

Chapter II



Horticulture

Horticulture

A. Fruits

Nurseries

1. To develop at least one progeny orchard of 25 acres in each district. These orchards should maintain the best clonal varieties of fruit plants suitable for the region.
2. To develop at least 4 model nurseries of 4 hectares in each district. These nurseries should be equipped with advanced technologies and modern equipment including clonal multiplication area, mist chamber, polyhouse, compost shade, sprinklers etc.
3. Nurseries already existing in the districts should be assessed by the competent officers of the state and 20-25 nurseries having more than 5 acres of area should be identified for modernization as “Satellite nurseries”.
4. The small registered nursery will be assigned with a target for production of quality planting materials by the state department annually. These nurseries should collect the certified scions from progeny orchard located in the district.
5. Strict vigilance should be made by the Government officials to ensure that quality planting materials are being raised by the listed nurseries.
6. Nursery Registration Act and Rules should be enforced in the state Government officials, retired qualified persons.
7. Any planting materials which are not in conformity with the specification laid down for each fruit crop, should not be lifted / distributed by the Department.
8. The price of planting materials should be fixed by the Department in consultations with Nursery Association of the state so that nurserymen could get a reasonable price for producing only quality planting materials.
9. Nurserymen may be trained in methods of propagation, selection of rootstock and scion, care of nursery plants and other nursery operation. The training programme may be conducted every three months the help of Krishi Vigyan Kendras (KVKs), Agriculture University, Research Stations (ICAR, State Govt.) and NGO’s dealing with such activity.
10. Self-help group members may be selected and trained in nursery practices . They should get mother plants from Government nurseries at subsidized rates and financial assistance for selling up nurseries.

Production related issues

1. Enhancement of productivity is most important for West Bengal. Thrust areas for development of fruit cultivation are identified as, promoting organic cultivation, promotion of IPM, INM technology, strengthening PHT facilities on

- farm and cold chains; promoting mechanization, precision agriculture, micro irrigation, value addition units for processing and extraction, promoting exports through AEZ, residue testing labs, awareness about Codex, etc. use of IT technology through software, GIS, satellite data and predictions about diseases, pests, cropped area and yields, strengthening export with international market data and finally campaigning for promotion of Indian fruits at International market. Detailed action plan for each will be required for implementation.
2. Wherever feasible, school Nutrition Gardens should be promoted. The aim of such garden is to generate awareness of the fact that for every major nutritional malady like Vitamin A deficiency induced blindness, iron-deficiency induced anemia, there is horticultural remedy. 'Every school with a Fruit Garden' should become a statewide goal. Home gardens and school gardens are important strategies in West Bengal where land is scarce.
 3. Production related areas of fruit crops development which needs to be recorded on priority are identified as area expansion and quality improvement, improvement and modernization of nurseries for quality planting material, speedy development and multiplication of market led varieties, promoting varieties suitable for processing, value addition and exports, developing package of practices for export production, synergization of quality standards for domestic as well as international markets, standardization of quality produce, IPM and INM modules, package of practices for organic farming, high density plantation, pruning, training and rejuvenation techniques, off-season production (pineapple, guava), micro-irrigation and fertigation and mechanization and production of high-value crops in greenhouses (strawberry).
 4. Efforts should be made to reduce cost of production by improving productivity and quality. For this, emphasis should be given on proper irrigation and drainage of areas under fruit crops, wastelands and dry lands should be brought under suitable fruit crops. Emphasis should be given on leaf and tissue analysis for use of micronutrients. Proper research support is needed for identification and promotion of cultivation of local fruit crops having commercial importance, management of serious pests and diseases like fruit borer, hopper, malformation, fruit fly in mango; fruit borer, mite in litchi; bunchy top, soft rot, beetle in banana; decline in citrus; fruit borer of pomegranate; wilt, fruit borer, anthracnose in guava; ring spot virus in papaya and heart-rot of pineapple.
 5. Encouragement should be given for product diversification and value addition. To catch up global market and to reduce the cost of cultivation, organic cultivation should be promoted. High-tech horticulture like high-density planting, use of micro-irrigation, fertigation, INM, IPM and NPM needs to be promoted for improving productivity. To achieve this HRD for officers and farmers is essential. Technology dissemination through demonstrations, training of farmers, publicity through different media, and use of IT should be

- encouraged. A database regarding area, production, productivity, export etc. needs to be updated regularly.
6. Postharvest management related issues which need to be talked are identified as use and application of maturity indices, improvement in harvesting techniques (use of harvester), on-farm and off-farm storage management, extension efforts for harvesting techniques, grading, handling and packaging techniques., measures to reduce postharvest losses, promoting small scale preservation in the village level.
 7. There exists a huge mismatch between production and postharvest handling which needs to be bridged through a mission mode approach by the state with an active private participation.
 8. Training in small scale processing to self-help groups and marketing of processed products by creating cooperatives at the village level needs to be undertaken. Similarly organized hi-tech processing industries should be set up both in cooperative and private sector for domestic and export markets.
 9. Marketing related issues which need to be tackled on a priority basis are identified as market intelligence, development of interstate and interstate markets, and risk coverage through insurance safeguarding the interest of the growers.
 10. With the expansion of area under fruits in the state the production is expected to increase substantially in the next 5-10 years. The marketing of fruits should be organized simultaneously. The present markets are dominated by middlemen and they decide the price of fruits. Unless the farmers form cooperative and open their sale outlets in urban areas, the exploitation from middlemen would continue.
 11. Awareness about national and international markets and introducing market intelligence system is necessary for small retailers and farmers.
 12. Strategy for marketing should be through the small farmers horticulture cooperative /group with common facilities for postharvest handling and marketing assistance. The support of the National Horticulture Mission/ National Horticulture Board should be sought for establishing such Cooperative/ Groups.
 13. A promotion campaign should be developed by the state appealing to the general people for intake of 3-5 serving of fruits every day.
 14. To create awareness about proper handling of the produce, for improving transport facility by rail or road and for timely availability of the transport, the state should constitute a separate cell, so that wastages in this sector are drastically reduced and quality of produce maintained.
 15. Cold storage and sale outlets should be developed in the major cities and industrial towns which will help the growers to earn more income for the quality produce and the up market segment customers could get the quality fruits.

16. Multi-product cool chain facilities need to be developed to minimize the huge postharvest handling loss.
17. The major fruit crops cultivated in the state are mango, litchi, banana, guava, pineapple, citrus, coconut and cashew nut. The productivity of pineapple, papaya and coconut is higher than the national average. However, the overall productivity of fruit crops in the state is 12.5 t/ha. The productivity should be increased up to 15 t/ha by the end of 11th plan and 20 t/ha by 2020.
18. The higher productivity should be achieved through measures like production and distribution of improved planting materials, rejuvenation of senile orchards, judicious use of natural resources like land, water and light, integrated nutrient, pests and disease management, disease surveillance, plant health clinics, mechanization of farm operations, etc. Assistance for these activities should be extended to the public as well as private sector.
19. The western districts of West Bengal (Purulia, Bankura, Birbhum, Paschim Medinipur and part of Burdwan) have potential for quality fruit production, particularly mango, guava, sapota, pomegranate, ber, sweet orange, anola, date palm, cashew, jack fruit, cashew, bael, jamun, etc. 'Alphonso' mango has a good potential in this region. The mango varieties suitable for cultivation in the state are 'Langra', 'Himsagar', Fazli', 'Amrapali' and 'Lakshman Bhog'. Though considerable areas have been brought under mango cultivation during the last 10 years, it is recommended to give further thrust on mango.
20. The old and new alluvial zones of West Bengal (Hooghly, Howrah, Nadia, 24-Parganas, Burdwan, Murshidabad, and Malda) are suitable for cultivation of mango, litchi, banana, papaya, guava, coconut and several tropical and subtropical fruits. The potentiality of growing banana, litchi, guava and papaya should be utilized properly in this region. Many new plantations of mango, guava, litchi and banana are being developed every year in these regions. Availability of quality planting materials should be ensured.
21. The foot-hills of Darjeeling districts (Siliguri sub-division), Jalpaiguri and Dinajpur have tremendous potentiality for extending the area under pineapple, banana, guava, and coconut and jackfruit. Suitable varieties for processing and export need to be grown only.
22. Considering the soil and climatic conditions, the area under minor fruits in the state is increasing. Some of these crops like sapota, anola, pomegranate, tamarind have very good export and / or processing potential, however, suitable varieties or clones need to be grown.
23. The efforts to introduce new fruits like strawberry, passion fruit in hill region. Comprehensive research about growing of strawberry under cover and use of alternatives like organic cultivation need to be emphasized.
24. Future emphasis in the state should be on organic cultivation of fruits using organic manures, crop residues, fermented organic matter, bio-fertilizer etc. and eco-friendly integrated pest and disease management for sustainable

- horticulture. This can be achieved through the use of various bio-control agents and completely eliminating poisonous synthetic chemical pesticides. In addition, plant-derived pesticides (botanicals) and insect pheromones may be applied for mating disruption, monitoring or lure-and-kill strategies should be promoted.
25. In order to avoid contamination of germplasm and health hazard genetically modified (GM) fruit plants should not be grown in the state.
 26. Constant monitoring and surveillance of insect, pests and diseases should be a compulsory activity. Moreover, bio-control laboratories in different regions of the state should be established to meet all the requirements of IPM.
 27. In order to promote the export of our fruits, pesticide residue laboratories are required to be established at Malda and Murshidabad since mango and litchi are now important fruit crops in these districts where vast export potential exists. It is also necessary to establish plant quarantine laboratories in these districts for issuing phyto sanitary certificates.
 28. Integrated pest management package of practices are not perfected for any particular area. Formulation of location specific package of practices and their fine tuning is necessary. IPM module for mango, litchi, banana, guava, citrus, cashew and pomegranate are required to be framed for the state. The strategy should be developed for very restricted use of pesticides in these areas. Simultaneously, non-pesticide management, and control of pests and diseases using biopesticides should also be standardized on different fruit crops.
 29. Farmers need to be trained for removal of pesticide residues from produce, water bodies and spray equipments and for proper usage as well as storage of such chemicals including their careful handling by the farm workers.
 30. It is recommended that for promotion of organic farming, area and group based approach should be adopted by the State Government. To provide technical support, SAUs/ KVKs/ Central Agencies/reputed NGOs/Agri-clinics should act as service providers.
 31. State Government should take up activities like publicity and creation of awareness among farmers to educate them, organizing them in groups, training the service providers in private sector and arranging their registration, promotion of local certification agencies and assistance in marketing.
 32. Facilitatory mechanism which State Government may take include: formation of organic farmers group, registration of farmers group with district authorities, documentation of individual farm/farm records, service providers, KVKs/ SAUs/ Agri-clinics/ private entrepreneurs, fixation of nominal fee accreditation agencies, certification and inspection agencies.
 33. The technology packages for organic farming as developed by farmers, NGOs and others may be evaluated and the successful technology may be expanded in larger areas. Bankable model schemes on organic farming may be prepared and circulated amongst the farmers for its adoption.

34. The recommendations on the improvement of various aspect of horticultural crops emerging from the research investigations by the SAUs should be transformed by the appropriate Govt. departments of the farmer for adoption.
35. Extensive investigations should be taken up on organic farming with diversification of horticultural crop and suitable intercrops orchards and plantations, its economic benefit, quality of the produce and sustainability in production and impact on health and environment.

Research priorities

36. Keeping in view the export potential of mango, the problem of quality management, mapping and control of fruit borer and fruit fly infestation, a complete protocol for postharvest handling of 'Lakshman Bhog', 'Langra', 'Himsagar' and 'Amrapali' needs to be taken up. Recommendations about crop geometry and pruning techniques for high density mango plantations need to be finalized.
37. Study of exotic varieties of mandarin orange to find out suitable seedless and firm skinned varieties need to be taken up. Extension efforts for better 'bahar' management, prevention of fruit drop of mandarin orange are essential.
38. Litchi has a great export potential from the state in near future. It is urgently necessary to introduce small seeded varieties, development of package for organic cultivation, scheduling irrigation for controlling fruit drop and cracking, alternative protocol for skin colour retention after harvest (other than sulphitation) and postharvest handling.
39. For banana, export oriented varieties with spotless, large sized fruits and resistance to sigatoka and soft rot; for papaya – ring spot virus resistant varieties, for sapota – small seeded varieties with maximum pulp content and better keeping quality with high TSS, for pineapple, introduction of varieties suitable for processing as well as fresh fruit (as used in Sri Lanka and Thailand).
40. Conservation of varietal treasure in tree fruits in research farms. Many varieties and clones are being lost.
41. Clonal selection and identification of high yielding mother plants of merit of mango, coconut, litchi, limes, sapota, etc. and identifying those as mother plants for raising progeny orchards in Government nurseries.

B. Vegetables

Strategies, action plans and recommendations

1. **Sustained research in the Agricultural Universities and Research Institutes**
 - (i) Mission and target oriented improvement programme in different vegetable crops

Priorities for developing multiple resistant cultivars with premium attributes

Crop	Targeted biotic stress	Prioritised trait (s) to be incorporated
Tomato	TLCV + early blight + bacterial wilt + RKN	Tolerant to high temperature, high TSS and lycopene
Brinjal	Phomopsis + bacterial wilt + fruit- and shoot-borer	Early maturing
Chilli	Leaf curl + thrips + mites + anthracnose	High oleoresin and less capsaicin
Capsicum	<i>Phytophthora</i> + thrips + mites	Adapted to tropical regions of India
Okra	YVMV + fruit-borer	Dark green pods with five ridges
Onion	Stemphyllium + purple blotch + thrips	Brown bulb, white bulb with high TSS
Cucumber	DM + mosaic	Pickling type
Muskmelon	PM + DM + anthracnose + fusarium	High TSS
Watermelon	PM + DM + anthracnose	High TSS and seedless fruits
Cabbage	Black rot + diamondback moth	Tolerant to high temperature
Cauliflower	Black rot + diamondback moth	Tolerant to high temperature

Note: TLCV, Tomato leaf curl virus; RKN, root-knot nematode; YVMV, yellow-vein mosaic virus; DM, downy mildew; PM, powdery mildew

- (ii) Research on hybrid technology which has been proved as an effective tool in enhancing the production of several vegetable crops need to be continued in sustained manner in the Agricultural University through implementation of different research projects.
- (iii) Exploration, collection, characterization of biodiversity of different vegetable crops for their effective utilization in the development of well adapted improved varieties of different indigenous and tropical vegetable crops particularly, brinjal, chilli, pumpkin, bottle gourd, bitter gourd, ridge gourd, cucumber, hyacinth bean, cowpea, pointed gourd, etc.
- (iv) Biotechnological interventions in vegetable breeding programmes particularly in characterization of diversity and tagging of novel genes using molecular markers and development of resistant varieties.
- (v) Identification of popular indigenous cultivars of different vegetable crops in different vegetable production zones, collection and their maintenance in pure form in the Agricultural Universities.
- (vi) Identification of suitable improved varieties as well as hybrids for different agro-climatic zones of West Bengal.

- (vii) Standardisation of organic cultivation of vegetables and to determine economic and nutritional benefits.
- (viii) Framing of integrated nutrient management system for major vegetable crop groups.
- (ix) Framing of integrated insect-pest and disease management system for major vegetable crop groups
- (x) Development of packages for export oriented vegetable production technology through identification of varieties/hybrids and integrated insect-pest, disease and nutrient management.
- (xi) Development of packages for production of high value crops like coloured capsicum, lettuce, cucumber, celery, etc under polyhouse.
- (xii) Development of package and practices for focused crops of short supply like onion and for different under-utilized and exotic vegetable crops like, sweet corn, baby corn, moringa, squash, leek, bunching onion, welsh onion, broccoli, brussels sprouts, Chinese cabbage, pointed gourd, kakrol, kartoli, ivy gourd, sweet gourd, faba bean, summer bean, lima bean, sweet pea, winged bean, sword bean, velvet bean, etc.
- (xiii) A vast tracts of land in Bankura, Birbhum, Purulia and West Midnapur is rain fed and some areas of South 24 Parganas are having saline soil. So specific production technology should be framed keeping the growing conditions of different locations in view.

2. Declaration of special vegetable production zone with adequate logistic support for market and export driven cluster-wise quality production

- Kalimpong zone
 - Haldibari zone
 - Dhupguri-Falakata zone
 - Tufanganj zone
 - Islampur zone
 - Baharampur zone
 - Krishnanagar zone
 - Madanpur zone
 - Bangaon zone
 - Barasat zone
 - Bhangar zone
 - Jaynagar zone
 - Jhargram zone
 - Garbeta zone
 - Ajoyadha zone
- (i) Development of logistic support and infrastructure viz., roads, packaging station, multipurpose cold storage, truck terminal, transportation facility, processing set up and market intelligence in the special vegetable production zones
 - (ii) Clustering of vegetable growers for facilitating credit from bank and availing of different Govt. subsidies.
 - (iii) Adequate provision for and timely positioning of different inputs viz., seeds, fertilizers, micro-nutrient chemicals, bio-control agents, botanicals, bio-fertilizers,

pheromone trap and recommended insecticides, antibiotics and fungicides for different vegetables.

- (iv) Structuring of Agri-business consortium in the special vegetable production zones and tying up of the exporters, intra-state traders and processing industries with the vegetable growers.

3. **Organic vegetable cultivation:** The use of costly chemical fertilizers and pesticides have not only made agriculture including vegetables non-remunerative but also caused a steady decline in soil fertility, productivity, sustainability, and loss of biodiversity, resulted in environment pollution, climate change and severe health hazard of both farmers and consumers including cancer and neurological diseases. Because of the alarming consequences of the indiscriminate use of chemical fertilizers and poisonous pesticides, farmers and consumers are being cautioned by the World Health Organization (WHO), and Food and Agricultural Organisations of the UN (FAO) who are emphasizing on an urgent need to eliminate industrial chemicals in agriculture and GM crops and shifting to low cost organic inputs like organic manures, crop residues, biofertilizers, biopesticides etc. for sustained production of high value crops nutritionally superior, free from toxic residues of pesticides, with low moisture contents, better colour, aroma, taste and storage life. Organic cultivation is of utmost importance in horticultural crops which are mostly consumed fresh or semi cooked and the fresh produces and processed products are sold at a premium price world over and have export potential.

4. **Improvement/establishment of regular markets/strengthening fresh vegetable marketing:** More regular markets for vegetables need to be established at suburban areas, town, and metropolices and the existing markets need to be modernized to encourage not only efficient marketing but also assure good quality and hygienic produce to the consumer. The condition of the weekly or bi-weekly big markets in the rural areas, local markets in the suburban areas need to be improved through providing adequate space, cleanliness inside the market and efficient transport facilities.

Adequate steps need to be taken to develop as well as restructure vegetable markets around Kolkata urban agglomeration area and other city area particularly, Siliguri-Jalpaiguri area, Islampur area, Bahrapur area, Krishnanagar area, Chakdah area, Panskura area, Bardhaman, Durgapur area, Asansol area, etc. with adequate, loading-unloading, cleaning and temporary refrigerated storage facility.

5. **Area increase under hybrids/improved varieties:** Promotion of hybrid vegetable technology/improved varieties is a major strategy to increase vegetable productivity. Out of the total area under vegetable cultivation, hardly 15 – 20 % area comes under hybrid vegetable crops moreover, major share goes to tomato and cabbage. Concerted efforts need to be made to cover about 35-40% area under

hybrids of different important vegetable crops viz, okra, chilli, sweet pepper, cauliflower, bottle gourd, bitter gourd, cucumber, ridge gourd, pumpkin, watermelon, muskmelon, summer squash, etc.

Promotion of seed production of improved varieties/ F₁ hybrids of vegetable crops in India capitalizing huge and low cost human resource should be the basic strategy for increasing productivity by ensuring quality seeds to the farmers and increasing profitability through export of vegetable seeds. Faster rate of seed replacement need to be accomplished through awareness among the growers about the new variety/hybrid and high level of quality seed production.

6. **Front line demonstrations:** (i) Large scale 'Front Line Demonstrations' (FLDs) and distribution of minikit trials for hybrids/improved varieties and newly introduced potential vegetable crops should be encouraged in selected village clusters identified for specific vegetable crops through Agricultural Universities / Krishi Vigyan Kendra / Government line department / NGOs, etc. to popularise the new and improved genetic materials among the vegetable growers. (ii) Model organic vegetable farms need to be established at least one in each block with facilities for training and demonstration including organic input production, postharvest management, value addition and marketing.
7. **Seed village clusters/cluster farming/export zones:** Cluster farming/seed village concept need to be encouraged to increase the production of seeds, planting materials and specified market driven product through identification of village clusters based on production potential of vegetables/vegetable seeds. Pesticide free areas/zones need to be declared preferably in the north-eastern hill region for promoting organic cultivation of specialized vegetables. Such cluster village concept will also strengthen cause of vegetables suitable for export. Western districts have specific advantage for seed production.
 - (i) *Seed multiplication through public-private tie up:* Multiplication of the seeds of open pollinated improved varieties as well as hybrids through strengthening public-private tie up and periodical renewing of basic seed from the public sector should be taken up.
8. **Farmers' cooperative societies/agri-business consortium:** The pro-active government policy with liberal funding to support cooperative societies would play a key role in sustaining vegetable productivity, production and marketing for ensuring profitability to the farmers. Vegetable farming as well as marketing of products under co-operatives will ensure:
 - (i) Assured availability of quality seed, other planting materials and agricultural inputs like, fertilizer, micronutrient chemicals, biofertilizer, biopesticides,

- botanicals, feromone trap, mulching material, machinery, etc. to sustain high productivity.
- (ii) High quality produces with higher productivity because of community level effectiveness of adoption of technologies and concepts like integrated plant nutrition management system and integrated insect pest and disease management.
 - (iii) Production of processable vegetable varieties for industries. Assured and cost effective availability of vegetables to industries.
 - (iv) Better access to domestic and export markets to sell the produce at competitive price.
9. **Crop diversification:** Most of the vegetables are of short duration and are suitable for growing in mixed, relay and companion cropping systems. Taking this advantage, crop diversification among the vegetables, growing of the underutilized and exotic vegetables for both domestic as well as export markets should be promoted.
10. **Hi-tech vegetable production:** To bridge the vast gap between actual and potential productivity, there is urgent need to adopt efficient and mechanized vegetable production technologies which will not only increase productivity but also enhance the product quality, thereby, ensuring better returns to the farmers.
- (i) Development of Hi-tech nursery for production of healthy seedling.
 - (ii) Protected vegetable cultivation around peri-urban areas.
 - (iii) Efficient use of water and nutrient through drip/sprinkler irrigation and fertigation.
 - (iv) Raised bed cultivation and use of organic/degradable biomass for mulching which will economize irrigation water, retain moisture, stabilize soil temperature, minimize weed population and ensure high quality production.
 - (v) Promotion of precision farming for maximizing input use efficiency to get higher and quality return.
 - (vi) Promotion of off-season production of vegetables to enhance availability of quality vegetables throughout the year and maximize the use of natural resources through the use of improved genetic materials and protected cultivation.
11. **Integrated plant nutrient management system (IPNS):** The integrated plant nutrient system (IPNS) includes balanced use of chemical fertilizers; organic manures and biofertilizers which not only increase the productivity in sustainable manner but also take care the soil health and productivity. The IPNS system is more result oriented in protected vegetable cultivation where crop rotation and soil replacement is a highly difficult task. It will be more effective and sustainable if both IPNS and IPM systems are adopted together.
12. **Integrated pest management (IPM):** It is the eco-friendly system approach in both strategies and technologies to reduce the dependence of chemicals for controlling the pest and diseases. Nevertheless, multiple support and co-operation

from public and private organizations is needed to harness full potential of available technologies and strategies. Use of resistant/tolerant varieties has to be encouraged.

- (i) Promoting awareness among the farmers about the predisposing factors for the occurrence of diseases and pests and at the same time harmful effects of indiscriminate use of chemical pesticides.
 - (ii) Emphasis on the development of behavioural and cultural management practices, use of sex pheromone, trap crop, predators, parasitoids and entomopathogens based management tactics to control pests and diseases.
 - (iii) Incorporation of botanicals, microbials and pheromones in IPM schedule to reduce dependency on chemical insecticides.
 - (iv) Emphasis on the quality control for the production of bioagents and botanicals and development of bioagent release technique to improve the performance of bioagents.
 - (v) Policy frame work for proper monitoring of the quality of commercially available bio-control agents as well as products starting from production unit till its delivery to the farmers.
13. **Non-pesticidal management (NPM):** A still more eco-friendly technology of pest management than the IPM in that under no circumstances synthetic chemical pesticides are used. It has been very successfully scaled in Andhra Pradesh by the Centre for Sustainable Agriculture and has covered over 10 lakh acres. NPM works through non-chemical interventions such as setting up bird perches, use of light and pheromone traps, trap crops, fermented cowdung and cow urine, neem seed kernel extracts and a wide range of botanicals, etc.
14. **Postharvest management:** Governmental policy interventions are needed for adequate postharvest management of the produce through the development of production centres based on cluster village concept and establishment of processing units which may include input subsidies for establishment of cool chain, processing into value-added products, pricing policies, import/export tariffs and facilities for marketing.
15. **Mechanisation of vegetable farming:** Precision farming and less labour intensive but efficient vegetable farming need mechanization in the different farming practices viz., direct seed sowing, transplanting, weeding, hoeing, spraying, harvesting etc. So, efficient and cost effective machinery and tools should be made available to the farmers with proper demonstration facilities. Considering very small vegetable plots small tools are required to be introduced.
16. **Increase in capital inflow in vegetable production system:** Keeping in view that percentage of advances to deposits of scheduled commercial banks in West Bengal in rural areas (32.78%) being much below the National average (52.72%) as well as all the leading states, immediate steps need to be taken so that at least specific market driven and export oriented quality vegetable production can be tagged with short or medium term bank loans for ensuring capital in flow in total agriculture in the state.

17. **Protection to farmers/risk assistance:** Crop insurance scheme should be strengthened for protecting/safeguarding the interest of vegetable growers in the situation of crop loss due to adverse weather conditions and poor quality seeds, fertilizers and plant protection inputs.
18. **Increasing the purchasing power of rural population:** Purchasing power of the population of the rural sector should be increased through increasing productivity of the crops and at the same time, by generating employment in the rural areas by encouraging them for specified farm and other related activities like, supply chain management of vegetable crops, development of packaging materials for transport and marketing of different vegetable crops, open pollinated and hybrid seed production, on farm processing of fresh vegetables, home scale vegetable processing, packaging, making organic manure like vermicompost from farm waste, etc.
19. **Grading standards:** In India grading started as early as 1937 with the Agricultural Produce (Grading and Marketing) Act. However, at present only three vegetables viz., potato, onion and garlic comes under grading only for export. In this era of WTO, export oriented competitive vegetable farming is gaining momentum. Therefore, grading standards need to be developed in order to compete in the global market. At the same time, proper follow up programmes has to be taken to introduce grading for domestic market also which will ensure better return to the growers.
20. **Development of bioresource centre for conservation of genetic resources:** Genetic resources are the building blocks for the new varieties as well as hybrids. The Indian gene center is extremely rich. The Indian sub-continent is one of the centers of origin and diversity of several vegetable and spice crops. Wide and prolonged cultivation of different introduced vegetable crops, indigenous, tropical and tropicalized vegetable crops triggered the development of huge diversity in local cultivars of most of the vegetable crops in the country. These indigenous varieties evolved through both natural and human selection, produced and used by the farmers of the developing countries worldwide including India, are called primitive cultivars by the corporate sectors of seed business. Germplasm of these freely available resource are apparently regarded valueless. The disappearance of ecological diversity and the intolerance of cultural diversity are processes that are intimately linked. The survival struggles of different communities are in fact, struggles for the preservation of diversity. In the last two decades or so, in addition to the proximate causes leading to the loss of biological resources like clearing of forests, over-harvesting of plants, indiscriminate use of pesticides and rapid urbanization; deliberate substitution of diversity by uniform improved varieties and hybrids have worsened the biodiversity crisis in different vegetable crops. Open field trials and cultivation of genetically modified (GM) vegetable crops would be a major source of contamination of our valuable germplasm. It is urgently needed to establish “Bioresource Centres” in different zones of the country with active

participation of the farmers to conserve the indigenous genetic resources of different vegetable crops for future use in breeding.

21. **Urban and periurban vegetable farming:** Urban and periurban vegetable farming through different forms of home / kitchen market gardens have gained momentum around different cities and metropolies. But it needs to be further developed and strengthened through farming of the practicing farmers for the use of “Good Agricultural Practices” for the production of the safe produce and appropriate pre and postharvest technologies to extend the availability of the produce. Codexes for pesticide residue level need to be created/developed and enforced through fresh vegetables pesticide residue testing in the “Quality control laboratory” to ensure safe vegetables supply to the consumers.
22. **River bed cultivation of vegetables:** Cultivation of vegetable crops particularly cucurbitaceous vegetable crops in the river beds or river basins constitute a distinct type of farming. These lands are familiarly called ‘diara’ lands in Uttar Pradesh and Bihar. To the east of the river Ganga it lays Jalangi, Mathabhanga, Churni, Ichhamati, etc. which form the dead channels or distributaries of the Ganga or Padma that flows from the north to the south. The entire Nadia district, north and south 24 Parganas excepting Sundarban region and the eastern part of Howrah, Hooghly and Murshidabad districts are the Ganga delta region formed by the silt deposited by the Hugli-Bhagirathi, Jalangi, Ichhamati, Damodar and Rupnarayan rivers. Huge river basin lands are still available along these rivers in these districts.

The Mayurakshi, Ajay, Damodar, Rupnarayan (combined flow of Silabati and Darakeswar) rivers flow from the Chotonagpur plateau in the west into the Bhagirathi-Hugli river to the east or south-east. These rivers are monsoon fed rivers, so carry more water in the monsoon season. Through the course of these rivers huge ‘diara’ lands have also been developed in Bardhaman, Medinipur, Bankura and Purulia districts.

Tista, Torsa, Jaldhaka, Mahananda are the rivers of North Bengal arising from different parts of the eastern Himalayas. These rivers are fed by snow melt waters and are perennial. However, conspicuous swelling of these rivers during monsoon has also created vast tract of basin lands through the course of these rivers and also their distributaries like Kalchini, Mansai, etc. However, no account on the availability as well as utilization of the river basin land in West Bengal is available at the Government level.

Cucurbits are specially suited and adapted to this system of vegetable cultivation due to their long tap root system. In these river basins, different cucurbits which are basically tropical in nature and heat loving in nature are forced to grow during the winter months and assure income to the farmers by early harvests of different cucurbits from February-March to June before the onset of

monsoon. The technology of production on river beds needs to be standardized, particularly for nutrient management.

23. **Home garden for nutrition and income:** Home garden is one of the important supplementary sources of family nutrition in underdeveloped countries, especially in Asia. Nutrients such protein, calcium, iron, and vitamin A significantly alleviate nutritional problems by adopting a well-planned home garden containing recognizable and nutritious crops, and in the process the family can use the underutilized yards at home to increase the production and improve the environment economically and aesthetically.

The home garden can be used to raise many kinds of fruit, vegetables, staple food crops, medicinal plants, spices and sometimes farm animals and fish and to generate income for households with access to markets. In a home garden, even a very small area of wetland, such as the banks of a drain, can be used for growing food all year. Home garden planning is directed towards an adequate supply of vegetables throughout the whole year. Choice and arrangement of crops in the home garden are exceedingly flexible. Basic nutritional needs and preference of the family and what grows well in a given locality are the primary factors to consider.

A well-developed home garden has the potential, when access to land and water is not a major limitation, to supply most of the non-staple foods that a family needs every day of the year, including roots and tubers, vegetables and fruits, legumes, herbs and spices, animals and fish. Roots and tubers are rich in energy and legumes are important sources of protein, fat, iron and vitamins. Green leafy vegetables and yellow or orange coloured fruits provide essential vitamins and minerals.

The home gardening project needs to be focussed on women both in gardening and nutrition education which appears to have an important empowering effect. This alone is crucial for achieving improved nutritional welfare for the family, especially for female members.

24. **Developemnt of plant health clinic:** With the shrinking land resources, more intensive crop husbandry and even more complex agri-horticultural production and marketing systems are coming up, the agro-biologists do face newer and intricate problems in combating different biotic stresses caused by fungi, bacteria, virus, insect pests, nematodes, rodents, weeds and abiotic stresses from nutrient deficiency, soil reaction, high temperature and high moisture condition. It is very necessary to understand these stress factors, their mode of action and introduce preventive measures with greater precision and vigour with strong laboratory support. Plant health clinic in district or specific production zone level laboratory based and service oriented project for the growers and other stake holders are

required to elevate their skill and operative standards to produce high quality and safe product through good Agricultural Practice.

25. **Vocational courses for entrepreneurs/Master farmers:** Development of knowledge base of the progressive vegetable growers through vocational courses in the State Agricultural Universities, Krishi Vigyan Kendras and Government establishments will play a pivotal role amongst a larger section of farmers to promote cluster farming in specified areas.
26. **Policies related to awareness and human resource development:** There is need to develop specialised human resource through trainings arranged nationally/internationally for knowledge empowerment of scientists, Govt. officials of line departments and the vegetable growers on various aspects of vegetable improvement, production and protection technologies, vegetable seed production, vegetable postharvest management and processing technologies. Different facets of such awareness and human resource development programmes may be outlined as below.
- (i) Development of specialized human resource at the scientist and Govt. official levels through trainings arranged nationally/internationally on various aspects of vegetable breeding, production and protection technologies, vegetable seed production, vegetable postharvest management and processing.
 - (ii) Extensive training programmes to the vegetable farmers regarding the use of GAP (Good Agricultural Practices) and production and protection management in different vegetable crops and appropriate pre and postharvest technologies for the vegetable crops to extend the availability of safe produce.
 - (iii) Capacity building for organic farming should be intensified at the village level through NGOs and SHGs.
 - (iv) Television and radio programmes on the benefits of fruit and vegetables in the diet, their proper washing, storage, healthy preparation, and cooking methods should be arranged at regular intervals.
 - (v) Educational activities for pre-school children including puzzles, posters and songs and such activity for the school children may encompass the followings-
 - (a) Educating children and creating awareness about fruit and vegetables and what constitutes a healthy diet e.g. through comics, posters and visible reminders in classrooms.
 - (b) Building children's food skills, e.g. how to select fruit and vegetables, how to prepare vegetable based foods.
 - (c) Training on production of fruits and vegetables *via* school gardening programmes.

C. Floriculture

1. Development of data base on production areas, market demand, agro-technologies and marketing of floricultural products of West Bengal.

2. Surveys of floriculture production areas and flower markets to assess the annual requirement of different floricultural products viz. seeds, plant materials, cut flowers, loose flowers, pot plants, dry flowers, etc.
3. Commercial flower and ornamental plant production should be taken up in Bankura, Purulia and Dakshin Dinajpur and Paschim Medinipur and plants for supply of fresh flowers to the towns in the districts and nearby markets at a low transport cost. Purulia can also be a major centre for dry flowers and flower seed production. Drip irrigation system may be installed in areas suffering from water scarcity.
4. Arrangements for forecasting of market demand for advance procurement of selected plant materials for mass multiplication and distribution among the growers are necessary for production and better income.
5. Computer net working between the production centres and the flowers markets within and outside the state should be provided.
6. Flower grower's co-operatives should be organized and effective linkage be established with the agricultural universities and state department of horticulture, NHB, APEDA, etc. for support in production, postharvest management and marketing.
7. Necessary arrangements should be made for procurement of suitable plant materials of export quality flowers/ cultivars which have very good demand in the flower markets and subsequent distribution to the growers and entrepreneurs at a reasonable price, for further multiplication and cultivation of elite plants.
8. Development of model floricultural farms with facilities of protected cultivation at the agricultural universities and research centres for practical demonstration and training is extremely important for capacity building of thousands of flower growers in all aspects of floriculture. Also to arrange visits for flowers growers and nurserymen to floriculture export production centres within and outside the state.
9. Use of proper packaging technologies and cropwise selection of suitable packaging materials and systems.
10. Arrangements for application of postharvest technologies for reduction of loss due to spoilage of plants and flowers and for extension of vase life.
11. Installation of cool chain system from the production site to the destination markets or departure terminals by engaging refrigerated vans.
12. Upgradation of existing markets with proper cold storage, grading and packaging facilities and also to develop new markets with proper infrastructure facilities in big cities of West Bengal.
13. Awareness among the growers regarding proper phytosanitation programme and monitoring during cultivation of flowers, postharvest handling and marketing.
14. Development of flower seed production industry of superior quality and necessary guidance should be provided to the growers.

15. Establishment of research centres on floriculture and well equipped laboratories for generating postharvest technologies at the SAUs is very important for domestic and export trade of flowers and plants. These laboratories should have, tissue culture, simulated transportation and greenhouse research facilities.
16. KVKs in different districts should provide training and demonstrations on floriculture and ornamental plants for income generation of SHGs and growers.
17. Crop insurance schemes to safeguard the growers from any crop loss should be applicable to flower growers also.
18. Advancement of industrialization would enhance environmental pollution. Hence, public awareness should be created about the beneficial effects of landscape gardening in reducing the pollution.
19. Improvement in production and value addition to dry flowers recommended for expansion of export market and higher income.
20. In West Bengal, majority of flower growers are poor, small and marginal farmers. In view of the sustainability in production at low cost, use of organic inputs is recommended for flower cultivation. This will not only improve the income and better livelihood of the growers but also enhance the quality of flowers, free from toxic insecticide residue, vase life, colour and aroma. Pest and disease problems would be much less in organic cultivation and biopesticides without any toxic effect can be used if necessary.
21. Virus indexing and production of virus free healthy plants should be made mandatory for the production centres using the tissue culture technique for the mass multiplication of plants.
22. Speedy and hassle free plant quarantine procedure should be adopted for the entrepreneurs for export and import of plants and flowers.
23. Reduced air freight and direct transportation facilities to the major destination centres should be made available to the flower exporters of West Bengal.

D. Plantation crops and spices

Plantation crops

a) Coconut

1. Coconut plantations of different districts of southern and northern parts of the State should be utilized for income and employment generation through planting of black pepper @ 2 cuttings/palm.
2. Senile coconut palms should be replaced with high yielding varieties like Philippines Ordinary, Lakshadeep Ordinary, Jamaican Tall, Hazari, DXT Hybrids.
3. Coconut based farming system (high density multicrop model) with or without animal components should be popularized.
4. In South 24-Parganas particularly in the Sunderban areas where land is available for dwarf coconut should be tried.

5. Establishment of seed garden is necessary for raising planting materials of coconut and arecanut. For the purpose elite palms are to be identified for seed nuts. Seed nuts of already identified varieties are also to be collected. Suitable farms are to be selected and seed nuts are to be planted for raising seedling. This would help in establishment of coconut and arecanut garden with high yielding uniform germplasms.
6. Value addition and byproduct utilization need to be emphasized.

b) Arecanut

1. Arecanut plantation of north and south Bengal should be planted with black pepper @ 2 cuttings/palm for additional income generation; inter crops like pineapple, turmeric, etc. may also be grown.
2. Senile arecanut palms should be replaced by 'Mohitnagar' variety.
3. Areca leaf sheath should be utilized for preparation of ply boards, decorative panels, packing cases, etc. This should be popularized.

c) Cashewnut

1. Area expansion through high yielding grafts (BLA-39-4 syn. Madak-1, BPP-1, BPP-5, BPP-6, Vengurla-1, Vengurla-2, Vengurla-3, Vengurla-4, Vengurla-5, Ullal-1, Ullal-2, BPP-8, Madakkathara, Priyanka).
2. Formation of self-help group for popularizing different products of cashew apple should be encouraged for strengthening the rural economy of the tribal people and particularly helping women empowerment in the villages.
3. Proper management practices must be adopted for rejuvenation of the old plantation.
4. Identified cashew varieties should be propagated using softwood grafting technique in suitable farms located at semiarid region of the state.
5. Rain water harvesting should be widely practiced to meet the need of irrigation water.
6. Emphasis should be given on intercropping in cashew orchard.
7. Value added products both from nut and apple of cashewnut should be given more emphasis.
8. Technical and financial support should be given to organic cashew cultivation.
9. Planting of cashewnut in reclaimed areas should be taken up to create a cover of vegetation following normally practiced soil conservation work.
10. Financial support for infrastructure development of nut processing units should be given.

d) Betelvine

1. Production of 'Mitha Pan' needs to be increased.
2. Betel leaf bleaching technology needs to be refined.

3. Betel leaf packaging and also transportation (cool chain system) need to be improved.
4. The possibility of alternate use (extraction of essential oil for pest control, extraction of juice for soft drink, etc.) should be explored.

e) Tea

1. Replanting and infilling of existing old tea areas with improved cultivars.
2. Growing of organic tea and extra land should be utilized for growing other economic crops.
3. Tea plantations have huge population of shade trees which should be trailed with black pepper for increasing additional income from tea plantations. Tea Board, Ministry of Commerce & Industries and other concerned organizations should work out detailed plans for solving the complex situation in closed or nearly closed tea garden in North Bengal.

The plantation crops which have immense potentiality are bamboo, palmyra palm and date palm.

f) Bamboo

1. Income should be generated through community agro-forestry.
2. Production of edible bamboo shoots should be encouraged.
3. Uses in laminates, flooring, handicrafts etc. should be encouraged.
4. Export potential of activated charcoal should be explored.
5. Area expansion should be encouraged through planting in homesteads, and if possible on farm boundaries, canal banks, foreshore of irrigation tanks, margin of ponds and other locations.

Food security through edible bamboo shoots should be a prime target. Bamboo shoot is the young culm harvested shortly after its appearance above the soil surface. The edible part is 40 to 50 per cent and has a crisp, sweet flavour. Green bamboo shoot is delicious, rich in fibre and vitamins. It has a high demand in South-East Asian countries as such the export potentiality is high. Bamboo shoot production helps to achieve economic development in a comparatively short period.

g) Palmyra palm

1. Planting elite palm (not haphazardly growing natural palms) should be encouraged in the wasteland, pond bank, bunds demarcating fields, borders of garden etc. particularly in the dry tract of the state.
2. Emphasis should be given on value added products (sweet toddy, palm cola, jaggery, palm sugar, palm candy, molasses, tender fruit, pulp, etc.).

3. Products from leaves (export quality) through SHG should be encouraged for economic development.
4. Plantations may be developed with staggered flowering for tapping almost throughout the year.
5. Palmyra palm and local date palm should be considered as potential crops for the Sunderbans.
6. Water harvesting for better production should be encouraged.

Spices

1. Spices should be encouraged under different farming systems as mixed crops. Black pepper can be introduced in tea, coconut and arecanut gardens while tree spices and rhizomes can be grown as intercrops
2. For good quality planting materials, nurserymen should get the tested nucleus materials from Research institutes/SAUs. Development of seed villages for multiplication of the materials locally under supervision of Horticulture Directorate should be explored for the purpose.
3. For black pepper multiplication and distribution of cutting of the following varieties are recommended: (a) Panniyur 1,2,3,4,5 & 6, (b) Sreekara, (c) Subhakara, (d) Kottanadan, (e) IISR, (f) Thevam, (g) Panchami.
4. For turmeric multiplication and distribution of high yielding varieties like Suguna, Rajendra, Sonia, Suranjana, IISR Aleppy Supreme, IISR Kedaram, TCP-2, TCP-11 are recommended.
5. For ginger multiplication and distribution of high yielding variety like Suruchi, Surabhi, IISR Varada are recommended.
6. Production of seeds for seed spices should be priority.
7. Area expansion under onion and garlic in traditional areas should be encouraged.
8. Seed production of Sukhsagar onion variety under West Bengal condition.
9. Seed spices like coriander (Pant Haritma), fenugreek, fennel, black cumin, cumin(Gujarat cumin 1,2,3 R219), aniseed, ajwan, ajmund, etc. already growing in some areas will have to be promoted with improved varieties.
10. Curry leaf is also a potent crop and should be promoted for organized cultivation.
11. Coriander leaf production year round is also a promising area of intervention.
12. Tejpata/cinnamon may be introduced in the forestry programme in the state.
13. Suitable varieties of tamarind PKM-1,DTS-1 should be introduced.
14. Nutmeg cultivars IISR Viswashree, Konkan Sugandha, Konkan Swad should be introduced in the state.
15. Cultivation of large cardamom in the northern hilly areas of the state should be encouraged as it has enormous scope for area expansion and improvement.

Diseased plantations should be uprooted and replanted using only healthy seedlings.

16. Potentiality in self employment of women and youth in the state should be encouraged through processing and value addition in spices (even at farm level).
17. Organic cultivation of spices is the best option but Good Agricultural Practices (GAP) would be a wise alternative.
18. Large number of local entrepreneurs should be developed for producing biocontrol agents and biofertilisers including vermicompost.
19. Quality assurance in spices either whole or processed should receive prime attention for export potential of Indian spices.
20. The scope of growing spices in multi-crop farming system in coconut and arecanut gardens in North Bengal districts should be explored. UBKV should develop model plantations of multi-crop farming with fruits, plantation crops and spices in all the districts for demonstration and training for implementing the programme to generate additional income from the same land.
21. Initiative should be taken for seed production of seed spices in the semiarid region of West Bengal.
22. Medium cost protected cultivation in suitable locations is recommended for cultivation of non-conventional herbal spices.
23. Development of small processing units for extraction of essential oil, oleoresin, etc. need to be taken up.
24. Formation of self help groups and their training on curing and processing of turmeric, ginger and tree spices should be arranged.
25. Available protocols for micro-propagation of spices need to be standardized with SAUs.

E. Medicinal and aromatic plants

1. In order to promote the uses of medicinal and aromatic plants for health care, cosmetics and nutraceuticals a comprehensive state level planning is considered essential with the participation of all the stakeholders including industries, institutions, exporters, representatives of State and National Medicinal Plant Boards, NGOs and line departments in the State, like forest and industries, etc.
2. Proper co-ordination should be established among the State Medicinal Plant Board, research institutes, universities, laboratories of various drug manufacturing companies, NGOs and collectors and producers of herbals for evaluating and monitoring the progress of development.
3. In order to promote awareness of the enormous uses of medicinal and aromatic plants, their cultivation and marketing of the produces should be included in the district level planning of rural health care systems.
4. Training and demonstration on good cultivation practices, postharvest management and storage of medicinal and aromatic plants should be provided to the farmers at Panchayat levels.

5. For authentication of the samples of medicinal and aromatic plants, plant parts and herbarium should be organized and maintained in the districts and one at the state level.
6. Field based research and documentation on traditional knowledge (TK), indigenous technological knowledge (ITK) in medicinal and aromatic plants should be promoted along with adequate steps for undertaking their survey and mapping for protecting patent right (PR) and intellectual property right (IPR).
 - 6a) There is immense scope to grow medicinal and aromatic plants on wastelands, wet lands and unused tea gardens, taking into consideration the agro-climatic zones in West Bengal.
 - 6b) Testing of the contents of active principles from recognized laboratories and certification by the appropriate authorities for the purpose is essential.
7. Legal safeguard to the farmers should be ensured for getting certificate from the Forest Department, Botanical Survey of India and other authorized bodies for their produces for export and domestic market. Only the certified items should be sold for commercial use and research purpose.
8. Cultivation of medicinal and aromatic plants would be remunerative only with assured purchase of raw materials by the industry, therefore contract growing, with guaranteed buying back by reputed pharmaceutical companies/traders should be organized with direct involvement of the local Panchayat.
9. Agricultural farms in the State may produce authentic seeds and planting materials for medicinal and aromatic plant species besides their normal activities.
10. To promote cultivation of aromatic plants in West Bengal, immediate attention should be paid on installation of extraction plants at the Government level or on a co-operative basis through self help groups or Panchayats.
11. Two Medicinal and Aromatic Plant Parks, one in north Bengal and another in south Bengal should be established for cultivation, conservation, distribution of planting materials and training on cultivation, preparation of crude drugs, quality evaluation and marketing. The two parks should have facilities for storage of herbals, their extracts and shall serve as herbal banks for the State.
12. Efforts to be taken to conserve RET (rare endangered and threatened) potential medicinal and aromatic plant species in in-situ and ex-situ conditions.
13. Establishment of home herbal garden with medicinal plants for human and animal health care would be extremely useful.
14. Facilities should be provided to NGOs, SHGs and cooperative initiatives for promotion to Traditional Health Systems (THS) through training programmes on the uses, cultivation of medicinal plants and extraction of crude drugs.
15. Quality education access in traditional medicine in the State needs immediate and planned improvement. Because the education in traditional medicine needs to provide the transformational catalysis necessary to link traditional medical system sources with evidence based approaches, it will place the state in rightful

place in the global medical pluralism, and efforts should be made to introduce evidence-based approaches into current educational framework.

16. Apart from meaningful education on Ayurvedic, Unani and Homeopathy systems of health care, the institutions should develop medicinal plant gardens and well equipped laboratories and hospitals for authentic clinical test and research.
17. In spite of the enormous scope of medicinal and aromatic plants in health care, nutraceuticals and cosmetic of West Bengal, accepted world wide and the soil and climate being favourable for growing large number of these plants, there is a total lack of coordination among the educational institutions on Ayurvedic medicine, professional medical practitioners, research and development organizations, herbal industries and farmers in the State, the Commission emphasizes that in the interest of low cost and effective preventive and curative health care system of immense commercial feasibility in the country and scope of export worldwide, a Standing Advisory Committee on Medicinal and Aromatic Plants should be constituted by the State Government to monitor all aspects.

The State Agriculture Commission considers the following recommendations of the National Knowledge Commission on strategies to promote the knowledge systems of traditional medicine very relevant in the context of overall development of traditional system of health care.

1. **Transforming traditional medicine education:** The quality of and access to education in traditional medicine in the country needs urgent improvement.
2. **Undertaking advanced research on traditional health systems:** (THS) Investments in research and development of traditional medicine have been sub-critical and fragmented resulting in scarcity of evidence about the efficacy of THS. There is a need to urgently establish a network of world class research programmes in different parts of the country to address these lacunae with appropriate institutional and incentive structures.
3. **Strengthening of pharmacopoeial standards:** There is a strong need for creating internationally acceptable pharmacopoeias for herbal medications.
4. **Increasing the quality and quantity of clinical trials & certification:** Promotion of traditional medicine goes hand-in-hand with increase in the quality of rigorous, yet sensitively designed clinical trials to support or refute traditional medicinal claims of efficacy.
The pre-clinical and clinical efficacy validation and standardization of ten best THS products for global market should be supported as a flagship project. Similarly technological up gradation of the manufacturing units involved in

manufacture of these successful products to international standards must be carried out.

5. **Digitising traditional knowledge:** “Traditional Knowledge Informatics Programme” should be constructed to create a comprehensive list of available plant material-medicina (2,000 species), their products (40,000 formulations) and clinical applications (5,000 conditions).
6. **Creating suitable framework of intellectual property rights:** Emphasis should be put on creating suitable Intellectual Property Rights framework in the country for protection of the sources of traditional medical knowledge. The need is to create IPR systems that ensure that such knowledge remains in the public domain and is “protected” for the communities of origin through mechanisms such as GIs.
7. **Establishing goals for conservation of natural resources:** Natural populations of around 12% of the 6000 species of potentially medicinal plants are currently estimated to be under threat due to degradation and loss of habitats alongside unsustainable ways of harvesting and lack of cultivation.
The wild gene pool of India’s medicinal plants should be secured, via establishment of a nation wide network of 300 “Forest Gene Banks” across the 10 bio-geographic regions of the country.
8. **Support to non-Government and Corporate initiatives for promotion of THS:** The non-government and private sector have played an important role in building the public image of traditional health sciences. Non-governmental research and education institutions, NGOs and corporates with a global vision must be strategically supported in the interest of enhancing national and international awareness of India’s rich health system heritage.
9. **Promoting international cooperation:** International cooperation in exploration of traditional health systems must be given a big boost thorough substantial initiative like strategic research collaborations.
10. **Supporting primary healthcare in rural areas:** A nation-wide network of Home Herbal Garden and Community Herbal Gardens (CHG) can be created to support the primary health care needs of rural communities for those plants and medications established as efficacious by evidence-based research.
11. **Creating a major re-branding exercise of Indian traditional medicine:** Better branding of Indian traditional medicines proven to be effective in well-designed clinical trials can increase safe and effective healthcare options.
The National Knowledge Commission also recommended that the Government of India may consider establishing a National Mission of Traditional Health Knowledge (NMTHK), which would take up these tasks in an organized way.
The Commission also suggests that the above recommendations of the National Knowledge Commission should be implemented in West Bengal, besides the aforesaid specific recommendations of the Commission for development of medicinal and aromatic plants in the State.

F. Post harvest management of horticultural crops

1. Awareness and training programmes for introducing postharvest handling practices should be organised with all stakeholders in supply chain of horticultural produce beginning from producer to consumer. Agricultural universities, NGOs, KVKs and Government officials may be involved.
2. Creation of postharvest handling facilities for the fresh horticultural products like fruits, vegetables and flowers in production belts and consumer markets. It should have grading, sorting, pre-cooling, storing, packaging and other facilities.
3. Setting up of pack houses for fruits and vegetable near cities for primary processing and packaging to add value and avoid carrying in and out inedible garbage portion which could be converted to enriched manure.
4. Encourage minimal processing of fruits and display.
5. Low cost cool chamber and commercial size cool chamber may be tried in low humid seasons for use in low humid western districts where evaporation rate is higher.
6. Mobile precooling unit may be introduced in some of the important production belts of fruit and vegetables like mango, pineapple, litchi, cucurbits, okra, tomato, cabbage, cauliflower etc.
7. Postharvest handling facilities have to be extended to floriculture areas like Panskura-Deulti, Ranaghat, Kalimpong, etc.
8. Retail traders of agricultural produce with small resource should not be left as such to face unequal competition.
9. Cost of packaging materials should be reduced to popularize packaging of horticultural produce both fresh and processed. Packaging cost elevates price of commodities beyond the reach of common buyer. High cost of packaging is restricting business growth in horticultural produce both in domestic and export market. Introduction of cheap and attractive packages and training of farmers, traders and retailers in packaging is highly recommended. Packaging industry has to be provided with necessary assistance for lowering cost of materials.
10. Varieties of fruits and vegetables amenable to processing into products at competitive cost have to be introduced. Potatoes with higher solids, mangoes with better pulp consistency less fibre, pineapples with better flavour and more juicy, tomatoes with more TSS are to be popularized in the catchments area of proposed processing unit.
11. There should be a strong linkage between processor and farmer. A food processing unit cannot survive on procurement of raw materials in season from markets only. Government may consider policy for encouraging such contacts for the benefit of both.
12. Encouraging a strong partnership with private sector organizations to support the increasingly market oriented economy. Policy decisions are required to be demand driven in principle.

13. Setting up processing units of identified products is to be promoted by providing liberal assistance. Promising products are (i) juices, (ii) RTS beverage, (iii) potato products, (iv) frozen fruits and vegetables (v) tomato ketchup sauce and juice, (vi) products form processed minor fruits like bael, ber, jamuns, jackfruit, passion fruit, etc. (vii) banana and guava pulp, (viii) pickles and chutney (ix) aseptic bulk packed juice / pulp and intermediate products (x) brined vegetables in bulk package.
14. Processing industries may be encouraged to set up mobile processing units in production areas for making intermediate products for use in manufacturing finished food products.
15. Funds available from the National Horticulture Mission has to be judiciously utilized for production as well as postharvest management of horticultural produce with a view to generate employment, add value and increase business. The concept is to convert horticulture into an industry in all respects.

General observations and recommendations

1. A comprehensive programme for the development of various horticultural crops in the different agro-climatic zones, their utilization, processing and marketing and other relevant aspects based on the recommendations of the State Agriculture Commission should be prepared by the Department of Food Processing Industries and Horticulture. This will include all ongoing NHM and State Government schemes.
2. Strengthening of data base should receive priority.
3. The Government of West Bengal should emphasize on the urgent need for implementation of the programmes of NHM within the financial period of sanction of fund and demand more fund for taking up further development programmes in the State especially in the vast drought prone rainfed areas in the western districts and hill areas with degraded soil and poor farming communities where planned horticultural development would prove to be of utmost importance.
4. The availability of good quality and genuine planting materials in the State is very inadequate but the same must be ensured during the season otherwise the development programme will badly suffer. It should be organized with the initiative of the Department of FPI and Horticulture as the nodal agency in all the districts of West Bengal to minimize the transportation and damage of planting materials.
5. Immediate and effective programmes should be taken up for improvement of the farms under FPI & H. Apart from proper improved and remunerative management practices, propagation, nursery management and establishment of organic farming models with horticultural crops, production of vegetable seeds, etc. necessary facilities should be developed for training and demonstration of improved

horticultural practices to the self help groups and farmers of the districts for providing opportunities of employment and income generation. The farms should serve the purpose of growth centres and involve local people for development of horticulture.

6. Since capacity building for promoting sustainable farming with horticultural crops is one of the important components among the different groups of stakeholders including the officers and field staff of the Department of FPI and Horticulture, NGOs, SHGs, farmers, etc., management of natural resources, production technology, postharvest management of different horticultural crops and marketing, facilities for intensive training and demonstration should be provided by the faculty of horticulture of agricultural universities in collaboration with the allied departments of the Govt. of West Bengal and funds should be made available for infrastructure development and other expenses to support the programmes.
7. In order to prevent the continued decline in the income of the small and marginal farmers and improve the soil fertility and sustainability in production at low cost, organic farming is recommended by eliminating the use of expensive chemical inputs. Further, in view of great increase in demand of organic products in the domestic and export markets, the farmers in due course will be financially benefited.
8. Because of the increasingly enormous postharvest loss of perishable horticultural crops, mainly fruits, flowers and vegetables, as a result of area expansion and increase in production, a comprehensive programme should be taken expeditiously by the Departments of FPI and Horticulture, and Agricultural Marketing in collaboration with the State Agricultural Marketing Board and the SAUs for developing an effective postharvest management technology, primary processing and value addition for different groups of horticulture crops and necessary arrangements be made to provide such facilities in intensive crop growing areas at the first phase.
9. Immediate measures should be taken by the Government of West Bengal to ensure fair and remunerative price to the growers who have been deprived through decades mainly because of the ineffective and inefficient marketing policy. In the present system of marketing, farmers can never visualize their income and Govt. is aware of the situation.
10. Unused and underused land resource available in the State, particularly in Western tract, must be brought under dryland by liberalizing land laws, if necessary.
11. In view of the earlier recommendation of the Commission in its interim report to the State Government and from further adverse reports on GM crops globally, no GM horticultural and field crops should be allowed for field trials and cultivation in the State.
12. The Commission strongly recommends the constitution of a State-level Advisory Committee in Horticulture with experts fully conversant with the horticultural development activities in West Bengal for comprehensive planning,

implementation, monitoring and evaluation of all horticultural development programmes in the State with a view to utilize the natural resources for intensive cultivation of horticultural crops including fruits, vegetables, plantation crops, spices, medicinal and aromatic plants, floriculture and plant propagation and seed production, postharvest management, value addition and marketing, employment generation and socio-economic upliftment of the rural people in particular.