home stead farming

Small and Marginal farmers having very small and holding may find it difficult to develop only fruit crops for commercial viability The basket of business activities including fruits, vegetables, poultry, dairy, fishery, etc. together constitute a viable unit activity which can be supported with the bank finance.

14.2.9 Scheme Interventions

Following fiscal incentives are suggested by way of granting 150 per cent deduction of expenditure for all investments by the Pvt. Sector in agriculture and the entire agri-value chain as in the case of R & D.

Sec 35 (2AB)	**Proposed new section**
A company, which is engaged in the business of drugs, pharmaceuticals, electronic equipments, computers or any other thing as notified by the Board incurs	A company, which is engaged in the business of agri-commodities, agri-inputs, agri research and watershed development or any rural based activity where PPP has been proposed under a

any expenditure on the scientific research or in house research and development facility, the, there, shall be allowed a deduction of a sum equal to one and half times of the expenditure so incurred

Conditions

- The taxpayer is a company
- It is engaged in the business of biotechnology, pharmaceuticals, electronic equipments, computers, telecommunication equipments, chemicals or any other thing notified by the board
- It incurs any expenditure on scientific research and such expenditure is of capital nature or revenue nature. The expenditure on scientific research in relation to drugs and pharmaceuticals shall include expenditure incurred on clinical drug trial, regulatory approval and filing an application for a patent
- The above expenditure is incurred upto March 31, 2007 on in house research and development facility
- The research and development is approved by the prescribed authority
- The taxpayer has entered into an agreement with the prescribed authority for cooperation in such research and development facility and for audit of the accounts maintained for the facility.

Process of claiming benefit

- Details of expenditure to be audited by chartered accountant

Method of computation

- A deduction of a sum equal t one and one-half times of the expenditure so incurred is allowed

Union/State government Scheme or as notified by the Department of Agriculture or its Board incurs any expenditure on agri-extension work, crop development, scientific research or in house research and development facility in agriculture, then, there, shall be allowed a deduction of a sum as given in the method of computation

Conditions

The taxpayer is a company

- It is engaged in the business of agri-commodities, agri-inputs, agri-research and watershed development or any other thing as notified by the Board. It can also be a part of a company engaged in selling products other than agricultural products.
- It incurs any expenditure on agri extension, crop development and such expenditure which is of capital nature or revenue nature.
- The minimum expenditure in the agri extension activity must exceed Rs 10 lakhs in singly or multiple projects across the nation in a year
- The minimum expenditure in the infrastructure project by the company should not be less than Rs 50 lakhs in single or multiple projects across the nation in an year.

Process of claiming benefit

- On completion an activity report has to be submitted to the authority with whom the project was initially registered
- Details of expenditure to be audited by the statuary auditors of the company through a firm of Chartered Accountants

Method of computation

- A deduction of a sum equal to one and one-half times of the expenditure so allowed in incurred
- Wherever benefit is claimed under this section in respect of capital expenditure, depreciation benefit cannot be claimed in respect of the same capital expenditure

14.2.10 Development Aspects

State Governments are availing RIDF support from NABARD for creating the rural infrastructure. To give a greater focus, it is proposed that the horticulture clusters identified by the National Horticulture Mission in each State, may be given a higher priority by the State Government for creating requisite infrastructure like rural road, bridge for linking those clusters with the nearest highways and railways. Besides the RIDF loan may be used for development of PH directly by promoting plantation, improvement/ modernization of infrastructure, production of seedlings, etc.

Infrastructure needs to be created at the farm level for the primary processing/grading/packaging nearest to the farmers field itself which can further be transported to big town/cities for onward marketing or further processing.

14.3 PUBLIC PRIVATE INVESTMENT

The Ministry of Finance, Department of Economic Affairs, GoI has developed a scheme for support to "Public- Private Partnership" (PPP) in infrastructure in July 2005 which specifically covers roads, power, urban transport, SEZ and tourism infrastructure projects and does not include infrastructure for the Agriculture sector. An attempt has been made in this note to identify the potential areas where Public - Private Partnership could be developed in Plantation and Horticulture sectors.

14.3.1 Development of Infrastructure for Horticulture Produce

The horticulture crops being perishable in nature, require special type of marketing infrastructure. Keeping in view the National Horticulture Mission's objectives of doubling the horticulture production from the existing level of 147 million tonnes to 300 million tonnes by 2011 - 12, market intervention, has been identified as one of the important aspect for the growth of horticulture sector. The National Horticulture Mission has already allocated a sum of Rs.150 crores for the purpose of establishing terminal markets for horticulture produce during 2006-07.

This would offer an excellent opportunity for Public Private Partnership. The terminal market complexes are highly capital intensive projects with investment ranging between 80-100 crores, even more for individual projects. Both the Central and State Governments may consider their involvement through equity participation. These terminal markets may also act as Export Hubs with necessary testing facilities for quality control which is a perquisite for any export from the country.

The entrepreneurs of Agri-clinic and Agri-Business Centre (ACABC) under the GoI schemes may be encouraged to set up collection centres to feed the terminal market. This will facilitate the transfer of technology and market information to the farmer besides developing private extension services by the Agri-graduates. The State Government may ensure adequate infrastructure like roads and bridges to the catchment area of the collection centre and the terminal market.

14.3.2 Development of Supply Chain Infrastructure

Developing efficient supply chain for perishable horticulture crop is a pre-condition for the growth of this sector. Fruit, vegetable and flowers require sorting, grading and then pre-cooling before it is transported to far away destinations. This requires huge investments for Post Harvest Management.

While the infrastructure at the field level may be created by the individual farmers or farmers' group the pre-cooling centre, refrigerated van, cold storage could be developed by Corporate houses with equity participation from State/Central Government, Various Growers Association's could also be partners in this endeavor.

Creation of quick transport system for long destinations by road or rail is very important for

efficient supply chain management. While refrigerated van should be used for road transport, a dedicated refrigerated railway wagon should be put in place for long distance transport of horticulture produce. Corporate houses involved in production and marketing of horticulture produce may be allowed to manufacture their own refrigerated wagon as is presently done by many companies, for other industrial commodities. Introduction of a dedicated super fast train for horticultural produce could be considered from the centre of production to the major metro markets in the country.

Creation of cold storage facilities in select airports situated in the important horticulture production centres of the country to facilitate quickest transport to cater to both the domestic and export market. Creation of infrastructure will offer an excellent opportunity for investment through Public Private Partnership.

14.3.3 Research and Development

The partnership of Private and Public Sector may be extended to research and development. Many Corporate industries who are engaged in undertaking independent in house research in the field of horticulture may be provided financial support to the extent of 50% of the cost of the research project. Government may avail royalty from the commercial benefit earned out the research project.

The infrastructure facilities of the existing Horticultural Research Departments/Centres (which include State Agricultural Universities) could be made available to the corporate house for undertaking research projects and thereby share the commercial benefit of the research outcome.

India, being a potential exporter of horticultural crop, needs to have a number of sophisticated laboratories across the country whose certificate should be globally acceptable.

Similarly, there is a need for internationally accredited certifying agencies for organic farming for various horticultural crops.

There is a great opportunity to develop partnership with corporate houses to develop well equipped advanced laboratories across the country for testing the quality of the produce in conformity with International standards.

The private industry may be encouraged to share their infrastructure for the R&D activities with the public sector research organizations for mutually beneficial association.

The private sector may be encouraged to establish state of the art R&D infrastructure for taking up on cutting edge research projects in collaboration with the scientists of the public sector organizations in areas like nanotechnology, protected cultivation, biotechnology and information technology applications in horticulture.

The private sector may be encouraged to establish state of the art breeding stations with latest exotic varieties to evolve varieties that suit the international markets.

14.3.4 Horticulture Farms of the State Government/Agriculture University

Vast area under horticulture farms are owned by State Government/Agriculture University. These horticulture farms remain under utilised for various reasons. State Government may consider to lease out these farm to the small/medium private entrepreneurs for a period of 10-15 years and design good business model which can even act as a training ground for the prospective agri entrepreneurs of the University. Special preference need to be given to the Agri-clinic and Agri-business entrepreneurs who have undergone the requisite training under the GoI's ACABC schemes.

14.3.5 Development of Horticulture Park

Government (State/Centre) may consider developing Horticulture Park jointly with Corporate Houses. These Horticulture Parks, like Industrial Park/Food Parks may provide the entire requisite infrastructure, for production, processing and marketing in one compact area. This may be on the same pattern of AEZ.

14.3.6 Policy Recommendations

- Initiate Public Private Partnership in several key areas such as watershed management and wasteland development
- Initiation of Contract Farming and Direct Marketing of farm produce within a PPP framework.
- Encourage PPP models with tax benefits for the private sector
- Demand driven research and a customized PPP for R & D.
- Expand public private partnerships in areas such as
- Rural infrastructure, Research and Development, Extension, Value addition/ agro processing, Marketing and storage, Cold chains and transportation.
- Tap Private sector potential under the two following PPP models
  - Public funds and Private implementation.
  - Public infrastructure and Private management.
- Encourage Seed Development in PPP framework in
  - Germplasm development, Development of Value added traits, Market development for improved Germ plasm, Contract farming of hybrid seeds
- Evolve institutional mechanism for promoting PPP in agriculture research and extension. Develop public and private partnership with input companies on the basic research agenda.
- Agriculture biotechnology needs to be focused as one of the prime areas for PPP.

14.3.7 Suggested Modifications in The Existing Schemes/ Proposed New Schemes for The XI Five Year Plan

There are many options for designing the PPP model, the most commonly used options are Joint Ventures, Build-Operate-Transfer (BOT), Build-Own-Operate-Transfer (BOOT). However, the most preferred model for marketing would perhaps be the ‘Financially Free Standing’ projects. In this case the Public sector undertakes some of the initial planning, providing ancillary works or fulfillment of statutory procedures; whereas the private sector undertakes the project on the basis that costs will be entirely recovered through user charges. The Marketing Board may also participate in the equity to the extent of the cost of land to be allotted to the market.

CHAPTER XV
ELEVENTH PLAN PROGRAMMES, BUDGET AND PLOCY ISSUES

15.1 INTRODUCTION

Horticulture sector has made rapid strides during the X Plan period and has emerged as an engine of growth for diversification in agriculture through increasing productivity, providing nutritional security, increasing exports and contributing to national and regional economies. However, there are some grey areas, which need to be addressed during the XI Plan period to further strengthen the sector and consolidate the advances made during the X Plan. Efforts during the earlier Plans have reasonably succeeded in placing India as the second largest fruit and vegetable growing nation of the world. However, there still exists a large gap between the demand and supply of several horticultural commodities resulting primarily due to increasing demand coupled with poor productivity owing to inadequate quality planting material, lack of varieties for value addition, poor transfer of technologies, inadequate post harvest & marketing infrastructure and processing.

The strategy during the XI Plan will be to provide dynamism to the sector by consolidating the gains made during the Tenth Plan, and implement programmes which would ensure holistic development of horticulture sector. In this context, it would be necessary to give focused attention to enhancing productivity through regionally differentiated area specific technological interventions.

15.2 RECOMMENDATION ON X PLAN PROGRAMMES

The 12 sub-groups constituted under Working Group on Horticulture, plantation crops and organic farming, have made in depth study of various developmental programmes which are running in the country under the aegis of Ministry of Agriculture, Ministry of Commerce and Ministry of Food Processing Industries. Based on the reports received from various sub-groups, these programmes could be categorized into following:

- Programmes to be continued as such
- Programmes to continue with minor modifications
- Programmes to be restructured

15.2.1 Programmes to be Continued as such

This category largely comprises of programmes that were recently launched and, therefore, need to continue as such during the XI Plan period. These programmes are as follows:

- National Bamboo Mission
- Central Institute of Horticulture, Medziphema, Nagaland

15.2.2 Programmes to Continue with Minor Modifications

Most of the programmes in operation in the last Plan are still relevant and therefore need to continue with minor modifications. Programmes that need to continue after modifications are listed below:

15.2.2.1 Technology mission for integrated development of horticulture in north east and Himalayan states

Technology Mission for Integrated Development of Horticulture in North East and Himalayan States, has largely succeeded in its objective to harness the potential of horticulture in the region. The programme, therefore, needs to be consolidated and strengthened so as to bring

prosperity in these States and to bring them at par with other developed States of the country. The region is strategically located and touches boundary with many countries. Therefore, due emphasis should be given to target the markets of neighbouring countries and also to tap markets in the ASEAN countries. This programme therefore needs to be continued during XI Plan.

15.2.2.2 National horticulture mission

The National Horticulture Mission was launched only during May 2005. The Scheme should be continued during XI Plan period. NHM needs to be made technically more strong both at Central and State level. Besides, yearly external technical monitoring should be ensured to implement and identify gaps and also to make the process more effective and transparent at grass root level. A programme of such a dimension requiring diverse technical inputs and an overall appreciation of the potential of horticulture in different agri- ecological region of various crops will deliver proper dividend only if led by suitable and eminent technical persons rather than bureaucrats who are normally not well versed in the above technicalities. Its organizational structure thus needs to be reviewed.

15.2.2.3 Microirrigation

This is a very ambitious Scheme that was launched during the X Plan for efficient and judicious utilization of water. The Scheme needs to be extended to all horticultural crops and field crops. Besides, there is no provision of financial assistance for closed spaced crops or high density planting, for creating water sources, replacement of micro tubes, pumps. Accordingly there is urgent need to include these items and revise cost norms. It should also be made applicable to all horticultural crops.

15.2.2.4 Rubber board

The Objectives of the X Plan could not be achieved in full because of approval of the major scheme having been received during 2005 with the result that many programmes could not be implemented on time. Therefore, all ongoing schemes except the one for Export Promotion are proposed to be continued. Further support for rubber export is not found essential. Increased emphasis is to be given for participatory extension approach in productivity enhancement. RPS & SHG s have to be supported and strengthened. Environment conservation by soil protection and water harvesting in plantations is proposed. Development of tribal people through rubber plantation needs to be supported.

15.2.3 Programmes to be Modified

Most of the programmes under this category were launched during X Plan and needs major modifications to cater changing scenario.

15.2.3.1 National horticulture board

The National Horticulture Board was launched with the sole objective of promoting post harvest infrastructure of horticultural crops in the country. However, in due course of period the Board’s programme some how got diluted resulting in deviation from its identified objectives. It is felt that the National Horticulture Board should confine it self to over viewing the infrastructure development with regards to post harvest management, marketing, database and market information.

The National Horticulture Board is not recommended to be continued in its present form. In view of launching of Technology Mission for Integrated Development of Horticulture in North East & Himalayan States and National Horticulture Mission its role needs to be critically reviewed. This requires total overview of the structure of the horticulture division and its various units.

15.2.3.2 Coconut development board

On a review of the ongoing programmes of the Board it is proposed to restrict implementation of certain programmes in certain geographical areas and merge some of the schemes in order to remove overlap between regular schemes and Technology Mission on Coconut. The programmes proposed for discontinuance in traditional areas are as follows:

i. Regional Coconut Nursery;
ii. Production of hybrid seedlings;
iii. Expansion of Area under Coconut and
iv. Laying of Demonstration Plots – (one of the components of Integrated Farming).

- The schemes of Regional Coconut Nursery and Production of Hybrid Seedlings is recommended to discontinue as adequate support has been provided to the State Governments in traditional areas over the years, matching share is most often not provided by the State Governments. Hence utilization of the funds becomes difficult. Lastly, private sector participation in production of planting material is picking up.
- The Working Group also recommends discontinuation of schemes titled Expansion of Area under Coconut and Laying of Demonstration Plots, as there is very little area for further expansion of coconut cultivation in the traditional states. Need of traditional states which have old gardens is replanting rather than expansion. Laying of Demonstration Plot will be more useful to the farmers in non-traditional states. However, it is recommended to continue the programmes titled Regional Coconut Nursery; Expansion of Area under Coconut and Laying of Demonstration Plots in the non-traditional areas.
- With the introduction of Technology Mission on Coconut (TMOC) there are overlappings between the following regular programmes of the Board and the components in TMOC. The following schemes are also implemented in one form or the other under TMOC.

i. Market Promotion and Statistics
ii. Information and Information Technology

In order to remove the overlap it is proposed to bring all Market Promotion activities under Technology Mission and under the scheme titled Information and Information Technology so as to cover activities such as publications, media campaigns, production of films, seminars and exhibitions within the country, statistics and training, etc. As a result Information and Technology will be part of the regular programme and Market Promotion will be redesignated as a Market Research and shall remain under the Technology Mission.

- Further the scheme Technology Demonstration may be included in the scheme Information and Information Technology, which provides for imparting training and transferring technology.
- The following programmes are proposed to be continued in the XI Plan.

i. D.S.P. Farms
ii. Private Nurseries (Big & Small)
iii. Organic Manure Units
iv. Technology Mission on Coconut
v. Information and Information Technology
vi. Infrastructure and Administration

15.2.3.3 Coffee board

Coffee Board: A few Schemes of the Board which served limited purpose of providing some comfort to growers & exporters during the time of coffee crisis are recommended to be discontinued in the XI Plan. These are:

i. Interest subsidy to small growers
ii. Interest subsidy to large growers
iii. Transport subsidy to exporters

Besides, some of the programmes which need to be modified during XI Plan period to make them more effective are as follows:

- **R&D for Sustainable Coffee Production (Research)**: The existing X Plan scheme "Step up Production, Productivity and Quality" is proposed to be renamed as "R&D for sustainable coffee production" to reflect the required focus across all components in the scheme. This refocus is needed to ensure that each component is not carried out in isolation. In this connection it is necessary that Transfer of Technology also focuses on the sustainable coffee production.
- **Development Support (Field Activities)**: A number of components and activities coming under different X plan schemes viz., Infrastructure Development, Capacity Development and Transfer of Technology, Support to Small Grower sector, Interest Subsidy to small growers and Interest Subsidy to Large Growers, Coffee Development in NER/NTA were all towards providing subsidy to the beneficiaries largely amongst coffee growers and Labour Welfare measures. To have greater focus and consolidation of these subsidy schemes, it is recommended to bring all of them under one scheme, i,e, Development Support. It is also proposed to extend the benefits of financial assistance on education to the children of tiny growers in the XI Plan. Therefore, the allocations required for these components have been merged and brought together under the scheme.
- **Labour Welfare**: This is one scheme which has been carried forward from X Plan to XI plan by merging the transport subsidy under Export Promotion into the Market Development Scheme. Increased emphasis on domestic promotion is the main stay of XI Plan under Market Development. For a long time India depended on export of green coffee, a primary agricultural produce. Hardly 15 to 20% of the total value of the coffee is accruing to the coffee growers while another 20% is captured by the trade in the process of exports. Another 30% is usually captured by the roasters in the consuming countries and the balance is being captured by the retailers. The whole chain provides for huge employment opportunities. Consumption of about one MT of coffee within the country would support at least 10 jobs.

Programme on market development needs to be further strengthened and a new programme on risk management to growers is recommended to be added during the XI Plan period.

15.2.3.4 Tea board

To make the programmes both effective and result oriented there is need to improve the following programmes:

- Replantation to be accelerated in 11,000 ha /year as against the average rate of 3,000 ha during the X plan period
- Irrigation by removing one of the ceiling limits of subsidy and relating the level of subsidy to the actual cost of development
- Setting up of Self Help Groups amongst small growers;
- Modernization of processing factories- with more focus on value addition, quality assurance, certification and specialty teas

Besides there is also urgent need to modify the following:

- Rejuvenation to be restricted only to the hilly areas
- New Planting to be allowed only in hilly and non traditional areas of N.E Region

To implement these programmes some of the common policy issues which requires to be considered are given below:

15.3. POLICY ISSUES

There are several issues like technical infrastructure, financial, administrative and policy related which need to be looked into during XI Plan period. Most of them have been discussed under various Chapters. However, some common issues are listed below:

15.3.1 Administrative

- Budgetary allocation for horticulture development has increased many folds. However, there is acute shortage of manpower to look after the programmes. This calls for urgent review and suitable strengthening of Horticulture Division by redeployment from the Agricultural Division.
- Programmes on horticulture should be led by suitable technical persons who are well versed in technicalities of horticulture.
- There are several components, which are being under taken both under National Horticulture Mission, Technology Mission for North East Region and National Horticulture Board. There is need to consolidate such programmes so as to avoid overlapping.
- All commodities boards and programmes related to horticulture, under various Ministries, to be brought under Ministry of Agriculture

15.3.2 Technical

15.3.2.1. Regional priorities: Due emphasis needs to be given to expand area under horticultural crops in the following categories of States:

i. All the States where current area under horticultural crops is below 10% of the total cultivable area.
ii. States which has immense potential for horticulture but not fully exploited for e.g. M.P., Orissa and Bihar
iii. Newly formed States like Chhattisgarh, Jharkhand and Uttaranchal

15.3.2.2. Crop priorities

I. Fruit Crops

- Priorities need to be given for those and crops varieties, which are identified for a specific cluster and agri-export zones
- There is need to develop production technologies based on agri-ecological regions.
- Indigenous and unexploited fruits possessing nutritional, processing value for e.g. jamun, bael, custard apple, fig, phalsa, date palm etc. need to be given focused attention.
- Emphasis needs to be given to promote cultivation of suitable crops in dry-land, arid regions and wasteland.
- Most of the fruit orchards specially Mango and citrus have become very old and rejuvenation may not be the solution for such orchards. Therefore, replanting such orchards has to be taken on priority basis without further delay.
- The present developmental programmes of NHM cover only 291 districts out 462. It is felt that a district cannot represent a cluster, therefore, crop specific clusters have to be identified in all the Districts depending on the suitability of crop.

- Introduction of high yielding strains/varieties of temperate fruit crops on a large scale for increasing fruit production and productivity through new orchards as well as replacement of old and uneconomical orchards.
- Introduction of advance technologies in orchard management and economic use of inputs like fertilizers, growth regulator and pesticides.
- Promoting farming system approach and diversification by intercropping with medicinal and aromatic crops.
- Introduction of advance technologies for the on farm storage, grading and packing of fruits at gram panchayat level.
- Construction of fruit collection and forwarding centres in the fruit growing areas.

II. Vegetables

i. Vegetable contribute a major share in ensuring food and nutritional security of population however, no meaningful programme have been launched on vegetables in recent times. Vegetables are even excluded from the recently launched NHM. The following aspects of vegetable crops needs to taken on priority:
   - Saturation of area with F1 hybrids
   - Promoting leafy vegetables for nutrition particularly in villages and tribal areas
   - Protected cultivation for high quality vegetable for export
   - Promoting kitchen gardening
   - Focus on crop having short supply
   - Promotion of technologies for round the year production of crops like onion

III. Spices

i. Need to develop disease resistant high yielding varieties
ii. Urgent need to encourage multi-storeyed and intercropping system

III. Floriculture

i. Suitable programme needs to be launched for development of elite new varieties suitable for export on PP mode so as to slowly replace the patented varieties.
ii. There is need to develop an interface with R&D organization, farmers and the industry to promote larges scale production of pharmaceutical and nutraceutical flowers on contract farming movement.
iii. India need to reorient its exports based on pot plants and cut foliage. Incentives for identification, domestication and commercialization of indigenously available foliage and pot plants need to be given.
iv. Introduce funding for time bound market driven projects by the private organisations to supplement and strengthen the public sector R&D
v. Besides loose flowers, cut flowers and dry flowers there is a need to promote other sectors like florist and floral decorations, pot plant production and rentals, bedding plant production, corporate landscaping, turf industry, essential oil extraction, aroma therapy, pot pourri, natural pigments and dyes and flower seed production.

IV. Medicinal & Aromatic Plants

i. Several agencies are working on MAP crops
ii. Herbal gardens are being promoted to lay emphasis on sensitization of MAP cultivation. Any meaningful programme would call for commercializing those plants that are required in large quantities in domestic and international markets. Some species like Noni (*Morinda citrifolia*) which is gaining popularity needs to be given priority to exploit its potential.

iii. There is a need to establish a regulatory and controlling authority on the lines of drug and cosmetics Act and Seed & Nursery Act to prevent unscrupulous activity and boost he image of Indian MAP sector.

iv. Establishment of referral labs for crude drug analysis to ensure authenticity of herbal raw material.

v. Priority needs to be given in areas of new drug development from plants, development of pharmacopeia standards for quality, safety, efficacy and scientific validation of therapeutic claims

vi. A strong and viable national strategy is warranted for complete inventorisation, economic mapping, conservation, cultivation, post harvest technology and storage facilities of MAP crops.

vii. To allow suitable concessions for products which contain natural aromatic compounds (like vanilline) as flavouring agent to discourage large scale importation of synthetic vanilline.

V. Coconut

i. Coconut plantations in large area have become old and senile. Focus priority therefore should be accorded to large-scale replantation programmes.

ii. Very few farmers are practicing scientific farming in coconut. Development and transfer of technologies is the key for reviving coconut industry.

iii. There is need for focused attention on farm level processing, product diversification, byproduct utilization and value addition.

iv. Tree life insurance and welfare schemes for coconut climbers.

v. Due to shifting towards more lucrative white collar jobs there is an acute shortage of professional climbers to harvest the produce. Although machines are available to harvest but they are not safe and often cause fatalities. Concerted efforts need to be mad for the development of the sector.

vi. Still conventional varieties are being planted that have lot of disadvantages. There is a need to take up large scale plantation of Dwarf hybrids under high density planting to improve productivity and farm income.

Keeping in view of the above new programmes have been suggested which are as follows:

i. National Horticulture Information System
ii. National Vegetable Development Programme
iii. National programme on development of commercial floriculture, medicinal & aromatic Plants
iv. Establishment of Planting Material Authority
v. National Mission on Organic Farming
vi. Establishment of Cashew Board
vii. National Training Facility for Horticulture
viii. Horticulture Insurance
ix. Small Farmers' Horticulture Estates
x. National Bee Board

15.3.3 Infrastructural

- Government should create common infrastructure for post harvest management, vapour heat treatment (VHT), irradiation centers with equal participation from Central and State Government for promotion of horticulture exports. The operational part and maintenance may be entrusted preferably to some private agencies to ensure their uninterrupted functioning and proper maintenance.
- There is suggestion to create special seed production zones on the lines of SEZ's for hybrid seed production of vegetable/ flower seeds for domestic and export markets.

- Necessary infrastructure and financial support may be provided to the newly established commodity associations during XI Plan to enable them to for strengthening and contribute more effectively.

15.3.4 Financial

- Assistance under most of the Schemes are based on cost norms of IX Plan, which have become quite irrelevant in the current situation where cost of all the inputs have increased many folds. To make the assistance more realistic, review of cost norms for all the crops, green houses and shade nets, microirrigation, post harvest management and market infrastructure etc. is recommended.
- The financial assistance currently for area expansion is not adequate to enable high density plantations and for cultivation of high capital crops like grape, banana, strawberry, medicinal & aromatic plants. Besides, assistance for non-perennial crops are currently released in two instalments instead of one, does not serve the purpose for which it is intended.
- Special financial support may be provided for selected specialty crops and varieties in different states like Litchi in Bihar, Banganpally Mango of A.P, Dasheri of UP, Alphanso of Maharashtra, Pineapple of NER, Kinnow in Punjab, Passion fruit in North East and Grapes in Southern States to bring more area under these commodities required both for domestic and export market.

15.3.5 Policy Issues

- In order to reduce cost of cultivation VAT, Octroi and import duties on plastic raw material need to be abolished. Excise duty on micro irrigation system needs to be reduced considerably.
- There is urgent need to amend forest laws regarding cutting of trees as these are hampering the task of rejuvenation of horticultural plantation.
- Economy of North East region is largely based on salaried population and therefore very few entrepreneurs have come up to take horticulture activity. Besides, cost of transportation is extremely high both within and outside the region. Government should therefore provide incentives to promote entrepreneurship besides, transport subsidy should also be provided to the farmers in the region for moving goods within and outside the state. For goods originating from NER and underdeveloped states like Bihar, Chattisgarh and Jharkhand to provide level playing field to the farmers to market their produce.
- There is need to create a separate corpus fund for horticulture to meet any emergency requirements on project base so as to protect the farmers in distress.
- Geographical Identity of a particular crop which is dependent upon the soil and climatic conditions generally characterizes the superior quality of the produce and this zone should not be restricted to physical map and boundaries of the district/state etc. The name of such zones should have a particular place and its surrounding area irrespective of district/state boundary. The registration/patent should be given/named to that place for a particular fruit. Efforts need to be made to screen out the places linked with a particular fruit/vegetable and thereafter attempt for registration for Geographical identity.

15.4 BUDGET

The various issues concerning development of horticulture during the XI Plan have been discussed in earlier chapters. While it is felt that most of the major development programmes launched during the X Plan should continue with, it has clearly been brought out that several

areas still require concerted efforts for their development. While these are details are given chapter-wise, the budgetary requirements of these programmes are detailed below:

15.4.1. Current Programmes

15.4.1.1. Ministry of agriculture

I.) National Horticulture Mission

Table 15.1 Proposed outlay proposed for National Horticulture Mission

S. No.	Programmes	Projected Outlay (Rs in crores)
i.	Horticulture Development	10000.0
ii.	Post Harvest Management & Marketing	4900.0
iii.	NHM HQ	100.0
	Total	**15000.0**

II.) Technology Mission for Horticulture Development in North Eastern Region and Himalayan States

Table 15.2 Proposed outlay for TMNE and Himalayan States

S. No.	Activity	Rs. in Crores
	North Eastern States	
i.	Creation of horticulture production zones	1000.0
ii.	Creation of PHM infrastructure such as farm machinery, hi-tech horticulture, organic farming, grading packaging, cold storage, CA storage, refer vans rope ways including collection and marketing centres in horticultural production zones	500.0
iii.	Creation of infrastructure for processing and value addition in major horticultural production zones	300
iv.	Other infrastructural support including capacity building and R&D activities	150
v.	**Sub-Total (A)**	**1950.0**
vi.	**Himalayan States**	
vii.	Creation of Horticulture production zones	400
viii.	Creation of PHM infrastructure such farm machinery, hi-tech horticulture, organic farming, grading packaging, cold storage, CA storage, refer vans rope ways	300
ix.	Creation of infrastructure for processing and value addition in major horticultural production zones	300
x.	Other infrastructural support including capacity building and R&D activities	50
	Sub-Total (B)	**1050**
	TOTAL (A+B)	**3000.0**

III.) National Horticulture Board

Table-15.3 Proposed outlay for National Horticulture Board

S. No.	Name of the Scheme	Proposed outlay during XI Plan (Rs. in Crores)
i.	Cold Storage Scheme	100.0
ii.	Development of Commercial Horticulture	400.0
iii.	Technology Development and Transfer	50.0
iv.	Market Information Scheme	50.0
v.	Horticulture Promotion Scheme	50.0
vi.	Strengthening Capability of NHB	50.0
vii.	Primary Processing	300.0
	Total	1000.0

IV.) Coconut Development Board

Table 15.4 Proposed outlay for Coconut Development Board

S.No.	Schemes	Amount (Rs. in crores)
i.	Productivity improvement through Integrated nutrient management	175.0
ii.	Community based programmes on need basis a) Vermi compost/coir pith b) Bio fertilizers. Bio control agents c) Pest and disease management d) Training programme for harvesting and post harvest management	35.0
iii.	Promotion of primary processing and Marketing	30.0
iv.	Technology Mission on coconut	100.0
v.	Corpus Fund for pest and disease management	50.0
vi.	Special scheme for Non traditional areas	20.0
vii.	Production and Distribution of quality planting material	15.0
viii.	Quality Improvement programme	5.0
ix.	Extension and Publicity	20.0
x.	Strengthening of database	10.0
xi.	Welfare scheme for farmers and workers	15.0
xii.	Infrastructure and Administration	25.0
	TOTAL	**500.00**

V.) Microirrigation

Table 15.5. Proposed outlay for Microirrigation

S.No.	Components	Projected Outlay (Rs in Crores)
i.	Area Coverage under Drip & Microirrigation	3000.0
ii.	Creation of Water Sources	1000.0
iii.	HRD/Awareness (No.)	280.0
iv.	Project Management	220.0
	Total	**4500.0**

VI.) Central Institute of Horticulture (CIH)

Table 15.6 Proposed outlay for Central Institute of Horticulture

S. No.	Component	Proposed Outlay (Rs. in crores)
i.	Civil Work	4.0
ii.	Units, Structures & Fixtures	8.0
iii.	Farm Machinery & Transport facilities	4.0
iv.	Training/demonstration including maintenance of infrastructure and publication of bulletins/literatures	15.0
vi.	Working capital for farm activities/ technology refinement	15.0
vii.	E. Salary	4.0
	Total	**50.0**

VII.) National Bamboo Mission

Table 15.7 Proposed outlay for National Bamboo Mission

S. No.	Programme	Proposed Outlay during XI Plan (Rs. in crore)
i.	Research	95
ii.	Plantation Development	1640
iii.	Post Felling Management	350
iv.	Marketing	120
vi.	Human Resource Development & demonstration	120
vii.	Promotion of Bamboo Handicrafts	100
vii.	Management, Monitoring and Technical Support Group	50
	Sub Total	**2475**
viii.	Project Report Preparation Consultancy etc.; @ 1.5% of the Sub Total	25
	Grand Total	**2500**

15.4.1.2 Ministry of commerce

I.) Coffee Board

Table 15.8 Proposed outlay for coffee board

Schemes	Total (Rs. in crores)
R & D for Sustainable coffee production	100.00
Development support	500.00
Market Development	200.00
Risk Management	100.00
Total for all Schemes	**900.00**

II.) Tea Board

Table 15.9. Proposed outlay for Tea Board

S. No.	Scheme	Total Rs. In crores
i.	Plantation Development Scheme	460.0
ii.	Quality Up gradation and Product Diversification Scheme	150.0
iii.	Market Promotion Scheme	140.0
iv.	Human Resource Development	50.0
vi.	Research & Development	200.0
	Total	**1000.0**

III.) Rubber Board

Table 15.10 Proposed outlay for Rubber Board

S.No.	Name of scheme	Proposed Outlay (Rs. in crores)
i.	Rubber Plantation Development	350.0
ii.	Research	50.0
iii.	Processing, Quality upgradation & Product development	100.0
iv.	Market Development &Export Promotion.	300.0
vi.	HRD (including works & overseas training)	60.0
vii.	Rubber Development in NE	140.0
	Total	**1000.0**

IV.) Spices Board

Table 15.11 Proposed outlay for Spice Board

S.No.	Programmes	Financial Estimates (Rs. in Crores)
I	Export Oriented Production	1000.0
Ii	Export Development & Promotion of Spices	350.0
Iii	Export Oriented Research	100.0
4	Quality Improvement	35.0
5	Human Resources Development & Capital Expenditure	15.0
	Total	**1500.0**

V.) APEDA

Table 15.12 Proposed outlay for Rubber Board

S.No.	Name of the Scheme	XI Plan Proposed Outlay (Rs. In crores)
I	Scheme for infrastructure development	229.0
ii	Scheme for market development	170.3
iii	Scheme for quality development	150.0
iv	Scheme for research & development	0.7
v	Transport assistance scheme	200.0
	Total	**750.0**

15.4.2. NEW INITIATIVES PROGRAMMES

i.) National Horticulture Information System

Table 15.13 Proposed Outlay for National Programme on Horticulture Database

S.No.	Programmes	Projected Outlay (Rs. in crores)
i.	Network of HIS at districts, States and Centre	350.0
ii.	Horticulture census	100.0
iii.	Studying methodology	50.0
	Total	**500.0**

ii) National Vegetable Development Programme

Table 15.14 Proposed outlay for National Vegetable development programme

S. No.	Item	Outlay (Rs. In crores)
i.	Promote nutritionally important oriented vegetables	200.0
ii.	Saturation of area under F1 hybrids	300.0
iii.	Promotion of off season vegetable production technologies	200.0
iv.	Expansion of area under processing varieties around processing units	300.0
v.	Promote kitchen gardening in urban areas	200.0
vi.	Promotion of indigenous vegetables	200.0
	Total	**1400.0**

iii.) National programme on development of commercial floriculture, medicinal & aromatic Plants

Table15.15 Proposed outlay for national programme on development of commercial floriculture, medicinal & aromatic plants

S. No.	Programme	Proposed Outlay (Rs. in crores)
	Floriculture	
i.	R&D	200.0
ii.	Planting Material	300.0
iii.	Promotion of traditional flowers, cut flowers, dry flowers, pot plants and bedding plants	700.0
iv.	Post harvest and Value addition	300.0
	Sub Total	**1500.0**
	MAP	
i.	R&D	200.0
ii.	Technology Development and Evaluation	300.0
iii.	Infrastructure	2500
iv.	Services and Extension	150.0
	Sub-Total	**900.0**
	Total	**2400.0**

iv.) Establishment of Planting Material Authority

Table 15.16 Proposed outlay for planting material authority

S. No.	Programme	Outlay (Rs. in crores)
i.	Up gradation of nurseries to international standards,	350.0
ii.	Institutional Support	150.0
iii.	Registration, accreditation & regulation of import/ export of seeds & planting material,	150.0
iv.	Preparation & implementation of Model Nursery Act,	150.0
v.	HRD, demonstration and promotional activities	100.0
vi.	Tagging & Traceability	100.0
	Total	**1000.0**

v.) National Mission on Organic Farming

Table 15.17 Proposed outlay for Organic Farming Development & Regulation Authority

S. No	Proposed Activity	Budget (Rs. in crores)
i.	Farm conversion to organic farming and production processes	150.00
ii.	PHM, Value Addition and Domestic Organic Market	500.00
iii.	Export Market Development	300.00
iv.	Human Resource Development	500.00
v.	Developing a Network of Service Providers	300.00
vi.	Awareness Promotion	100.00
	Total	**2500.00**

vi.) Establishment of Cashew Board

Table 15.18 Outlays proposed for Cashew Board during XI Plan

S. No.	Programme	Outlay (Rs. in crores)
i.	Integrated development of production & productivity	150.0
ii.	Post harvest management	150.0
iii.	Marketing	100.0
iv.	Export	100.0
	Total	**500.0**

vii.) National Training Facility for Horticulture

Table 15.19 Proposed outlay for national training facility for horticulture

S. No.	Component	Proposed Outlay (Rs. in crores)
i.	Land & Civil Work	15.0
ii.	Units, Structures & Fixtures	30.0
iii.	Farm Machinery & Transport facilities	10.0
iv.	Training/demonstration including maintenance of infrastructure and publication of bulletins/literatures	70.0
v.	Working capital for farm activities/ technology refinement	60.0
vi.	E. Salary	15.0
	Total	**200.0**

viii.). Horticulture Insurance

The tentative estimated financial requirement for this programme during XI Plan is Rs 500.0 crores.

ix.) Small Farmers' Horticulture Estates

The National Farmers Commission on Horticulture observed in its report that generally, small and marginal farmers have not benefited particularly from the fruit revolution in the country. This is primarily due to their poor competitiveness both at the production and post harvest phases. However, it is now well established that small and marginal horticulture farmers in particular will excel in improving productivity once they are assured of quick and easy disposal of their produce at reasonable returns. In clusters, specially in villages adjoining large consumption centres, small farmers should be helped to organize themselves as Small Farmers' Horticulture Estates in the form of SHGs covering an area of 200-500 hectares. SHGs may undertake specialized activities like seed production, tissue culture propagation, vermiculture, biofertilizer, biopesticides and e-commerce. They should be duly empowered through enhanced access to modern technologies, formal credit and marketing. Since horticultural commodities are mostly perishable, these need effective infrastructure support in the areas not only for production, but much more for processing, storage, transportation and marketing. The group action will confer on the small farmers the power of scale both at the production and post harvest phases of the horticultural enterprises.

To promote programme on small farmers' horticulture Estates as recommended by Dr. M.S. Swaminathan, Chairman, National Commission on Farmers, there is a need to launch special programmes. The estimated financial requirement for this programme during XI Plan is proposed as Rs 500.0 crores. The details of outlay are given in Table 15.20o.

Table 15.20 Proposed outlay for small farmers' horticulture Estates

S. No.	Programme	Outlay (Rs. in crores)
i.	Rejuvenation of old & senile orchards	150.0
ii.	Development of Water Resources	150.0
iii.	Training & Demonstration	100.0
iv.	PHM & Value Addition	100.0
	Total	**500.0**

X. National Bee Board

Table 15.21. Proposed outlay for National Bee Board

No.	Activity	X Plan outlay (Rs. in rores)
i.	Promotion of Nucleus stock production	50.00
ii.	Production & distribution of bee colonies	60.00
iii.	Development of Infrastructure for handling, marketing & Export	100.00
iv.	Capacity building	50.00
v.	Promotion of Honey	20.00
vi.	Establishment of Apex Honey Lab	10.00
vii.	Support to NBB	10.00
	Total	**300.00**

15.5. SUMMARY OF TOTAL OUTLAY FOR ELEVENTH FIVE YEAR PLAN (2007-12)

The overall requirement of funds for the development of horticulture during the XI Plan would be to the tune of Rs. 41,500 crores. The detailed breakup is given in Table 15.22.

Table 15.22 Summary of Outlay for Horticulture Development

S. No	Existing scheme	Projected Requirement during XI Plan (Rs. in crores)
	Ministry of Agriculture	
i	National Horticulture Mission (NHM)	15,000.0
ii	Technology Mission for Integrated Development of Horticulture in North East & Himalayan States	3,000.0
iii	National Horticulture Board (NHB)	1,000.0
iv	Micro irrigation	4,500.0
v	Coconut Development Board (CDB)	500.0
vi	Central Institute of Horticulture (CIH)	50.0
vii	National Bamboo Mission (NBM)	2,500.0
	Sub-Total	**26,550.0**
	Ministry of Commerce	
i	Tea Board	1,000.0
ii	Coffee Board	900.0
iii	Rubber Board	1,000.0
iv	Spices Board	1,500.0
v	APEDA	750.0
	Sub-Total	**5,150.0**
	Proposed Schemes for XI Plan Scheme	
i	National Vegetable Development Programme	1,400.0
ii	National Programme on Development of Commercial Floriculture and M&A Plants	2,400.0
iii	National Mission on Organic Farming	2,500.0
iv	Cashew Board	500.0
v	National Training Facility for Horticulture	200.0
vi	Planting Material Authority	1,000.0
vii	National Horticulture Information System	500.0
viii	Horticulture Insurance	500.0
ix	National Bee Board	300.0
x	Small Farmers Horti. Estates	500.0
	Sub-Total	**9,800.0**
	Grand Total	**41,500.0**

CHAPTER XVI
ORGANISATIONAL REFORMS

16.1. BACKGROUND

The importance of horticulture was realized before independence when Indian Central Coconut Committee (ICCC) was formed in February 1945 to promote research and development of Coconut in the country. The sector was given due importance soon after Independence, when Government of India established a Directorate of Coconut Development during 1966 by abolishing Indian Central Coconut Committee (ICCC). Similarly, Government created Directorate of Arecanut & Spices Development at Calicut and Directorate of Cashewnut and Cocoa Development at Cochin, Kerala, during 1966 under the Ministry of Agriculture. During the VII Plan period the Government of India accorded high priority for the development of horticulture sector by carving out a separate Division of Horticulture out of the Crops Division of the Ministry in 1981 and a position of Horticulture Commissioner was created in 1985. The Division has been vested with responsibility of overseeing the overall accelerated development of horticulture sector at the national level. Subsequently, a Task Force on "Group of Perishable Commodities" under the Chairmanship of Dr. M.S. Swaminathan, recommended creation of National Horticulture Board during 1981 for integrated development in post harvest management of horticulture produce. Accordingly the National Horticulture Board with its headquarters in Gurgaon was set up during 1984.

While a large number of programmes have been launched during IX and X Plan, development of infrastructure in the Division has not kept pace with number of programmes and increased budgetary allocations. As a result, the staff of the Division remains as it was during the VIII Plan except addition of two joint secretaries, one each in NHM and Horticulture Database. There are also two Joint Secretary rank officers each looking after the National Horticulture Board and Coconut Development Board. After the launching of National Horticulture Mission one Joint Secretary was appointed as Mission Director after considering several alternatives. Besides, a post of Joint Secretary was also created for looking after horticulture data base. A Technical Support Group comprising of four persons is also in existence to support the Division. This has resulted in multiplication of nodal points in the Ministry, resulting in horticulture becoming a multi window activity.

16.2. PRESENT ORGANIZATIONAL STRUCTURE

As a result of the above strengthening a number of agencies have come up in several other Ministries, besides, the Ministry of Agriculture. These are given below:

16.2.1 National

16.2.1.1 Ministry of Agriculture:

i) **Indian Council of Agriculture Research (ICAR)**: looks after research on all horticultural crops except Tea, Coffee and Rubber.

ii) **Department of Agriculture & Cooperation (DAC)**: looks after research on organic farming

iii) **National Agricultural Cooperative Marketing Federation of India (NAFED)**: looks after research and development of onion, garlic, etc.

16.2.1.2 Council of Scientific & Industrial Research (CSIR): looks after research on medicinal & aromatic plants, flowers and processing

16.2.1.3 Ministry of Commerce:

i) **APEDA**: Export of fruit, vegetables, seeds, processed fruits & vegetables and

organic farming.

ii) **Coffee Board**: Looks after research, development and export of coffee

iii) **Rubber Board**: Looks after research, development and export of rubber

iv) **Tea Board**: Looks after research, development and export of tea

v) **Spices Board**: looks after research, development and export of cardamom, ginger, saffron, etc.

16.2.1.4 Ministry of Rural Development: implements expansion of area of horticultural crops under employment guarantee scheme.

16.2.1.5 Ministry of Food Processing Industries: Processing and value addition.

16.2.2 Ministry of Agriculture

- Even in the Ministry of Agriculture, the horticultural programmes are not consolidated and are being implemented by many parallel units.
- Management of these programmes in the Ministry of Agriculture has been undergoing constant changes since the inception of the Division in 1985 as follows:

i. Initially Horticulture Commissioner was responsible for all the activities/ programmes in horticulture including the Coconut Development Board, National Horticulture Board, Directorate of Cashew and Cocoa Development and Directorate of Spices and Arecanut Development.

ii. Subsequently National Horticulture Board (NHB) was detached from the Division and kept under a Joint Secretary (credit) followed by Joint Secretary (NHB) and is currently under Joint Secretary (Horti. & NHM).

iii. Similarly, Coconut Development Board (CDB) continued to be under Horticulture Commissioner until the launching of the National Horticulture Mission. However it has been administratively been shifted under the control of Joint Secretary (Horti. & NHM).

16.2.3 Division of Horticulture

The organisational structure got a sea change after the launching of National Horticulture Mission during 2005-06, which can be seen in the Fig-16.1. The programme in horticulture were fragmented and distributed among several functionaries in the process losing its focus, technical guidance and major linkages with each other. The current allocation of work of horticulture division is as follows:

Horticulture Commissioner: is currently in-charge of the following schemes:

- Technology Mission for Integrated Development of Horticulture in North East Region and Himalayan States
- Central Institute of Horticulture
- National Bamboo Mission
- National Bee Board

Joint Secretary (NHM): is currently in-charge of the following schemes:

- National Horticulture Mission
- Micro-irrigation
- Coconut Development Board
- National Horticulture Board

Managing Director (NHB): is currently responsible to Joint Secretary (NHM)

Chairman, (CDB): is currently responsible to Joint Secretary (NHM)

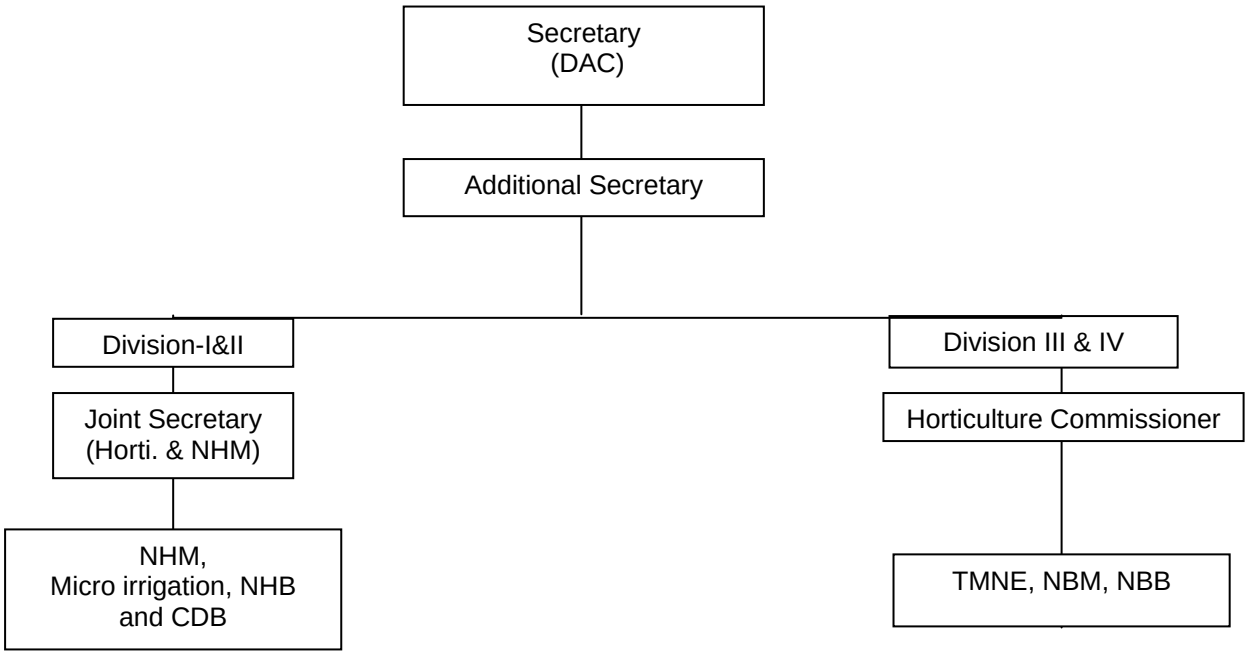
An Additional Secretary level officer, who has some other major responsibilities like extension, IT, NOVOD Board, Farm Machinery etc. is coordinating the overall functioning of the programmes of the Horticulture Division also.

16.3 CONSTRAINTS IN THE PRESENT ORGANISATIONAL STRUCTURE

The Horticulture Division now stands divided into two major sections with a haphazard and irrational allocation of work. The present arrangement has resulted in several constraints, which are as follows:

- The Technical manpower has got divided between the two nodal officers of the division, viz. Joint Secretary (NHM) and Horticulture Commissioner.

Fig 16.1 Current organisational structure of horticulture division



- While the Horticulture Commissioner is vested with subsidiary programmes e.g. Bamboo Mission/ Bee Board etc. The flagship programme of NHM has been left with a JS.
- Horticulture Commissioner has virtually no role to play in the implementation of the major horticultural initiative of the country i.e. NHM except being one of twenty one members of its Executive Committee Chaired by Secretary.
- Besides, NHB and CDB, which used to be directly under the Horticulture Commissioner, now have no linkage (technical/ finance) with Horticulture Commissioner.
- Even Chief Consultants employed for NHM, who are technical, are not attached to HC for guidance.
- As a result Horticulture Commissioner who is expected to be the Principal Advisor to the Ministry of Agriculture in all matters related to technical aspects of horticulture development is actually constrained as he cannot fulfil these responsibilities. This has led to lack of technical guidance at the nodal level, confusion and overlapping of programmes, affecting adversely implementation and monitoring of the programmes for horticulture development.

The current organisational structure of the horticultural programme is resulting in lot of duplication and overlapping and lacks vital linkages and therefore calls for rethinking and reorganisation of the organisational structure in the best interest of the utilisation of large allocation likely to be made during the XI Plan to enable achieve of the objective set for these programmes.

16.4 SUGGESTIONS FOR ORGANIZATIONAL REFORMS

It is therefore quite timely that the Division of Horticulture with a budget allocation of more than double than the Department of Agriculture Research and Education and Department of Animal Husbandry Dairying & Fisheries during X Plan is upgraded and restructured under the Ministry of Agriculture as suggested below:

- The position of Horticulture Commission (Ex Officio Joint. Secretary) should be upgraded to be equivalent in rank with that of the Agriculture Commissioner and Animal Husbandry Commissioner (ex officio Additional Secretary) in the Ministry of Agriculture.

The Working Group studied and discussed various options for restructuring of the Horticulture Division. While it is too complex a job to suggest a fool proof structure for the Division for its programmes, some suggestion for considerations are given below:

16.4.1 Consolidation of Different Organisations Devoted to Horticulture

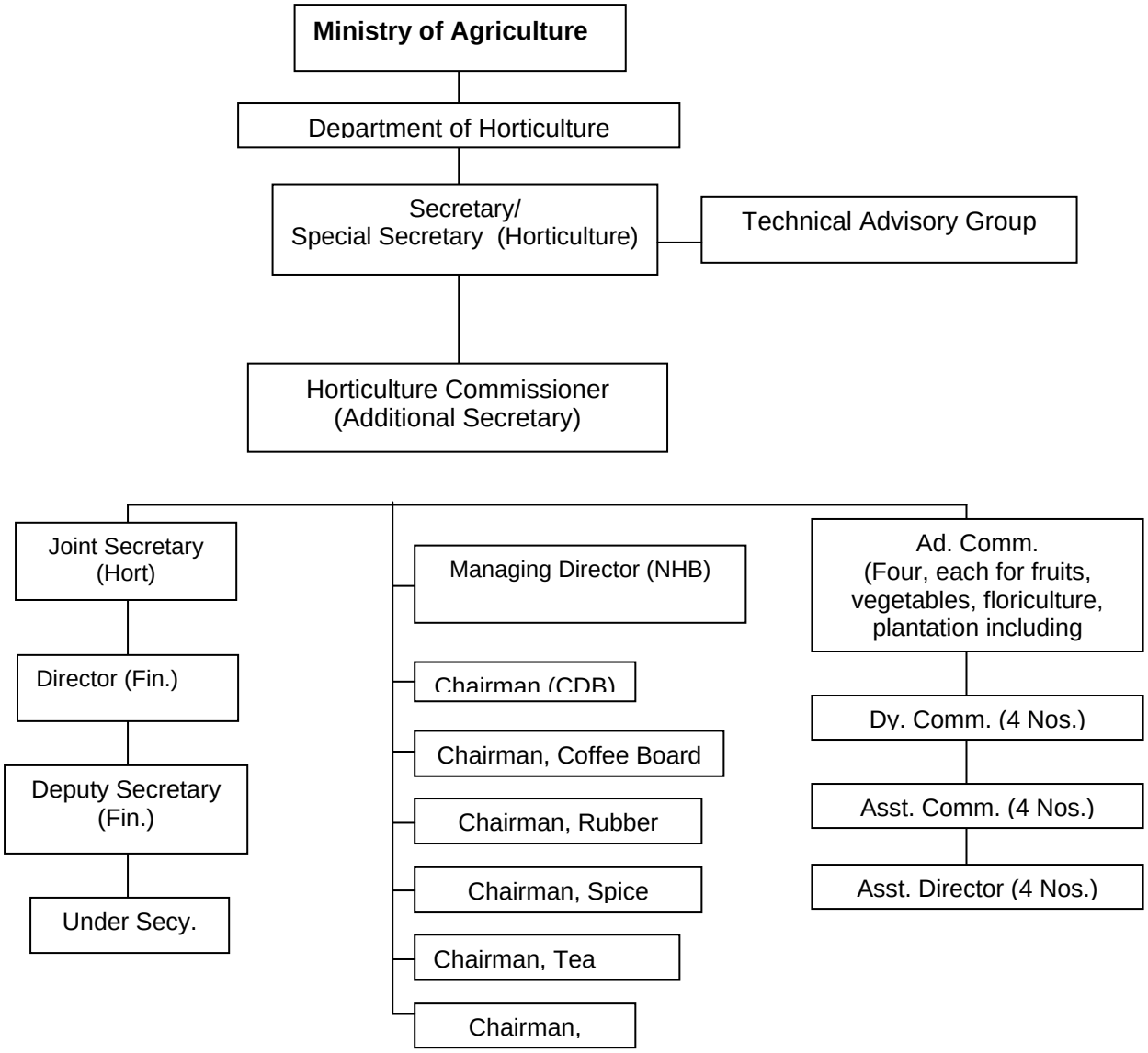
- All units engaged in horticultural activity in various Ministries eg. Ministry of Agriculture (NHM, TMNE, Microirrigation, NBM, NHB, CDB & NBB), Ministry of Commerce (APEDA, Coffee Board, Rubber Board, Spices Board & Tea Board), Ministry of Food Processing Industries and Ministry of Rural Development need to be integrated to form a Department of Horticulture under the Ministry of Agriculture with an independent Secretary or a pos of Special Secretary (Technical) exclusively for horticulture
- Alternatively, an Indian Council for Horticultural Research and Development be created, as suggested in 1993 by the than Agriculture Minister, to take care of all activities of R&D in horticulture including marketing and exports.
- Creation of a National Authority for Horticulture Development under Ministry of Agriculture, on the pattern of National Rainfed Development Authority in the Ministry of Agriculture, is also recommended in case the above modules are not found feasible.

16.4.2 Constitution of a Technical Advisory Group (TAG):

The Division of horticulture, which deals with more than 100 crops including fruits, vegetables, spices, floriculture, medicinal & aromatic plants etc and several aspects like production, plant protection, post harvest management, marketing and exports, calls for strong technical inputs to achieve desired objectives. It is therefore suggested, that the proposed Department of Horticulture, may be supported by a high level Technical Advisory Group of permanent nature to overview advice and monitor the technical programmes of the Division. This group will be responsible for providing technical inputs for systematic development of horticulture, creation and development of suitable literature, human resource development and data base. Though this group would be advisory in nature, all technical decisions requiring various interventions would be their responsibility. The group may be chaired by horticulturist and comprise of members with specialisation in (i) fruits & plantation crops (ii) vegetables & spices, (iii) floriculture & medicinal and aromatic plants, (iv) plant protection, (v) post harvest management and value addition (vi) marketing & export.

The proposed structure of the Division would thus be as given in Fig. 16.2.

Fig 16.2. Proposed organogram for department of horticulture



16.4.3. Considering the importance of horticulture in Indian economy, it is suggested that a post of Member (Horticulture) be created in the Planning Commission to provide technical guidance and linkages with the various programmes that are being implemented by different Ministries.

16.4.3 State Level Reforms

- Almost all the States except Goa, Jharkhand and Kerala have separate Department of Horticulture. Government of India should advise these states to create separate horticulture Departments in these States.
- Several crops within the purview of horticulture continue to be the responsibility of the Department of Agriculture in some State e.g.
  - Fruits- Oilpalm with oil seed crops
  - Floriculture- Department of Tourism (J&K)
  - Vegetables- Department of Agriculture (J&K)

- Potato- Department of Tourism (H.P.)
- Medicinal & Aromatic- Department of Agriculture (J&K)
- Coconut- Department of Agriculture (TN)
- Oilpalm- Department of Agriculture (TN)

  The consolidation of these crops with the State Department of Horticulture will help in implementing their programme in a sound and scientific manner

- Director (Horticulture) should be made State Mission In-charge of NHM. All officers down the line should have the background of horticulture.
- The posting of State officials should be made as per the cluster, which is indicated in the work plan, and accordingly their specialization should be considered for posting in NHM/ TMNE programme.
- At District level District Horticulture Officer should be made Mission in-charge instead of District Magistrate.
- All future employees of horticulture Department should be from horticulture stream.

Annexure-0.I

CHAIRMEN AND CO-CHAIR OF SUB-GROUPS OF WORKING GROUP ON HORTICULTURE

S.No.	Sub-Group	Chairman	Co-Chairman	Member Secretary
1.	Horticultural Research and Development	Dr. K.L. Chadha	Dr. S.P. Ghosh,	Dr. Jose C. Samuel D. S.N. Pandey
2.	Hi-tech Horticulture and Biotechnology	Dr. S.S. Magar	Dr. R.P. Sharma	Shri Prasanta Misra Dr. S.K. Singh
3.	Planting Material	Dr. R.P. Awasthi	Shri B.B. Pattanaik	Dr. S.K. Pandey Shri Sangram R. Jagtap
4.	Organic Farming	Dr. Tej Pratap	Dr. S.Dave	Dr S.K.Yadav
5.	Public- Private investment, risk assessment; Post Harvest Management and Marketing (including primary processing and Market Intelligence)	Mr. Gokul Patnaik	Mr. J.N. Chamber Sh. S.K. Pattanayak	Dr. A. S. Dhatt Shri A.D. Ratnoo
6.	Export , WTO and Price Fluctuation	Mr. K.S. Money		Shri. S. Dave
7.	Technology dissemination and Small and Marginal Farmers	Dr. C. Prasad	Dr. Jagmohan Singh	Dr.R. N. Padaria
8.	Human Resource Development and Data Base in Horticulture	Dr. Kirti Singh	Dr. A.K. Bhatia	Dr. B.D. Tripathi Shri Brijendra Singh
9.	Fruit and Plantation Crops	Dr. H.P. Singh	Mrs. Minnie Mathew	Dr.M.G.Bhatt Dr.V.B.Patel
10.	Vegetable Crops	Dr. K.V. Peter	Dr. T.A. More	Dr.Pitam Kalia
11.	Floriculture and Medicinal and Aromatic Plants	Dr. M.L. Choudhary	Dr. S.P.S. Khanuja	Dr.K.V.Prasad
12.	Plantation Sector	Shri G.V. Krishna Rau	Shri Basudev Banerjee	Mr.G.Boriah

Annexure-0.2

SUB-GROUP-1: HORTICULTURAL RESEARCH AND DEVELOPMENT

Dr. K.L. Chadha Ex. DDG (Hort.) and National Professor, Div of Fruits & Hort. Technology IARI Pusa, New Delhi-110012	Chairman
Dr. S.P. Ghosh Ex. DDG (Hort.) 68, Qutub View Apartments, Katwaria Sarai New Delhi	Co-Chairman
Dr. S.N. Pandey ADG (Fruits) ICAR KAB-II Pusa New Delhi-110012	Member Secretary
Dr. Jose C. Samuel Additional Commissioner (Hort.) Room No. 339 Division of Horticulture Krishi Bhavan New Delhi-110001	Member Secretary

Annexure-0.3

SUB-GROUP- II: HI-TECH HORTICULTURE AND BIOTECHNOLOGY

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Prof. Akhilesh Tyagi, University of Delhi, South Campus, Dhaula Kuan, New Delhi.	Member
Dr P. Ananda Kumar, Principal Scientist, NRC on Plant Biotechnology, IARI, New Delhi 110 012.	Member
Dr Renu Swaroop, Director, Department of Biotechnology, Ministry of Science and Technology (GOI), Block-2, CGO Complex New Delhi- 110 003	Member
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Dr Ramesh Chandra, Head, Division of Crop Improvement and Biotechnology, Central Institute for Sub-tropical Horticulture, PO Kakori, Rehmankhera, Lucknow-227 107	Member
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Dr P.S. Naik Principal Scientist, Central Potato Research Institute, Shimla, Himachal Pradesh,	Member
Dr V.A. Parathasrathy, Director, Indian Institute of Spices Research, Calicut, Kerala -673 012	Member
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Ms. Usha Barwale, Managing Director, MAHYCO, Jalna, Maharashtra	Member
Dr Sanjay Kapoor, Scientist, Institute for Himalayan Bioresource Technology, Palampur, Hiamachal Pradesh	Member
Dr. D.R. Sharma, Dean, Dr Y.S. Parmar University of Horticulture and Forestry, Solan, Himachal Pradesh	Member
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Sh. Prasanta Misra, JS, NCPAH 2 nd Floor, Himalaya House, 23 Kasturba Gandhi Marg New Delhi-110001	Member Secretary
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(Number of Meetings held: 3)

Annexure-0.4

SUB-GROUP-3: SUP – GROUP ON PLANTING MATERIAL

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S.K. Pandey — Member Secretary
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(Number of Meetings held: 2)

Annexure-0.5

SUB GROUP-4: ORGANIC FARMING

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Ms Binita Shah Centre for Organic Farming, 201 Vasant Vihar-1, Dehradun, Uttranchal	Member
Raj Shekhar Reddy Seelam, 24L Mantra Organic Super Store 203 Pavani Annexe, Banjara Hills, Hyderabad-500 034. AP	Member
Mr Sanjay Bansal Ambootia Tea Estate, 34 A Metcallfe Street Calcutta-700013	Member
Dr S.K.Yadav Regional Director, Regional Centre of Organic Farming MOA-GOI, N.S. Building Civil Lines, Nagpur-44001	Member Secretary

(Number of Meetings held: 3)

Annexure-0.6

SUB-GROUP-5: POST HARVEST MANAGEMENT AND MARKETING; PUBLIC PRIVATE INVESTMENT, RISK ASSESSMENT

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Shri P.M. Sinha Chairman Agriculture & Rural Development Committee FICCI B-787, Sushant Lok, Phase-I, Gurgaon-122002 Haryana	Member
Mr Vikram Puri, Chief Executive officer Mahindra Shubhlabh Services Limited Mahindra and Mahindra Ltd Mahindra Towers, 5th Floor, A- Wing Worli Mumbai- 400018	Member
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Mr Sanjeev Asthana — Member
CEO Reliance Agri Projects
Reliance Industries Limited
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DLF Cyber City – Phase II
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Mr Rahul Garg — Member
Chief Manager and Head-Global Agri Desk
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(Number of Meetings held: 1)

Annexure-0.7

SUB-GROUP-6: EXPORT, WTO AND PRICE FLUCTUATION

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Sh. S.K. Sharma, Executive Director, Global Agri Systems (P.) Ltd., K-13A, Hauz Khas Enclave New Delhi-110016	Member
Vijay Sardana. Executive Director Centre for International Trade in Agriculture and Agro-based Industries(CITA) Vaikunth (3rd Floor), 82-83, Nehru Place, New Delhi-110019	Member
Shri. S. Dave, Director, APEDA 3, Siri Institutional Area, August Kranti Marg, New Delhi - 110 016	Member Secretary

(Number of Meetings held: 3)

Annexure-0.8

SUB-GROUP- 7: TECHNOLOGY DISSEMINATION AND SMALL AND MARGINAL FARMERS

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Dr. G. Eshwarappa	Member

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(Number of Meetings held: 3)

Annexure-0.9

SUB-GROUP-8: HUMAN RESOURCE DEVELOPMENT AND DATA BASE IN HORTICULTURE

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Dr. Rajender Prasad, National Fellow IASRI, Library Avenue, PUSA, New Delhi - 110 012	Member
Dr B.S. Bisht ADG(HRD) 217 KAB II PUSA New Delhi- 110012	Member
Dr. G.K. Vasanta Kumar, Director of Horticulture, Govt. of Karnataka, Lalbagh, Bangalore - 560 001.	Member
Mr. Sunil Kumar Jain, Central Statistical Organisation (CSO), New Delhi	Member
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(Number of Meetings held: 3)

Annexure-0.10

SUB GROUP-9 SUB-GROUP ON FRUITS & PLANTATIONS CROPS

Dr. H.P. Singh Vice Chancellor Rajendra Agriculutre University Pusa, Samastipur- 848125 Bihar	Chairman
Mrs Minnie Mathew Chairman, Coconut Development Boar, Ministry of Agriculture, P. B. No. 1021, Kera Bhavan Kochi – 682 011, Kerala, India	Co-Chairman
Sri. Surjeet Choudhary, IAS APC & Secy (Hort.), Government of Tamil Nadu Chennai-600009. Tamil Nadu	Member
Professor Y.R. Chanana, Head, Deptt. of Horticulture, Punjab Agriculture University, Ludhiana	Member
Sh. P. Rethinam 18, Shree Laxmi Nagar S.N. Palayan, Sugarcane Breeding Institute Coimbatore-641 007 (TamilNadu)	Member
Sh. K.R. Maurya, Dean, Rajendra Agriculutre University Pusa, Samastipur- 848125 Bihar	Member
Sh. S.S. Mehta, President President, Amla Growers Association of India 256, Advaita Ashram Road, Fair Lands Salem – 636 016(TN)	Member

Sh. Ajit Jain — Member
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Dr. Tamil Selvan — Member
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Shri V.J. Kurian — Member
Chairman,
Spices Board
'Sugandha Bhavan'
N.H.By Pass Palarivattom.P.O
Cochin : 682028
Kerala

Dr. George V. Thomas — Member
Director,
Central Plantation Crops Research Institute,
Kasaragod-671124, Kerala

Dr. Shyam Singh, — Member
Director,
NRC on Citrus, P. O. Box-464,
Shankar Nagar P.O.
Nagpur- 440010
Maharashtra

Dr. A.A. Sofi — Member
Director
Central Institute Of Temperate Horticulture
P.O. Sanatnagar,
Srinagar – 190 005 (J&K)

Dr. Vasanta Kumar — Member
Director of Horticulture,
Govt. of Karnataka, Lalbagh,
Bangalore - 560 001.

Dr. M.G. Bhat — Member Secretary
Director,
NRC Cashew,
Puttur- 574202

Dr. V.B. Patel — Member Secretary
Scientist
Div of Fruits & Hort. Technology
IARI
Pusa, New Delhi-110012

(Number of Meetings held: 2)

Annexure-0.11

SUB-GROUP-10: VEGETABLE CROPS

Dr. K V Peter Professor (Hort) Kerala Agricultural University, Vellanikara Trichur - 680656 Kerala	Chairman
Dr. T A More Director of Research Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth Dapoli-415712 Ratnagiri Maharashtra	Co-Chairman
Dr. Mathura Rai Director, IIVR, PB No. 01 PO Jakhani (Shanshahpur), Varanasi-221305(UP).	Member
Dr. K.R.M. Swamy Head, Division of Vegetable Crops, IIHR Hessarghatta Lake Post, Bangalore-560089 (Karnataka).	Member
Dr. A.S. Sidhu Head Dept. of Vegetable Crops, PAU, Ludhiana-141004 (Punjab).	Member
Dr.N. Ahmed Dean (Agriculture) & Head, Department of Olericulture, Shere-E-Kashmir University of Agriculture & Technology, Shalimar, Srinagar-191121 (J&K).	Member
Dr. U.K. Kohli Dean, College of Horticulture, Dr. YS Parmar University of Horticulture & Forestry, Nauni, Solan (H.P.)	Member
Dr.T.Gopalkrishnan Head,Dept of Olericulture College of Horticulture, KAU P.O., Vellanikkara 680 654	Member

Shri J.C.Rana — Member
Director,
Department of Agriculture,
Himachal Pradesh,Boileoganj, Shimla-171 005 (HP)

Dr.Pranab.Hazara — Member
Professor,
Faculty of Horticulture
Bidhan Chandra Krishi Viswavidyalaya,
Mohanpur, West Bengal, 741255

Dr. Pritam Kalia — Member Secretary
Principal Scientist
Div of Vegetable Crops
IARI
Pusa, New Delhi-110012

(Number of Meetings held: 2)

Annexure-0.12

SUB-GROUP-11: FLORICULTURE AND MEDICINAL & AROMATIC PLANTS

Dr. M.L. Choudhary — Chairman
Horticulture Commissioner
Department of Agriculture & Cooperation,
Government of India
Room No. 239, Krishi Bhavan,
New Delhi-110001

Dr.S.P.S.Khanuja — Co-Chairman
Director,
Central Institute of Medicinal and Aromatic Plants (CIMAP)
P.O. CIMAP, Near Kukrail Picnic Spot,
Lucknow – 226015, India

Mr. Nadeem Ahmed — Member
MD, Tanflora Infrastructure Parks Ltd,
#824, 7th Main Road, 2nd Cross
HAL second Stage, Indira Nagar,
Bangalore-560008

Dr.P.K.Rajeevan, — Member
Head,
Department of Pomology and Floriculture,
KAU P.O. 680 656, Kerala Agriculture University,
Vellnikkara, Trichur, Kerala

Shri K. Natarajan — Member
President, Flower Growers Federation of India
Natural Synergies Ltd., 20 (Old 156)
Santhome High Road
CHENNAI – 600004 (t.n.)

Dr. S.B.Maiti, — Member
Director,
National Research Centre for M&A Crops,
Boriavi, Anand, Gujarat

Dr.R.S.Raina — Member
Associate Professor, Department of Medicinal and Aromatic Crops,
Dr.Y.S.Parmar University of Horticulture and Forestry
Nauni, Solan

Dr. Ramakant Harlalka — Member
Nishanth Aromas
424 Milind Industrial Estate
Cotton Green Park
Mumbai-200036

Dr.Girish Parikh Vice-President, Zandu Pharmaceutical Works Pvt. Ltd.. 70, Gokhale Road South, Dadar, Mumbai - 400 025	Member
Dr.Janardhan Scientist, CIMAP Central Institute of Medicinal and Aromatic Plants, P.O. CIMAP, Near Kukrail Picnic Spot, Lucknow – 226015, India	Member
Sh. Thakur Randhir Singh 298, E.P. Flat, Wazarat Road, Jammu Tawi (J&K)-180001	Member
Shri Rajesh Prasad Managing Director Zopar Exports, ELL WEE Haven Arbuthnot Road, Nongrimmaw, Laicumkhrah Shillong-793011	Member
Dr. C.S. Tyagi Head cum Coordinator IGMP, Medicinal & Aromatic Plants, Dept. of Plant Breeding CCSHAU, Hissar-125004 Haryana	Member
Mr. Rakesh Kumar Shukla Room No. 239 Department of Agriculture & Cooperation Krishi Bhavan New Delhi-110001	Member
Dr.K.V.Prasad Senior Scientist, Division of Floriculture and Landscaping, IARI, Pusa Campus New Delhi-110012	Member Secretary

(Number of Meetings held: 2)

Annexure-0.13

SUB-GROUP-12 PLANTATION SECTOR

Shri G.V. Krishna Rau Chairman Coffee Board, Bangalore-1 Fax.No: 080 22255557	Chairman
Shri.Basudev Banerjee Tea Baord, 14 BTM Sarani Kolkata- 700 001 West Bengal	Co-Chairman
Shri. Percy Temurasp Siganporia Managing Director Tata Tea Ltd 1 Bishop Lefroy Road Kolkata 700 019	Member
Shri. Sudhir Prakash Chairman Tea Research Association, 113 Park Street, 9th Floor Kolkata 700 016	Member
Shri. E.B. Sethna President, UPASI, Glenview, Coonoor 643101 Nilgiris Dt, Tamil Nadu	Member
Shri. Harish Bijoor Coffee Domain Specialist P-47 Gloden Enclave Airport Road Bangalore-560 017	Member
Dr. A. Deka Prof & Head Department of Tea Husbandry & Technology Assam Agricultural University Jorhat- 785 013	Member
Dr. Jayarama Director of Research Central coffee Research Institute Balehonnur 577117, Chikmagalur Karnataka	Member

Shri. K.G. Mohanan — Member
Deputy Rubber Production commissioner
Rubber Board,
P.B.1122, Keezhukunnu
Kottayam
Kerala 868 001

Shri. E.P. Ramanarayan — Member
Technical Officer
Coffee Board
1., Vidan soudha Veedi
(1.Dr. Ambedkar Veedi)
Bangalore –560001
Karnataka

Shri Rajesh N. Jagdale — Member
President, Vanilla Growers Association
Jagdale Industries Ltd.
782, 15 cross, 1st Phase,
J.P. Nagar, Bangalore
Tel: 08026635660
9845010741
Fax 080-2663527

Shri. G.Boriah — Member Secretary
Director of Tea Development
Tea Baord,
14 BTM Sarani
Kolkata- 700 001
West Bengal

(Number of Meetings held: 3)

Annexure- 2.1

LIST OF SOME RESEARCH INSTITUTES UNDER PUBLIC SECTOR WORKING ON HORTICULTURAL CROPS/ ISSUES

1. INDIAN COUNCIL OF AGRICULTURAL RESEARCH INSTITUTES

The Horticulture Division of the Indian Council of Agricultural Research, New Delhi nine research institutes, 11 national research centres and 13 coordinated research projects.

a. Major Thrust Areas

- Development of improved varieties/hybrids of fruits, vegetables, plantation crops, medicinal and aromatic crops, flowers and ornamental crops, spices, cashew, oilpalm with high production potential, biotic and abiotic resistance and export value.
- Standardization of techniques for rapid propagation of planting materials, agro-techniques, water management, integrated plant nutrient management system and integrated disease and pest management for horticultural crops.
- Evolution of appropriate horticultural based cropping systems for different agro-climatic areas.
- Development of post harvest handling, storage and processing system, product diversification and value addition.

b. Central institutes and Institutes

1. Indian Institute of Horticultural Research, Bangalore, Karnataka
2. Indian Institute of Vegetable Research, Varanasi, Uttar Pradesh
3. Central Institute for Sub-Tropical Horticulture, Lucknow, Uttar Pradesh
4. Central Institute of Temperate Horticulture, Srinagar, J&K
5. Central Institute of Arid Horticulture, Bikaner, Rajasthan
6. Central Potato Research Institute, Shimla, Himachal Pradesh
7. Central Tuber Crops Research Institute, Trivandrum, Kerala
8. Central Plantation Crops Research Institute, Kasaragod, Kerala
9. Indian Institute of Spices Research, Calicut, Kerala,
10. Central Agricultural Research Institute, A&N Group of Islands, Port Blair

c. National Research Centres

1. NRC for Cashew, Puttur, Karnataka,
2. NRC for Citrus, Nagpur, Maharashtra
3. NRC for Mushroom, Solan, Himachal Pradesh
4. NRC for Oilpalm, Pedavegi, Andhra Pradesh
5. NRC for Orchids, Pakyong, Sikkim
6. NRC for Grapes, Pune, Maharashtra
7. NRC on Medicinal and Aromatic Plants, Anand, Gujarat
8. NRC for Onion & Garlic, Rajgurunagar, Pune, Maharashtra
9. NRC for Banana, Trichi, Tamilnadu,
10. NRC on Seed Spices, Tabiji, Ajmer, Rajasthan
11. NRC on Pomegranate, Solapur, Maharashtra
12. NRC on Litchi, Muzzaffarpur, Bihar

d. All India Coordinated Research Projects

1. All India Coordinated Research Project on Betelvine, NRC for Medicinal and Aromatic Plants, Boriavi, Gujarat

2. All India Coordinated Research Project on Cashew, NRC Cashew, Puttur, Karnataka
3. All India Coordinated Research Project on Floriculture, Division of Floriculture & Landscaping, IARI, New Delhi
4. All India Coordinated Research Project on Mushrooms, National Centre for Mushroom Research & Training, Chambaghat, Solan, Himachal Pradesh
5. All India Coordinated Research Project on Palms, CPCRI, Kasaragod, Kerala
6. All India Coordinated Research Project on Arid Fruits, CIAH, Bikaner
7. All India Coordinated Research Project on Potato, Central Potato Research Institute, Shimla, Himachal Pradesh
8. All India Coordinated Research Project on Subtropical Fruits, Central Institute for Sub-Tropical Horticulture, Lucknow, Uttar Pradesh
9. All India Coordinated Research Project on STF (Grapes), NRC for Grapes, Pune, Maharashtra
10. All India Coordinated Research Project on Spices, Indian Institute of Spices Research, Marikunnu, Calicut, Kerala
11. All India Coordinated Research Project on Temperate Fruits, CITH, Srinagar (J&K)
12. All India Coordinated Research Project on Tropical Fruits, IIHR, Hessaraghatta Lake Post, Bangalore, Karnataka
13. All India Coordinated Research Project on Tuber Crops, Reg. Stn. of CTCRI, Thiruvananthapuram, Kerala
14. All India Coordinated Research Project on Vegetables, IIVR, Varanasi, Uttar Pradesh

Besides these there are several multi-crop institutions which also work on different horticultural crops and there related issues like IARI, New Delhi, ICAR Complex for NE Region, Shillong, ICAR Complex for Goa, Panji, HARP, Ranchi etc.

2. COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH LABORATORIES

1. Central Food Technological Research Institute, Mysore
2. Central Institute of Medicinal & Aromatic Plants, Lucknow
3. Institute of Himalayan Bioresource Technology, Palampur
4. National Botanical Research Institute, Lucknow
5. National Chemical Laboratory, Pune
6. Regional Research Laboratory, Bhubaneswar
7. Regional Research Laboratory, Jammu
8. Regional Research Laboratory, Jorhat
9. Regional Research Laboratory, Thiruvananthapuram

3. DEFENCE RESEARCH & DEVELOPMENT ORGANISATION (DRDO)

1. Field Research Laboratory (FRL), Ladakh, (J&K)
2. Defence Agricultural Research Laboratory, Pithoragarh (Uttaranchal)
3. Defence Food Research Laboratory (DFRL), Mysore
4. Defence Research Laboratory, Post bag No.2, Tezpur (Assam)

Annexure –2.2

TECHNOLOGIES DEVELOPED

I. Technologies for commercialization developed by the ICAR

- Zero energy cool chamber.
- Indigenous fruit based beverages from *bael* & *jamun* fruits
- Fruit based carbonated beverages
- Whole tomato crush
- Post harvest technology of cut roses
- Crop regulation technique in guava
- Technology for mass multiplication of ber plants in short time
- Technology for long term preservation of raw mango slices in brine for use in pickling
- Management of post-harvest decay in citrus management of post-harvest decay in citrus
- Production of vermouth type medicated wine from grape
- Mechanized sorting, wax treatment and grading of citrus fruits
- Low cost processing of cereals and spices
- Small scale dehydration of vegetables
- Potato chips at rural level
- Solar candle making machine
- Extraction of essence from curry leaves
- Pectin & fibre extraction from mango peel

Besides above a list of technologies available for transfer and identified for wide adoption as identified by a group of experts at the National Academy of Agricultural Science during its Round table Conference are listed hereunder.

Sl. No.	Name of crop	Technologies/ support available for sharing
1	Mango	• Availability of promising varieties and scion shoots of new colons, • Density plantation, • Technology up gradation in propagation, rejuvenation, IPNM, IPM Post Havest handling and Value addition,
2	Guava	• Availability of promising varieties and scion shoots of new clones, • Density plantation, • Technology up gradation in propagation, rejuvenation, Integrated Plant Nutrient, Pest Disease Management, Post Harvest Handling and value addition
3	*Aonla*	• Availability of promising varieties and bud wood of new clones, • Technology up gradation in propagation, rejuvenation, Integrated Plant Nutrient, Pest, Disease Management, • Post Harvest Handling and Value Addition.
4	Grape	• Availability of promising table, wine varieties and rootstocks. • Integrated Nutrient, Pest Disease Management, • Technology up gradation in Post Harvest Technology, Sanitary, Phyto sanitary measures, residual toxicity assessment

5	Citrus	• Promising varieties, rootstocks, • Technology up gradation in newer methods of propagation, density plantation, • Integrated plant nutrient, water, pest & disease management. • Post Harvest Handling, Value addition
6	Banana	• Promising verities, Tissue cultured (TC) plants, • Density plantation, • Integrated Plant Nutrient, Pest, Disease management, • Post Harvest Handling, Value Addition, • Distant marketing.
7	Pineapple	• Density Planting, Crops Regulation
8	Papaya	• Seeds of promising varieties, • Density plantation • Integrated Crop Management Practices,
9	Pomegranate	• Improved varieties, • Density plantation. Crop regulation, • Integrated Nutrient, Water, Pest, Disease Management, • Post Harvest Handling and Value Addition
10	Litchi	• Promising varieties, • Density Plantation, Rejuvenation, • Post Harvest Handling & Value Addition
11	Sapota	• Planting material, Density Plantation, • Post Harvest Handling
12	Tomato	• Seeds of promising varieties including hybrids, • Parental lines and Tech. Up gradation for seed production, • Use of agro-nets and low cost polyhouse for seedling product8ion and off-season vegetable cultivation, • IPNM, IPMM, IDM and Post Handling and Value addition
13	Chillies	- do -
14	Capsicum	- do -
15	Cucurbits	- do -
16	Onion	• Seeds of promising varieties, • Production technology for main season and Kharif, • Seed and seeding production technology, • IPNM, IPM, IDM, • Post harvest handling and storage.
17	Flowers: Rose Carnation, Gladiolus Gerbera, Anthurium, Orchids etc	• Promising varieties including planting materials • Production technology in open and, protected condition, • Post Harvest Handling and Value addition
18	Cashew	• Availability of improved varieties, • Tech. Up gradation in propagation. • Establishment and management of “Scion Bank” • Vermin-composting, • Density Plantation,

		• Integrated water, nutrient, pest and disease management • Post harvest Handling and Value Addition
19	Coconut	• Availability of improved varieties, • Establishment of Nucleus Seed Garden, • Tech. Up gradation in coconut based farming, • Establishment of Nucleus Seed Garden • Promotion of Coconut based Farming, • High Density Multi Species Cropping System (HDMSCS), • Integrated Water. Pest and Disease Management, Post harvest handling and value addition
20	Cocoa	• Promising varieties and hybrids, • Tech. Up gradation in p in propagation, • Establishment of Clonal Seed Garden
21	Black pepper	• Availability of HYV, • Tech. Up gradation in rapid multiplication, • Crop management technology, • Integrated Pest and Disease Management, • Post Harvest Handling and Value addition,
22	Ginger	• Availability of improved varieties, • Tech. Up gradation in rapid multiplication, • Integrated Pest and Disease Management, • Post Harvest Handling and Value addition
23	Turmeric	- do-

Annexure-3.1.

NORMS OF ASSISTANCE FOR PROGRAMMES UNDER TECHNOLOGY MISSION FOR INTEGRATED DEVELOPMENT OF HORTICULTURE IN NORTH EASTERN REGION AND HIMALAYAN STATES

Mini Mission –I	Assistance
Seed and planting material(Supply of nucleus/basic seed and planting material of Horticulture crops)	Project based
Technology standardization (Standardization of production and protection technologies in fruit, vegetable, spices and plantation crops , development of organic farming practices and eco- friendly integrated pest and disease management)	Project based
Technology refinement (Technology refinement and imparting training through on farm trials on farmers fields and training to extension functionaries.)	Project based

Mini Mission-II

Sl. No	**Name of the Crop**	**Unit**	**Percentage assistance**	**Maximum limit**
1.	(a) Fruits (perennials) +	Hectare	(a) 75%	Rs. 22,500
	(b) Fruits (no-perennials) ++		(b) 50%	Rs. 15,000 Rs. 15,000
	(c) Rejuvenation of senile plantations +++		(c) 50%	
2.	Vegetables*	-do-	50%	Rs. 13,000
3.	Root and Tuber Crops	-do-	50%	Rs. 13,000
4.	Spices	-do-	50%	Rs. 13,000
5.	Cashew nut	-do-	50%	Rs. 13,000
6.	Medicinal Plants	-do-	50%	Rs. 13,000
7.	Aromatic Plants	-do-	50%	Rs. 5,000
8.	Floriculture	1unit of 0.2 ha.	50%	Rs. 13,000

1. Production of planting material

(i) Integrated multicrop nursery;

a. Nursery - 50 % of the cost limited to Rs. 8.00 lakhs for big nursery and Rs. 3.00 lakh for small nursery in private and 100% cost limited to R. 18.00 lakh in public sector for big nursery and Rs. 3.00 lakh for small nursery. Progeny and herbal gardens Rs. 3.00 lakh for public sector and Rs. 1.50 lakh for private sector.

b. Tissue culture- 50% of the cost limited to Rs.10.00 lakhs for Private/NGO and100% of the cost limited to Rs. 21.00 lakhs Public

2. Expansion of area

(i) Fruits (perennials) - assistance @75% of the estimated cost of cultivation of Rs.30000/-subject to a maximum of Rs.22,500/ ha limited to 4 ha per beneficiary. The assistance for cultivation will be spread over for a period of three years in the ratio of 50:30:20 in the first, second and third year respectively. Assistance for the second year will be subject to 75% survival of the new gardens and for the third year, the assistance will be subject to 90% survival of the plants. The perennial fruit crops covered under the scheme are orange, lime, lemon, mango, guava, litchi, pomegranate, apple, passion fruit, kiwi, walnut, cherry, pear, peach and others.

(ii) Fruits (non-perennials) - assistance @50% of the estimated cost of cultivation of Rs.30000/ subject to a maximum of Rs.15,000/ha, limited to 4 ha./beneficiary. The assistance for cultivation will be spread over for a period of three years in the ratio of 50:30:20 in the first, second and third year respectively. Assistance for the second year will be subject to 75% survival of the new gardens and for the third year, the assistance will be subject to 90% survival of the plants. The non- perennial fruit crops covered under the scheme are banana, pineapple, strawberry and papaya.

(iii) Rejuvenation of senile plantations – assistance @ 50% of the estimated cost of rejuvenation of Rs.30000/ subject to a maximum of Rs.15,000/ha limited to 2 ha/ beneficiary.

(iv) Protected cultivation – Assistance @ 50% of the cost for covering up to 1000 sq.m (@ Rs.325/Sq.m for hi-tech and Rs.125/Sq.m for normal green houses).

(v) Promotion of Integrated Nutrient Management (INM) / Integrated Pest Management (IPM) – Sanitary and Phytosanitary - 100% assistance to Public Sector on project basis for creation of infrastructure for sanitary and phytosanitary certification facilities.

(vi) Pollination support through bee keeping – 50% of the cost subject to a maximum of Rs.800/- per colony with beehive.

3. Creation of Water Sources:

(i) Community Tanks- Rs. 10.00 lakhs/ tank @ Rs. 1.00 lakh per ha.

(ii) Tubewells –@ 50% of cost limited to maximum of Rs.12,500/- per tubewell

(iii) On farm water management: Existing scheme of “Horticulture Development through Plasticulture Intervention”- 50% of the cost limited to Rs 28,500/-

4. Transfer of technology Through training front line demonstration, publicity and training of trainers:

i. Farmers Training-Rs. 1500/ farmer for 7 days;

ii. Training outside the state – Rs.2500/farmer

iii. Training of trainers –Actual cost limited to Rs. 50,000 per trainee

iv. Supervisor Level Training centre – Supervisory-Rs.20.00 lakhs

v. Gardener- Rs. 2.0 Lakhs

5. Organic farming

i. Existing schemes of fertilizer Division for Bio fertilizer production/promotion.

ii. Earthworm multiplication farm-Rs. 30,000 per unit;

iii. Incentive for adopting organic farming-Rs.10000/ ha.

iv. Assistance for obtaining certification-90% of the cost limited to Rs. 5 lakhs for group of farmers

6. Promotion and Popularization of agriculture equipments

i. Training to farmers – Rs.1,000/ farmer; Assistance for purchase of equipments limited to Rs. 1500/- for manually operated, Rs. 5,000 for power operated, Rs. 45,000 for power tiller and Rs. 9,000 for diesel engine.

7. Integrated Pest management

i. Setting up of Bio-control Labs. @Rs.80.00 lakhs per Lab in public sector and 50% of cost in private sector upto maximum of Rs. 40.00 lakhs.

ii. Financial assistance of Rs.1000/ha, for adoption of IPM (use of biopesticides, pheromones, etc.) covering an area of 11,600 ha.

iii. Assistance for forewarning of pests and diseases @ Rs.4.00 lakhs per unit per year

iv. Plant health clinic: Rs. 20.00 lakhs for Government/ PSU and Rs. 5.00 lakhs for private sector

v. Leaf analysis laboratory: Rs. 20.00 lakhs for Govt/ PSU and Rs. 5.00 lakhs for Private sector.

8. Women development

100% Govt. assistance as per the approved scheme of DAC “Women in Agriculture for North- eastern States”.

9. Remote sensing: Project based, as per requirement

Mini Mission-III

1. Post harvest management (NHB)

a. Controlled Atmospheric (CA) storage – Credit linked back - ended capital subsidy @ 33.33% of the project cost of Rs.16.00 crore/ unit.

b. Cold storage - Credit linked back-ended subsidy @ 33.33% of the project cost of Rs.2.00 crore/ unit.

c. Technology development – 100%

d. Strengthening of nutritional status Rs. 250/minikit/faimily, Rs. 2,500 for zero energy cool chambers and Rs. 5,000 per school for demonstration

2. Marketing (Directorate of Marketing and inspection)

a. Establishment of Market infrastructure (Wholesale markets**)** – Credit linked back-ended subsidy@ 33.33% of the project cost of Rs.100.00 crore.

b. Rural primary market @50% of project cost with maximum limit of Rs. 7.50 lakhs

c. Apni mandi's 50% maximum limit of Rs. 7.5 lakhs

d. Quality control through strengthening of laboratories 100% of project cost with maximum limit Rs. 2.5lakhs

e. Alternate Marketing System -25% of the project cost with maximum limit of Rs. 60 lakhs.

Mini Mission-IV

1. Promotion of new unit –Credit linked back ended capital investment assistance of -50%of cost with maximum limit of Rs. 4.00 crores

2. Upgradation and modernization of existing units: back ended capital investment subsidy- 50% of capital cost with maximum limit of one crores.

3. Promotional activities – as per MFPI pattern.

Annexure: 3.2

NORMS OF ASSISTANCE FOR PROGRAMMES UNDER NATIONAL HORTICULTURE MISSION

S. No.	Programme	Estimated Cost	Assistance
A.	**PLANTATION INFRASTRUCTURE & DEVELOPMENT**		
1	Production of planting material		
	a) Public sector		
	i. Model nursery (4 ha)	Rs. 18.00 lakh/unit	Maximum of Rs. 18.00 lakh per nursery
	ii. Small Nursery (1 ha.)	Rs. 3.00 lakh per unit	Maximum of Rs. 3.00 lakh per nursery
	iii. Rehabilitation of existing tissue culture units	Rs. 8.00 lakh/unit	Maximum of Rs. 8.00 lakhs per unit
	iv. Rehabilitation of TC labs and related units in SAUs	Rs. 8.00 lakh/unit	Maximum of Rs. 8.00 lakh per unit
	b) Private sector		Credit linked back ended subsidy
	i. Model nursery (4 ha)	Rs. 18.00 lakh/unit	50% of cost limited to Rs. 9 lakh/nursery
	ii. Nursery (1 ha.)	Rs. 3.00 lakh per unit	50% of cost limited to Rs. 1.5 lakh/nursery
	iii. Rehabilitation of existing tissue culture units	Rs. 8.00 lakh/unit	50% of cost limited to Rs. 4.00 lakhs
	iv. Vegetable seed production		
	a. Public Sector (ICAR, SAUs & State Depts.)	50,000 per ha	100% of the total cost
	b.Private sector	-do-	50% of the total cost subject to maximum of Rs. 25,000/ha limited to 5 ha.
	v. Seed Infrastructure		
	a. Public Sector	Project based	100% of cost
	b. Private sector	Project based	25% of cost as credit linked back ended subsidy
2	**Establishment of new gardens (ha.)**		
	i. Fruits (Perennials)		
	a. Small & Marginal	Rs. 30,000/ha (average)	75% of cost subject to a maximum of 2 ha/beneficiary for Small Scale Growers
	b. Other farmers	-do-	75% of cost subject to a maximum of Rs. 22,500/ha limited to 4 ha/beneficiary

	ii. Fruits (Non-Perennials)		Maximum of Rs. 15,000 per ha limited to 4 ha/beneficiary
	iii. Flowers		
	(**A) Cut Flowers**	70,000/ha	
	a. Small & Marginal Farmers		50% of the cost @ Rs. 35,000/ha limited to 2 ha. per beneficiary
	b. Other farmers		33% of the cost @Rs. 23,100/ha limited to 4 ha per beneficiary
	(B) Bulbulous Flowers	90,000/ha	
	a. Small & Marginal Farmers		50% of the cost @ Rs. 45,000/ha limited to 2 ha. per beneficiary
	b. Other farmers		33% of the cost @Rs. 29,700/ha limited to 4 ha per beneficiary
	(**c) Loose Flowers**	24,000/ha	
	a. Small & Marginal Farmers		50% of the cost @ Rs. 12,000/ha limited to 2 ha. per beneficiary
	b. Other farmers		33% of the cost @Rs. 7,920/ha limited to 4 ha per beneficiary
	iv. Spices, Aromatic Plants		
	a. Small & Marginal	Rs. 15,000/ha (average)	75% of cost limited to 2 ha per beneficiary
	b. Other farmers	-do-	75% of cost subject to a maximum of Rs. 11,250/ha limited to 4 ha per beneficiary
	v. Plantation crops including coastal horticulture		
	a. Small & Marginal	Rs. 15,000/ha (average)	75% of cost limited to 2 ha per beneficiary
	b. Other farmers	-do-	75% of cost subject to Rs. 11,250/ha limited to 4 ha per beneficiary
3	**Rejuvenation/ replacement of senile plantation**	Rs. 30,000/ha (average)	50% of the total cost subject to a maximum of Rs. 15,000/ha limited to 2 ha per beneficiary
4	**Creation of water resources sources**		
	Community tanks on farm ponds on farm water reservoir	Rs. 10.00 lakh/unit	Upto Rs.10 lakh /unit of 10 Ha.

	-(No.) with use of plastics-100% assistance		
5	**Protected cultivation**		
	1. Green House (Hitech)		
	a. Small & Marginal Farmers	Rs. 650/ Sq. m.	50% of the cost subject to a maximum of Rs.325/Sq.m for hi-tech and Rs.125/Sq.m for normal GH, limited to1000 Sq.m./beneficiary
	b. Other farmers	-do-	33.3% of cost subject to a maximum of Rs.215/sq.m for hi-tech and Rs.67/Sq.m for normal GH limited to 1000 Sq.m.
	2. Mulching	Rs. 14,000/ha	50% of the total cost subject to a maximum of Rs. 7000/ha limited to 2 ha per beneficiary
	3. Shade Net	Rs. 14 / Sq. m.	50% of cost subject to a maximum of Rs. 3500/ 500 Sq.m limited to 2 ha per beneficiary
	4. Plastic Tunnel	Rs. 10 / Sq. m.	50% of cost subject to a maximum of Rs.5000/1000 Sq.m limited to 5 ha per beneficiary
6.	**Precision Farming development and extension through PFDCs**	Project based	100 % of cost to PFDCs.
7.	**Promotion of INM/IPM**		
	i. Sanitary and Phytosanitary (Public Sector)	Project based	project based
	ii. Promotion of IPM	Rs. 2000/ha	50 % of cost subject to a maximum of Rs 1000/ha limited to 4 ha./ beneficiary
	iii. Disease fore casting units (PSUs)	Rs. 4 lakhs/unit	Upto Rs. 4 lakh/unit
	iv. Bio-control labs	Rs. 80 lakhs/unit	
	a) Public Sector		Upto Rs. 80 lakh/unit
	b) Private Sector		Upto Rs. 40 lakh/unit
	v. Plant health clinics)	Rs. 20 lakhs/unit	
	a) Public Sector		Upto Rs. 20 lakh/unit
	b) Private Sector		Upto Rs. 10 lakh/unit
	vi. Leaf/Tissue analysis labs.	Rs. 20 lakhs/unit	
	a) Public Sector		Upto Rs. 20 lakh/unit
	b) Private Sector		Upto Rs. 10 lakh/unit

8.	**Organic Farming**		
	1. Adoption of organic farming	Rs. 20,000/ha	50% of cost subject to a maximum of Rs.10000/ha limited to 4 ha. per beneficiary.
	2. Vermi compost units	Rs. 60,000/unit	50% of cost subject to a maximum of Rs.30000/unit
	3. Certification	Project based	Rs.5 lakhs in cluster of 50 hectares
9	HRD including horticulture institute	Project based	100% assistance
10	Pollination support through beekeeping	Rs. 1600 per colony with hive	50% of the cost subject to maximum of Rs.800/ colony with beehive
11	Technology dissemination through demonstration/Front line demonstration	Project based	75% of cost
B.	**POST HARVEST MANAGEMENT**		
	1. Pack houses	Rs. 2.50 lakh/unit	Credit linked back-ended subsidy @ 25% of the capital cost of project.
	2. Cold storage units	Rs. 2.00 crore/unit	-do-
	3. C.A Storage	Rs. 16.00 crore/unit	-do-
	3. Ref. vans / containers	Rs. 24.00 lakh/unit	-do-
	4. Mobile Processing Units	Rs. 24.00 lakh/unit	-do-
	5. Market Intelligence	Project based	Project based
	6. Buy back intervention	Project based	Project based
	7.Establishment of Marketing Infrastructure for horticultural produce in Govt./Private/Cooperative sector		Credit linked back-ended subsidy @ 25% of the capital cost of project in general case and 33.33% in the case of hilly, backward States.
	a) Wholesale markets	upto Rs. 100.00 crores	-do-
	b) Rural Markets/Apni Mandis/ Direct Markets	Rs. 15.00 lakh	-do-
	c) Functional Infrastructure for collection, grading etc.	Rs. 15.00 lakh	-do-
	d) Extension, quality awareness and market led extension activities for fresh processed products	Project based	100% assistance
C.	**PROCESSING & VALUE ADDITION**		The MFPI will sanction projects on food processing out of their budget provision.

D.	**MISSION MANAGEMENT**		
	(i) State & Districts Mission Structure including additional manpower & project preparation cost		5% of total annual expenditure on the basis of appraised needs
	(ii) Support to cooperatives for infrastructural requirement		Project based
	(iii) Institutional Strengthening, hire/purchase of vehicles, hardware/software		Project based
	(iv) Technical Support Group (TSG) Institutional strengthening		Project based subject to a ceiling of Rs. 5 crore per annum
	(v) Collaboration with International agencies like FAO, World Bank etc.		Project based

Annexure-3.3

NORMS OF ASSISTANCE FOR PROGRAMMES UNDER NATIONAL BAMBOO MISSION

Sl. No.	Programme	Estimated Cost	Revised pattern of assistance
A	**Research & Development**		
1.	Research on:		
	a. Harvesting & Sustainable Development	Project based	100% to Public/Private Sector Institutes
	b. Developing new Bamboo Agro forestry techniques	-do-	-do-
	c. Bamboo & Livelihood	-do-	-do-
B	**Plantation Development**		
1.	Planting Material (Forest Area)		
	A. Centralized Nurseries		
	i) Public Sector (0.25 ha)	2.73 lakhs	100% assistance subject to a maximum @ Rs. 2.73 lakhs per Nursery.
	ii) Private Sector (0.25 ha)	2.73 lakhs	25% of cost subject to a maximum of Rs. 68,000 each as credit linked back ended subsidy.
	B. Nurseries in Private Sector		
	i) Kisan Nurseries (0.10 ha)	Rs. 26,000/- per unit	25% of cost subject to a maximum of Rs. 6,500/- per Nursery.
	ii) Mahila Nurseries (0.10 ha)	Rs. 26,000/- per unit	25% of cost subject to a maximum of Rs. 6,500/- per Nursery.
2	Planting Material (Non-Forest Area)		
	A. Centralized Nurseries		
	i) Public Sector (0.25 ha)	2.73 lakhs	100% assistance for subject to a maximum @ Rs. 2.73 lakhs per Nursery.
	ii) Private Sector (0.25 ha)	2.73 lakhs	25% of cost subject to Rs. 68,000 each as credit linked back ended subsidy
	B. Nurseries in Private Sector		
	i) Kisan Nurseries (0.10 ha)	Rs. 26,000/- per unit.	25% of cost subject to a maximum of Rs. 6,500/- per Nursery.

Sl. No.	Programme	Estimated Cost	Revised pattern of assistance
	ii) Mahila Nurseries (0.10 ha)	Rs. 26,000/- per unit.	25% of cost subject to a maximum of Rs. 6,500/- per Nursery.
3	Funds for Certification of Planting Material	Project based.	100% assistance to Public/Private Sector Institutes.
4	a. Tissue Culture Units in Public Sector (Nos)	Rs. 21.00 lakhs per TC unit	100% assistance to PSUs, maximum of Rs. 21.00 lakh.
	b. Tissue Culture Units in Private Sector (Nos)	Rs. 21.00 lakhs per TC unit	50% assistance subject to a maximum of Rs. 10.50 lakhs as credit linked back ended subsidy at par with Technology Mission for the Development of North-Eastern Region(TMNE)
5	Area Expansion (Captive Plantation)		
	a) Forest Area through JFMCs (ha)	Rs. 25,000/ha	100% assistance in two equal installments. (50:50)
	b) Non Forest Area through NGOs, SHGs, Individual Farmers, Farm Associations (ha)	Rs. 16,000/ha	50% of cost subject to a maximum of Rs. 8,000 per ha subject to the limit 4 ha per /beneficiary.
6	Improvement of Existing Stock (ha)	Rs. 8000/ha	100% assistance subject to the limit 2 ha per beneficary for non-forest area.
7	Technology Transfer & HRD		
	a. Training of Farmers/ entrepreneurs	Project Based	Rs. 1520/- per participant for within State; Rs. 2500/- each outside State of seven days.
	b. Training of Field Functionaries	Project Based	Rs. 8000/- per participant for a period of seven days.
	c. Demonstration of Plantation Technology	Project Based	50% of cost subject to a maximum of Rs. 10,000/ha. for a maximum area of 0.50 ha per beneficiary.

Sl. No.	Programme	Estimated Cost	Revised pattern of assistance
	d. Workshops/ Seminars/Training	Project Based	100% assistance.
	i) International Level	Project Based	100% assistance subject to a maximum of Rs.40 lakhs.
	ii) National Level	-do-	100% assistance subject to a maximum of Rs.5.00 lakh per event of two days.
	iii) State Level	-do-	100% assistance subject to a maximum of Rs.3.00 lakh per event of two days.
	iv) District Level	-do-	100% assistance subject to a maximum of Rs.1.00 lakh per event of two days.
8	Pest and Disease Management At the Plantation Level (ha)	Rs. 400/ha	50% of cost subject to a maximum of Rs. 200/- per beneficiary per ha to a limit of 2 ha for non-forest area.
9.	Innovative Interventions	Project Based	100% assistance
10.	Post harvest storage and treatment facilities	Project based	100% assistance subject to maximum of Rs.20 lakh per unit
11	Irrigation		
	Micro-Irrigation in Non Forest Area (ha)	Rs.40,000/ha	50% of cost subject to a maximum of Rs. 20000/- per ha to a limit of 4 ha. per beneficiary.
C.	**Handicrafts, Marketing and Exports**		
1.	Bamboo Wholesale & Retail Markets (Nos.)		
	a. Bamboo Wholesale & Retail Markets near Villages (Nos.)	Rs.16.00 lakhs per unit	25% of cost subject to a maximum of Rs. 4.00 lakh for general areas and 33.33% of cost subject to a maximum of Rs. 5.33 lakh for Hilly/Tribal area.
	b. Bamboo Bazars (Nos.)	Rs. 27.00 lakhs per unit	25% of cost subject to a maximum of Rs. 6.75 lakh for general areas

Sl. No.	Programme	Estimated Cost	Revised pattern of assistance
			and 33.33% of cost subject to a maximum of Rs. 9.00 lakh for Hilly/Tribal area.
	c. Retail Outlets (Showrooms) (Nos.)	Rs. 40.00 lakhs per unit41	25% of cost subject to a maximum of Rs. 10.00 lakh for general areas and 33.33% of cost subject to a maximum of Rs. 13.33 lakh for Hilly/Tribal area.
	d. Innovative interventions	Project Based	100% assistance
2.	Participation in Domestic Trade Fairs	Project Based	75% of cost (Rs.3.75 lakh) for an event of 2 days @ Rs.5 lakh per event.
3.	Participation in International Trade Fairs	-do-	75% of cost (Rs.7.5 lakh) for an event of 5 days @ Rs.10.00 lakh per event.
4.	Conducting of Market Surveys, etc.	-do-	100% of cost.
D.	Implementation Monitoring Mechanism		
1	National Bamboo Cell		
	a. Evaluation and Monitoring	Project Based	100% of cost
	b. Bamboo Technical Support Group	-do-	100% of cost for engaging consultancy for specified task in specified period.
	c. Coloured Brochures and Leaflets	-do-	100% of cost.
	d. Promotional campaigns through Electronic/ Audio-visual Media/ Newspapers	-do-	100% of cost.
	e. Database Generation & Management (Information, Web Based Database)	-do-	100% of cost to Central / State level institution/ ICAR / ICFRE etc.
2	State Implementation Bodies	-do-	
	Project Report Preparation, Consultancy.		Up to 1.5% of the project cost.

Annexure-3.4

NORMS OF ASSISTANCE FOR PROGRAMMES UNDER MICROIRRIGATION

(i) Coverage of Area

Under the Scheme, it is proposed to provide financial assistance @ 50% of the unit cost of the drip and sprinkler irrigation systems. The beneficiaries may contribute their share of 50% of the unit cost, either through his/her own resources, or through loans(s) from any financial institutions. The financial assistance of 50% would be jointly shared between the Centre and State Governments. The Government of India share would be 40% of unit cost and the balance 10% of the unit cost will be met by the respective States either through the State resources or by availing Rural Infrastructure Development Fund (RIDF) of NABARD.

(ii) HRD for farmers and Staff

It is proposed to have a strong component of HRD both for farmers and field functionaries at different levels for keeping the personnel abreast of the micro irrigation technology. Several extension programmes, publicity campaigns, periodical surveys will be undertaken. Monitoring of the project and quality control testing will be taken up to ensure delivery of good quality system and technology to the farmers. The investments required for the HRD activities are to the tune of Rs.50 crore for Tenth Plan.

Annexure- 3.5.

NORMS OF ASSISTANCE FOR PROGRAMMES UNDER NATIONAL HORTICULTURE BOARD

1. **Development of Commercial Horticulture through Production and Post-Harvest Management:** Back-ended capital subsidy not exceeding 20% of the project cost with a maximum limit of Rs 25 lakh per project for production of horticultural crops and for PHM/primary processing. Rs 30.00 lakh for NE/Hilly areas.

2. **Capital Investment Subsidy Scheme for Construction/ Expansion/ Modernization of Cold Storages/Storages:** Back-ended capital investment subsidy not exceeding 25% of the project cost with a maximum limit of Rs 50 lakh per project (@ 33% upto Rs 60 lakh for NE).

3. **Cold Storage Scheme:** Back-ended capital investment subsidy @ 25% of the total project cost with a maximum limit of Rs 50 lakh per project. However, for the North-Eastern/ Tribal/Hilly Areas, maximum limit of subsidy would be Rs 60.00 lakh per project.

4. **Market Information Scheme**: Project based assistance

5. **Horticulture Promotion Scheme: Project based assistance**

Annexure- 3.6.

NORMS OF ASSISTANCE FOR PROGRAMMES UNDER COCONUT DEVELOPMENT BOARD

1. Production and distribution of planting material: This scheme has 4 components:

(i) Production and distribution of planting materials: Project based. Under this programme 7 DSP Farms have been set up by the Board with the objective of demonstrating scientific cultivation of coconut and functioning as a reliable source of quality planting material.

(ii) Aid to private coconut nurseries: This scheme has been implemented from the IX Plan onwards with the objectives of narrowing down the wide gap between demand and supply of quality coconut seedlings and augmenting the availability of quality planting material. Coconut Development Board provides financial assistance to individual farmers / NGOs / Quasi Government Organizations for establishing seed garden for multiplying various planting materials produced by research stations. The financial assistance is 25% of the total expenditure payable over three years limited to a maximum of Rs.6 lakhs. Financial assistance is also provided to the private sector for starting nurseries. The financial assistance is 25% of the cost of production of seedlings limited to a ceiling of Rs.2 lakhs to be paid in two annual installments.

(iii) Production and distribution of Tall and Dwarf hybrid seeds: This is one of the earliest scheme of the Coconut Development Board for propagating the production of TxD hybrids through randomly selected tall mother palms with tolerant selected dwarf palms. The programme was implemented in the departmental farms of the State Government. This is a 50% Centrally Sponsored Programme where the State Governments are also required to contribute a matching share.

(iv) Establishment of Regional Coconut Nurseries: This is also a centrally sponsored programme under which the Coconut Development Board provides 50% financial assistance to State Governments for increasing the production of quality coconut seedlings in the departmental nurseries and farms.

2. Area Expansion Programme

The Area Expansion Programme which has been under implementation since 1982-83, has been continued in all the subsequent Five Year Plans. Currently Rs.8000/- per ha is being

provided as subsidy to farmers who plant atleast minimum of 10 seedlings. Subsidy is available up to a maximum extent of 4 ha under this scheme.

3. Integrated Farming for Productivity Improvement: Under this Scheme assistance is provided under following three components:

i. Management of disease affected palms: This scheme aims to improve production and productivity of coconut holdings by cutting and removal of disease affected, senile and unproductive palms by providing compensation at Rs.250 per palm.

ii. Laying out of Demonstration Plots: For adopting integrated management practices and achieving higher productivity, financial assistance of Rs.35,000/- per ha is provided for laying out of demonstration plots.

iii. Assistance for organic manure units: Financial assistance of Rs.20,000/- per unit is provided to farmers for setting up of organic manure units for improving the productivity of coconut holdings

4. Technology Demonstration: This is a project based assistance programme.

5. Market Promotion and Statistics: This programme includes collection and dissemination of market intelligence, market promotion, market surveys and evaluation studies. To facilitate the adoption of better drying methods, financial assistance at 25% of the cost subject to a ceiling of Rs.10,000/- was provided to the individuals and organizations for purchasing improved copra dryers.

6. Information and Information Technology: Dissemination of information on coconut cultivation and processing technologies is carried out under this programme. Publications in different languages, production and screening of films, participation in exhibition and fairs, training programme in harvesting and post harvesting etc are some of the activities being taken up by the Board for the benefit of coconut farmers and processors.

7. Technology Mission on Coconut: The Technology Mission was launched in January 2002 with a view to bringing about synergy among numerous ongoing programmes and ensuring adequate, appropriate and timely attention to all the links in the production, post harvesting and consumption chains Technology Mission was also designed to promote diversification and value addition in the coconut sector. The other programmes envisaged in the Mission are, Market promotion and market expansion.

i. Management of Insect Pests and Disease affected gardens: Under the programme assistance provided for various components are as follows:

Development of technologies	Demonstration of technologies	Adoption of technologies
o 100% of the cost of project limited to Rs. 50.00 lakhs for ICAR(CPCRI)/ State Agricultural Universities/State Deptt. of Horticulture/Agriculture/and cooperative sector. o 50 % of the cost of project limited to Rs.25 lakhs for NGO's and other organisations	o 100% of the cost limited to Rs.25 lakh projects to ICAR (CPCRI)/ State Agricultural Universities/State Deptt. of Horticulture/Agriculture/other related public sector units/Registered cooperative societies. o 50% of the cost for individuals / group of farmers/NGO's, private companies limited to Rs.10 lakh.	o 25% of the cost of technology adoption. o 25% of the cost in case of group of farmers/ NGO's/other organizations.

ii. Processing and Product Diversification: Under the programme assistance provided for various components are as follows:

Development of technologies	Demonstration of technologies	Adoption of technologies
o 100% of the project cost limited to Rs.75 lakhs for all the Govt. institutions and cooperative societies. o 50% of the project cost limited to Rs.35 lakhs for NGO's, Individual entrepreneurs and other research organisations	o 100% of the cost to all the Govt. institutions and cooperative societies. o 50% of the cost for the NGO's, Individual entrepreneurs and other organizations.	o Back-ended credit capital subsidy limited to 25% of the cost not exceeding Rs.50 lakhs for NGO's, Individual entrepreneurs and other organizations (As described in Annexure III and paras in other conditions).

iii. Market Research and Promotion

(a) Market research
- 100% of the cost limited to Rs.25 lakhs for Govt. agencies and cooperative societies.
- 50% of the cost limited to Rs.12.50 lakhs for Individuals, NGO's and other organizations.

(b) Market Promotion
- 100% of the cost limited to Rs.25 lakhs for Govt. agencies and cooperative societies
- 50% of the cost limited to Rs.10 lakhs for NGO's and private institutes.

Annexure 3.7

NORMS OF ASSISTANCE FOR PROGRAMMES UNDER COFFEE BOARD

1. **R & D For Sustainable Coffee Production**: The plan assistance for this scheme would be to develop technologies for sustainable coffee production and also transfer of technology and does not provide for any direct financial assistance to the stakeholders of the industry like growers, processors, exporters and domestic retailers.

2. **Development Support** :

a) 50% subsidy to small growers and 25% subsidy to large growers for taking up re-plantation of saline coffee production. The remaining investment to come from grower contribution as also loans from financial institutions

b) 50% subsidy to small growers and 25% subsidy to large growers for taking up on farm capital investments like Water Augmentation, Quality Upgradation and Pollution abatement activities. The remaining investment to come from grower contribution as also loans from financial institutions

c) 25% financial assistance for coffee development activities like new planting, consolidation and quality upgradation to coffee growers in NE region and also marketing support upto Rs. 10/Kg for transportation, processing and marketing of coffees produced in NE region. The remaining investment to come from grower contribution and financial support from State Government.

d) 25% subsidy for coffee expansion in Andhra Pradesh and Orissa states and 50% subsidy for quality upgradation activities and Rs.2/Kg for transportation, processing and marketing of coffee in Andhra Pradesh and Orissa. The remaining investment to come from grower contribution and financial support from State Government.

e) 5% interest subsidy on working capital loans availed by the growers from financial institutions.

f) Financial assistance to workers employed in coffee plantations and tiny coffee growers (below 2 ha) for education of their children and for strengthening the infrastructure of health institutions in coffee growing regions.

3. **Market Development**: Transportation assistance to export coffee from Mangalore Port to exporters, so as to reduce the logistic costs.

4. **Risk Management To Growers**: Up to 50% subsidy to growers in the premium to be paid by them to insure against weather (rainfall)related risks.

Annexure 3.8.

NORMS OF ASSISTANCE FOR PROGRAMMES UNDER RUBBER BOARD

a) Planting grant:

i) Same rate of assistance, i.e. 25% of the cultivation cost is proposed for new planting as well as replanting.

ii) Eligibility is limited to 2.00 ha in the traditional region and 20.00ha in the nontraditional region.

iii) In the non-traditional region, additional assistance in the form of reimbursement of cost of planting materials subject to a maximum of Rs.4000/- per ha and transportation grant limited to Rs.4000/- per ha for transportation of plantation inputs are also proposed. Technical assistance at all stages will be free.

iv) Payment of financial assistance will be in the form of reimbursement in 6 annual installments after the plants attain the prescribed growth standards.

v) Rubber planting projects aimed at settlement of tribal people will be undertaken directly by the Board with financial support from the concerned State Governments. In such projects, Board's financial involvement will be around 45 to 50% of the project cost.

b) **Support to farmer groups**.

- Financial assistance subject to a maximum of 50% of the cost is proposed for developing infrastructure for primary processing of latex produced by small growers under Rubber Producers Societies (RPS).
- RPS are also supported to set up infrastructure facilities for latex/sheet/scrap collection from member growers.
- Assistance is also proposed for setting up demonstration units for agromanagement practices as well as group approaches in problem identification and problem solving. These will be in clusters of around 50 small holdings in a compact area under each RPS
- Small growers will be financially supported for undertaking soil protection and water harvesting programmes in their holdings. Proposed assistance is Rs.3000/- per ha.
- RPSs will be supported to purchase computers and construction office building etc.
- RPS/SHGs will be supported for setting up labour banks, running nurseries, honey collection and processing units, rubber seed collection, cover crop seed collection etc.

c. **Processing & Marketing support**.

- Big processing units established in the RPS/Co-operative and private sector are proposed to be supported for modernization of their factories, augmentation of effluent treatment plants, obtaining ISO certification etc. The assistance is available both for NR processing and Rubber wood processing units.
- Marketing assistance is provided by way of participation in trade fair, providing interactive web facilities and also working capital support wherever needed.

d. **Support to plantation workers**.

- Plantation workers (tappers) both in the organized and unorganized sector are supported by providing housing subsidy, educational stipend , sanitary facilities, health care and group insurance.

Annexure 3.9.

NORMS OF ASSISTANCE FOR PROGRAMMES UNDER TEA BOARD

I. Plantation Development Scheme

Sl.No	Activity	Pattern of Assistance
1	Replanting and Rejuvenation	Back end subsidy@25% of the approved unit cost
2	Extension Planting	Back end subsidy@25% of the approved unit cost limited to only small holdings in NE Region and in the state of Uttranchal
3	Irrigation	Back end subsidy@25% of the actual cost subject to a ceiling limit of Rs.10000 per ha
4	Drainage	Nil
5	Green leaf Transport vehicles – Trucks, trailers etc	Nil
6	Self Help Groups	i)Transport Vehicle – 50% of actual cost (1 vehicle for every 1000 kgs of green leaf per day) ii)Leaf Collection sheds – 100% of cost or Rs. 30,000 per shed (lower of the two). 1 leaf shed for every 2000 kgs of green leaf per day. iii)Plastic Crates / Bags / Weighing Machines – Actual cost recommended by field offices iv)Pruning Machines – 25% of the cost (max Rs. 7,500 per machine) per grower. For SHGs 1 machine per 10.12 ha of holdings.

II. Quality Upgradation and Product Diversification

Sl.No	Activity	Pattern of assistance
1	Processing Machinery	25% of the actual cost of the machinery
2	Value addition- colour sorters, cleaning, blending, packaging etc	25% of the actual cost of the machinery
3	Certification for HACCP/ISO/Organic	50% of the one time certification fee subject to a ceiling of Rs.75,000 per certificate.
4	Setting up of mini hydro power units; Setting up of Bio-gasification units and for opting for installations using non conventional energy sources	Nil
5	Incentive for production of Orthodox teas	NIL

Annexure -5.1

PRIORITY RESEARCH PROGRAMMES FOR DBT TO BE TAKEN UP DURING XI PLAN

Taking into consideration different upcoming need of the horticulture sector during the XI plan adequate research back up is required to be taken up on priority and accordingly the programmes and projects be invited /sanctioned;

1. **Micropropagation**
   a. Scaling up/improvement/commercialization of candidate crops.
   b. Establishing large number of hardening units/facilities/infrastructure to minimize the cost of plant material especially under public sectors.
   c. Strengthening the existing the accredited laboratories/institutes and establishing some new centres in different zones for certification regarding the quality of TCPs in terms of clonal fidelity and freedom from diseases.
   d. To establish/ standardize protocols for virus detection and to develop molecular diagnostics for different pathogenic micro-organisms.
2. **Genetic enhancement**
   a. Distant hybridization through embryo rescue and protoplasmic fusion for transfer of desired genes in best-adapted genotypes.
   b. Application of Marker-Aided Selection (MAS) for achieving precision in breeding.
   c. Transgenic development and related issues including bio-safety concerns in target horticultural crops.

3**. Molecular diagnostics**

Diagnostic kits to be developed for specific pathogens, i.e. viruses, viroids, MLOs, BLOs, etc. which is a great concern in vegetatively propagated horticultural crops.

Activities for DBT to strengthen the R&D activities XI Plan period

- It is proposed that the commercial micropropagation in desired in different horticultural crops like banana, strawberry, pineapple, ornamental crops, MAPs, etc. The production to be strengthened to meet the growing demand for plant material. The research emphasis should now be on bringing down the cost of production of tissue culture raised plantlets.
- Development of large-scale hardening facilities in different agro-climatic regions for TC to bring down the cost of the tissue culture plantlets.
- Protocols need to standardize on direct regeneration pathways to minimize somaclonal variations.
- Research institution to evolve suitable marker systems for adjudging clonal fidelity.
- DBT should make/amend norms for implementation QC norms in TC plant business. There should be provision for quarantine norms for imported TC material in the country for checking the entry of new diseases like pathogenic viruses, viroids; MLOs etc. which may spread rapidly along with infected material. These norms should be made mandatory for all tissue culture imports.
- Use of biotechnology for strengthening conventional crop improvement programmes like genetic characterization, MAS, in vitro selection, embryo rescue, Genetic engineering etc.
- While, implementing projects in Genetic transformation, DBT should ensure not to sanction projects on crops while are the major export items. It is suggested that agencies should

sanction projects in specified areas crop-wise/trait-wise and also prioritize them keeping in view the national needs, infrastructure and human resource availability.

CROP-BASED ISSUES TO TAKEN UP DURING XI PLAN PERIOD

I. FRUIT CROPS

a. Mango: Use of molecular markers in genetic characterization of the enormous diversity existing in the country to be taken up on priority linked to economic traits like regularity, malformation, long self-life etc. With a view to establish new orchards on clonal rootstocks, *in vitro* regeneration using nucellar tissue was decided to be targeted using polyembryonic genotypes. It was also emphasized that in mango emphasis to be given on secondary rhizogenesis using *Agrobacterium rhizogenes* transformation.

b. Banana: DNA fingerprinting of local genotypes and clones. Breeding involving embryo rescue and developing diagnostic for identification and control of viruses.

c. Guava and litchi: DNA fingerprinting of different genotypes and local variants and refining the micropropagation protocols.

e. Temperate fruits: Collection, characterization and fingerprinting of indigenous species, varieties of scion and rootstock genotypes in apple, pear, peach, cherry, walnut, almond, etc.

II. PLANTATION CROPS

a. Making use of available molecular maps in coconut and areca nut germplasm for evolving superior genotypes with desired trait(s).
b. Developing effective protocol for micropropagation of superior genotypes of coconut. Mass multiplication of improved varieties of black pepper, vanilla, cardamoms, ginger, turmeric, tree spices, etc.
c. Molecular characterization of indigenous and exotic genotypes for their use in crop improvement.
d. Devising bio-control packages for important pest and diseases in coconut, areca nut, cashew nut, etc.

III. VEGETABLE CROPS

a. Developing transgenics in tomato and brinjal for biotic stress tolerance.
b. Developing interspecific crosses in tomato, brinjal, okra, pepper for disease and insect pest tolerance and virus resistance. Developing transgenics for virus and pest tolerance.
c. Use of MAS in supplementing traditional crop improvement in target crops.
d. Molecular cataloguing of indigenous vegetables and wild relatives for future gene mining.
e. Value addition/ breeding for quality in carrots, cauliflower and cabbage.

Cole crops

a. Production and maintenance of cms lines in *Brassica oleracea* using different related /wild species by back crossing. It was decided that for this purpose the advanced breeding

lines available from private/ public sources be explored on priority and used in breeding programmes.
b. Development of *Bt*-transgenics in cabbage and cauliflower for insect-pest tolerance.
c. Multiplexing of genes in cruciferous vegetables like cauliflowers and cabbage for major diseases.
d. To exploit the single gene high pro-vitamin A content mutants in different crucifers like cauliflower and broccoli.

Potato

a. Conservation of genetic diversity to continue along with their effective molecular characterization to avoid duplications/synonyms and variants/mutants.
b. For screening germplasm for any disease/pest it should be done under controlled laboratory conditions using standard inoculation procedures. Natural field procedures for screening to be avoided since dependent on weather factors.
c. Multiplexing of resistant genes to continue in established hybrids/varieties fit for growing in different agro-climatic regions.
d. For quality seed production, the breeder seed once given to public/ private seed producers either in public or private sectors to be monitored by the ICAR by having at least one member in the seed monitoring committees.

Tuber crops

a. Identification and cloning of dwarfing genes in yams and cassava mosaic resistance from *Manihot caerulescence.*
b. Development of transgenic cassava with enhanced starch content and starch quality.
c. Identification of molecular markers in cassava associated with starch quality traits, CMD resistance and protein content from the mapping population available at CTCRI and use them in MAS.
d. Molecular characterization of genetic diversity in minor tuber crops.
e. PCR, RT-PCR, NASH and ELISA to be developed for virus diagnosis in cassava, sweet potato, yam and colocasia and to be utilized for indexing planting material for distribution.

Mushrooms

a. Identification, cloning and sequencing of mating type genes in *Agaricus*. MAS for identification and tagging of agronomically important QTLs and prediction of heterosis in F_1 hybrids of commercially cultivated mushrooms.
b. Identification of cheaper substrates and use of course cereals in place of wheat grains in spawn production and technology for shelf-life enhancement.
c. Protected cultivation technology for production of edible mushrooms such as *Agaricus bitorquis*, *Auricularia* spp., *Lentinula edodes* and medicinal mushroom *Ganoderma lucidum*.

IV. FLOWER CROPS

a. Micropropagation to be undertaken in carnation, gerbera, orchids, anthuriums, chrysanthemum and liliums.
b. Use of embryo rescue in breeding for *Fusarium* resistant gladiolus, rose and carnation.

c. Molecular profiling of important varieties in major flower crops and cataloguing them along with international descriptors for creation of reference databases.

V. SPICES

a. Use of biotechnological tools for; biotic stress resistance in (a) Black pepper (Phytophthora, Pollu and nematode); (b) Small and large cardamom (Rhizome rot, virus resistance); (c) Ginger (Rhizome rot)
b. Micropropagation: To be continued in black pepper, cardamom, ginger, turmeric, vanilla etc.

VI. MEDICINAL AND AROMATIC PLANTS (MAPs)

a. Collection, characterization and molecular characterization of indigenous MAPs and their conservation *in vitro*.
b. Commercial micropropagation of important MAPs like *Isabgol*, *Beach*, *Aswagandha*, *Kalmegh*, Coleus, *Safed Musli*, *Brahmi*, *Atees*, *Kutki*, *Gudmar*, etc. identified by the National Medicinal Plants Board (GOI).
c. Establishing large-scale Hi-tech nurseries for plug plant production.

USE OF MOLECULAR MARKERS IN HORTICULTURAL CROPS

a. **Genetic characterization and conservation**: Use of molecular markers was especially felt for the DNA finger printing of the priority crops like **Fruit**s: Mango, banana, citrus, guava, *aonla*, saffron, walnut and apple; **Vegetables:** Major vegetables like solanaceous group, cucurbitaceous group, and indigenous minor vegetables; **Flowers:** Indian-bred roses, indigenous species and cultivars in gladiolus, orchids, chrysanthemum, **Spices**: Black pepper, cardamoms(small and large), turmeric, ginger, tree spices etc.; **Plantation crops**: Coconut, cashew nut, superior tea clones and coffee genotypes; **MAPs**: Different important species identified by the National Medicinal Plant Board, GOI.
b. Markers for differentiation of nucellar and zygotic seedlings in citrus and mango and sex specific markers in papaya and kokum.

EMBRYO RESCUE

Use of this technique should be made to raise larger hybrid population for making effective selection in mango, grape and banana; and distant hybridization in papaya, citrus, brinjal, cucurbits, rose, carnation, gladiolus, etc.

MOLECULAR BREEDING

It was proposed that in few solanaceous crops like tomato and potato, crucifers like cabbage and cauliflower and cucurbit like cucumber, bulb crops like onion and garlic, work to be initiated in consortia mode to evolve superior biotic stress tolerant varieties. In coconut for root wilt and bud rot. Areca nut for Yellow Leaf Disease.

TRANSGENICS

This approach will be adopted in certain selected target crops for evolving superior genotypes in fruits, vegetables, and plantations baring those crops/group that are the exportable items. The different research activities and approaches during XI plan are list in the table.

MOLECULAR DIAGNOSTICS

It is useful approach for generating virus-free planting material. It is necessary to follow the careful indexing based on recent biotechnology methods such as immuno-probes, nucleic acid probes and polymerase chain reaction (PCR). This should ensure phyto-sanitory safety during the movement of planting materials. Similarly, molecular testing should ensure quality control. The PCR based techniques (Randomly Amplified Polymorphic DNA; RAPD) providing a reliable methodology for identifying genotypes and studying the genetic variation. Different centres accredited by the DBT should be encouraged to develop protocols for virus diagnosis by developing kits for efficient detections and maintaining the quality propagules for clonal fidelity. To certify that TC raised plants are virus-free and of an assured quality. Diagnostic kits are also to be developed in black pepper, cardamom, vanilla.

Annexure-5.2

DIFFERENT PRIORITY HORTICULTURAL CROPS AND THE ISSUE TO BE TARGETED USING BIOTECHNOLOGICAL INTERVENTIONS

Sl. No.	Crop	Methodology	Remarks
i.	**Fruits**: Banana, citrus, and apple, strawberry, garcinia, *ber*. **Vegetables:** Potato, cassava, sweet potato, yam, colocasia **Spices:** Ginger, turmeric, black pepper, garlic **Ornamentals**: Orchids, gladiolus, carnation, chrysanthemum,	*In vitro* & cryo-conservation	Priority should be to those crops where already work is on and where protocols are available.
ii.	**Fruits:** Mango, banana, citrus, guava, *aonla*, *jamun*, *ber, mahua*, walnut, *chilgoja*, apple and pear rootstocks **Vegetables:** Brinjal, gourds, cucurbits **Ornamentals**: Roses, gladiolus, chrysanthemum, orchids **Spices**: Black pepper, cardamoms (small and large), turmeric, ginger, tree spices **Plantation crops**: Coconut, cashew nut, tea and coffee **MAPs:** Indigenous medicinal plants	Molecular characterization of germplasm	Crops of indigenous origin and where large number of collections are available be given priority

i.	**Fruits**: Apple root stocks, banana, papaya, guava, strawberry, citrus (rootstocks), *aonla*, grapes (rootstocks) and pineapple **Vegetables and spices:** Potato, pepper, cardamom, vanilla, ginger **Flowers:** Orchids, chrysanthemum, carnation, gerbera, anthurium, lilium, gladiolus etc. **Plantation crops:** Tea and coffee **MAPs**: All plants identified by National Medicinal Plants Board (AYUSH)	Up-scaling for commercialization	All horticultural crops which are under commercial micropropagation and those for which there is dearth of planting material due to area expansion.
ii.	Mango, cashew nut, sapota, areca nut, pomegranate, litchi, *karonda,* walnut, pecan nut, date palm, oil palm, coconut, saffron, garcinia, medicinal plants, tree spices	Research on micropropagation	*In vitro* methodologies need to be developed for these crops on priority.
iii.	Mango, citrus, papaya, nutmeg, mangosteen and Kokum	Markers for differentiation of nucellar and zygotic seedlings in citrus and mango and sex specific markers in papaya, nutmeg and Kokum	These crops are prioritized based on the importance in the vegetative propagation.
i.	Mango, grapes, banana, papaya and citrus	Introgression of desirable genes from wild relatives and for routine plant breeding	Superior genotypes can be evolved for different intended use with added characters like tolerance to abiotic and biotic stresses.
i.	**Tomato** – *Rhizoctonia* and *Fusarium* wilt, **Cabbage & cauliflower** – *Sclerotium*, powdery	Identification of markers and application in breeding	For assisting the research programmes on different fruit crops and aspects in focused manner. These programme to be long term in nature and be continued even in the XII plan period to develop

	mildew, quality cucumber, **Potato** – Quality & biotic resistance, **Onion** - blight, **Cassava and pea** – disease resistance **Mango** – malformation & spongy tissue **Guava** – wilt banana – sigatoka, wilt **Pomegranate** – Aril browning and bacterial nodal blight **Mushroom** – For heterosis		the end product as improved varieties.
i.	**Vegetables:** Brinjal – insect resistance, Cabbage and cauliflower – insect and fungal resistance Onion – fungal resistance Okra – virus and insect resistance Potato – virus and late blight Cassava – virus and starch quality Chilli – insect and virus resistance Tomato – virus, slow ripening, Sweet potato – insect	Work on transgenics is already in progress in some crops and will terminate in March 2007.	At least 10 transgenic crop species will be developed within the plan period.

	resistance Mushroom (*Agaricus*)– shelf-life **Fruit crops:** Banana – virus, shelf life Papaya – virus Grapes – fungal resistance Watermelon – virus Citrus - virus **Flower crops** Chrysanthemum – virus, insect resistance Carnation - fungal resistance and shelf-life Rose- fungal resistance Gladiolus – virus		
i.	Development of diagnostic kits for major diseases of horticultural crops	1.Existing knowledge should be converted into usable technology 2. A National Centre for Plant Disease Diagnostics is to be established	The different accredited centers to be given financial aid for developing diagnostic kits for target disease(s) in important horticultural crops. A new centre totally dedicated for conducting research and developing kits for disease management to establish under DAC.
i.	Tomato Potato Banana	Already in operation under DBT To be initiated in the XI Plan - do-	The ongoing programme of DBT to continue and provision for initiating new programmes on potato and banana due to their importance in Indian horticulture.
ii.	ICAR institutes	Modernization of existing facilities	The different programmes of DBT to continue along with the some additional

	SAUs CSIR Institutes ICMR Other research organizations working on horticultural crops		budget for initiating research work on the horticultural crops for specific traits. The financial aid will be provide to develop research capabilities in different biotech labs under public sector.	
	HUMAN RESOURCE DEVELOPMENT NEEDS			
	Area of research	**No. of personnel to be trained**	**Remarks**	**Place of training**
i.	*In vitro* conservation and cryo-preservation	15 personnel to be trained and deployed	These personnel to be trained and deployed at different genebanks associated with the horticultural species.	Five international Ten national
ii.	Molecular characterization of germplasm	20 personnel to be trained	1. These personnel to be trained and deployed at different centers undertaking research on genetic characterization and germplasm management on major horticultural crops.	All national trainings at NBPGR, NRCPB, ICGEB, NCPGR, New Delhi
iii.	Micropropagation, embryo rescue and anther culture	50 personnel (training in India) 10 personnel (training in abroad)	2. These personnel to be trained and deployed at different research centers undertaking research on crop improvement and micropropagation in the identified crop and	International trainings will be on recalcitrant horticultural crops only

			aspects.	
iv.	Molecular tagging & marker assisted selection	20 personnel (training in India and abroad)	3. These personnel to be trained and deployed at different research centers undertaking research on crop improvement	Five trainings in abroad on advanced techniques of molecular markers
v.	Transgenics	20 personnel (training in India and abroad)	Personnel to be trained and deployed at different research centers undertaking genetic transformation on important horticultural crops other than those which are exportable items.	Five trainings in abroad on recalcitrant species
vi.	Molecular diagnostics	10 personnel (abroad)	-do-	On all important diseases for diagnosis and kit development
v.	Genomics & bioinformatics	10 personnel	These personnel to be trained and deployed at different research centers on different aspects of genomics and proteomics.	On important identified crops like tomato, cauliflower, etc.
i.	Different aspects of biotechnological research work	Approximately 500 additional technical and scientific staff is necessary in XI Plan	These personnel to be trained and deployed at different research centers for assisting the ongoing long term research programmes	
i.	For developing research infrastructures and	About 10% of the proposed allocation to be earmarked for	For both setting of research labs through need	All target horticultural crops and aspects to be covered under the

	HRD	biotechnology and high-tech horticulture in NEH region	based project funding through DBT and HRD activities	allotted budget

Annexure 10.1

LIST AGRI EXPORT ZONES IN HORTICULTURE SECTOR

S No	State		AEZ Project	Districts / Area
1	West Bengal	1	Pineapple	Darjeeling, Jalpaiguri, Uttar Dinajpur, Cooch Behar, Howrah
		2	Lychee	Murshidabad, Malda, 24 Pargana(N) and 24 Pargana(S)
		3	Potatoes	Hooghly, Burdhwan, Midnapore (W), Uday Narayanpur, Howrah
		4	Mango	Maldah and Murshidabad
		5	Vegetables	Nadia, Murshidabad and North 24 Parganas
		6	Darjeeling Tea	Darjeeling
2	Karnataka	7	Gherkins	Tumkur, Bangalore Urban, Bangalore Rural, Hassan, Kolar, Chitradurga, Dharwad and Bagalkot
		8	Rose Onion	Bangalore (Urban), Bangalore (Rural), Kolar
		9	Flowers	Bangalore (Urban), Bangalore (Rural), Kolar, Tumkur, Kodagu and Belgaum
		10	Vanilla	Districts of Dakshin Kannada, Uttara Kannada, Udupi, Shimoga, Kodagu, Chickamagalur
3	Uttranchal	11	Lychees	Udhamsingh Nagar, Dehradun and Nainital
		12	Flowers	Dehradun, Pantnagar, Udhamsingh Nagar, Nainital and Uttarkashi
.		13	Medicinal & Aromatic Plants	Uttarkashi, Chamoli, Pithoragarh, Dehradun, Nainital, Haridwar and Udhamsingh Nagar
4	**Punjab**	14	Vegetables (Cabbage Broccoli, Okra, Peas, Carrot, Baby Corn, Green Chillies, Green Beans, Tomato)	Fatehgarh Sahib, Patiala, Sangrur, Ludhiana and Ropar
		15	Potatoes	Singhpura, Zirakpur Distt. Patiala and satellite centres at Rampura Phul, Muktsar, Ludhiana, Jullundur
5	Uttar Pradesh	16	Potatoes	Agra, Hathras, Farrukhabad, Kannoj, Meerut, Baghpat and Aligarh, Janpad Badaiyun, Rampur, Ghaziabad, and Firozabad
		17	Mangoes and Vegetables	Lucknow, Unnao, Hardoi, Sitapur and Barabanki
		18	Mangoes	Saharanpur, Muzaffarnagar, Bijnaur, Meerut,

				Baghpat and Bulandshahr, Jyotifulenagar
6	Maharash-tra	19	Grape & Grapevine	Nasik, Sangli, Sholapur, Satara, Ahmednagar
		20	Mangoes	Rantagiri, Sindhudurg, Raigarh and Thane
		21	Kesar mango	Aurangabad, Beed,Jalna, Ahmednagar and Latur
		22	Flowers	Pune, Nasik, Kolhapur and Sangli
		23	Onion	Nasik, Ahmednagar, Pune, Satara, Jalgaon, Solapur
		24	Pomegranate	Districts of Solapur, Sangli, Ahmednagar, Pune, Nasik, Osmanabad & Latur
		25	Banana	Jalgaon, Dhule, Nandurbar, Buldhana, Parbhani, Hindoli, Nanded and Wardha
		26	Oranges	Nagpur and Amraoti
7	Andhra Pradesh	27	Mango Pulp & Vegetables	Chitoor
		28	Mango & Grapes	Rangareddy, Medak, Mehboobnagar
		29	Mangoes	Krishna
		30	Gherkins	Districts of Mahboobnagar, Rangareddy, Medak, Karimnagar, Warangal, Ananthapur and Nalgonda
		31	Chilli	Guntur
8	Jammu & Kashmir	32	Apples	Srinagar, Baramula, Anantnag, Kupwara, Kathua and Pulwama
		33	Walnut	Baramulla, Anantnag, Pulwama, Budgam,Kupwara, Srinagar, Doda, Poonch, Udhampur, Rajouri and Kathua
9	**Tripura**	34	Pineapple	Kumarghat, Manu, Melaghar, Matabari and Kakraban Blocks
10	Madhya Pradesh	35	Potatoes, Onion and Garlic	Malwa, Ujjain, Indore, Dewas, Dhar, Shajapur, Ratlam, Neemuch Mandsaur and Khandwa
		36	Seed Spices	Guna, Mandsaur, Ujjain, Rajgarh, Ratlam, Shajapur and Neemuch
		37	Oranges	Chhindwara. Jpsjamgabad. Betul
11	Tamil Nadu	38	Cut Flowers	Dharmapuri
		39	Flowers	Nilgiri
		40	Mangoes	Districts of Madurai, Theni, Dindigul, Virudhunagar and Tirunelveli
		41	**Cashewnut**	Cuddalore, Thanjavur, Pudukottai and Sivaganga
12	Bihar	42	Lychee, Vegetables & Honey	Muzaffarpur, Samastipur, Hajipur, Vaishali, East and West Champaran, Bhagalpur, Begu Sarai, Khagaria, Sitamarhi, Saran and Gopalganj

13	**Gujarat**	43	Mangoes & Vegetables	Ahmedabad, Khaida, Anand, Vadodara, Surat, Navsari, Valsad, Bharuch, Narmada
		44	Value Added Onion	Districts of Bhavnagar, Surendranagar, Amreli, Rajkot, Junagadh and Jamnagar Districts
14	**Sikkim**	45	Flowers (Orchids)& Cherry Pepper	East Sikkim
		46	Ginger	North, East, South & West Sikkim
15	Himachal Pradesh	47	Apples	Shimla, Sirmaur, Kullu, Mandi, Chamba and Kinnaur
16	**Orissa**	48	Ginger and Turmeric	Kandhamal
17	Jharkhand	49	Vegetables	Ranchi, Hazaribagh and Lohardaga
18	Kerala	50	Horticulture Products	Thrissur, Ernakulam, Kottayam, Alapuzha, Pathanamthitta, Kollam, Thiruvanthapuram, Idukki and Pallakad
		51	Medicinal Plant	Wayanad, Mallapuram, Palakkad, Thrissur, Ernakulam, Idukki, Kollam, Pathanamittha, Thiruvananthapuram
19	Assam	52	Fresh and Processed Ginger	Kamrup, Nalbari, Barpeta, Darrang, Nagaon, Morigaon, Karbi Anglong and North Cachar
20	Rajasthan	53	Coriander	Kota, Bundi, Baran, Jhalawar & Chittoor
		54	Cumin	Nagaur, Barmer, Jalore, Pali and Jodhpur