Chapter II

Horticulture

Preamble

While preparing the report on Horticulture in collaboration with the subject matter specialists from the State Agricultural Universities and the State Department of FPI & Horticulture, West Bengal, it revealed that although no sound data was available on market survey, import of horticultural products in West Bengal from other states was enormous. These include, besides temperate fruits, which obviously need to be imported, other varieties of fruits, vegetables, flowers, plantation crops, spices, medicinal plants, processed fruits and vegetables that are consumed in the State. It is a modest estimate that fresh and processed horticultural commodities worth Rs.600 to 800 crore are imported annually, and the import is increasing every year. In the absence of any official record the situation appeared to be unbelievable and so horticulture development was not considered as a priority programme.

It is true that each and every state in India cannot produce all the crops consumed by the people, or used in the industries as raw materials. For example quality apple can not be grown in West Bengal. At the same time huge quantities of mango, sweet orange, mandarin orange, pomegranate, ber, custard apple, etc. are brought from other states while these could be grown in thousands of hectares of uncultivated upland and medium upland in the drought prone districts of West Bengal lying fallow for centuries. There is also a scope of increasing the production of banana which comes from other states in large quantities. Orchards of mandarin orange in the hill areas in Darjeeling district, one of the best of its kind, are on the verge of decline and collapse due to infected propagating materials and lack of orchard management practices. Very old mango orchards in Malda and Murshidabad have outlived their economic life and need replacement or rejuvenation.

Similarly, tonnes of major seed spices like coriander, fennel, fenugreek, cumin, etc. which can also be grown in the drought prone areas in the State, are mainly brought from other states keeping our farmers unaware of the remunerative farming from crop diversification in suitable locations. Many high value spices like black pepper, cinnamon, large cardamom and common spices, e.g. ginger, turmeric, garlic, etc. are brought from other states which can easily be grown in suitable agroclimatic regions in the district of North Bengal as remunerative cash crops in the farming system of small holding through models, demonstrations and training. Multitier cropping system with horticultural crops is popular and remunerative in southern states of India for income and employment generation.

Though cashew is a commercial crop in India which is also a major crop for export, the potential areas in coastal part of Purba Medinipur and the red lateritic zones

of the State suitable for cashew cultivation has never been explored seriously and effectively and the present production from seedling plants (not grafts) is very meagre. As a result, processed cashew worth crores of rupees is brought to the State annually from southern states. No progeny orchard and nursery where planting material of high yielding varieties of cashew, sweet orange, varieties of pomegranate, aonla, ber, etc. could be established even after a decade since the inception of the department. Coconut seedlings of high yielding varieties are in great demand almost throughout the State but its limited availability has restricted the expansion of this remunerative crop. On the contrary new disorders have come to West Bengal with seed nuts from South India.

In subtropical and mild temperate climate at many locations in the Darjeeling district, off season high value vegetable cultivation in low cost polyhouse would provide substantially higher income to the poor small farmers and reduce the quantum of import from other states. Sporadic attempts made by a few elite farmers here and there has not been properly promoted for real development. Organized cultivation of high value cut flowers of longer vaselife i.e. orchids, anthuriums, lilies, etc. in selected locations in hills supported by marketing and export assistance could significantly improve livelihood of the growers.

Seed production of vegetables and flowers in the hills, terai areas and also in the red lateritic zone of the State which have been completely overlooked and never attempted as an important horticulture development programme could immensely contribute to the economic condition of the farmers. Though potato is a major crop in West Bengal the farmers often suffer financial loss because of lapses in marketing system and uncertain price. Very little effort has been made to grow seed potato in the State although a huge amount is being paid by the growers to procure seed potato from Punjab at a high price.

Present development of vegetable and flower production in West Bengal is primarily due to the effort of small farmers to cope with the growing demand of the consumers, mainly with the help of extension network of the seed companies and their local agents. Unfortunately, the role of the Department of Marketing in handling, storage and marketing of perishables has not been felt anywhere for providing fair and remunerative price to the farmers, reducing the post harvest loss by developing transport and storage facilities or providing assistance in trading of the produce. The growers of vegetables and flowers usually get about 30% of the price paid by the consumers. This may be even lower during the period of glut.

It is also necessary to mention that the farms under the Department of FPI & Horticulture are fairly large but most of them are lying underutilized for many years. These can be effectively utilized for collection of germplasm, propagation of planting

materials, establishment of model gardens and demonstration and training of SHGs and farmers for employment and income generation.

In view of the enormous scope of development of horticulture and food processing in West Bengal, a Department of Food Processing Industries was established in 1992 on the recommendation of a committee constituted by the State Government and the merger of horticulture with the FPI was done subsequently. The Commission is of the opinion that in absence of any comprehensive plan for development of horticulture and food processing industries, inspite of its enormous scope and possibilities, progress in the production and utilization of horticultural crops have not been satisfactory and need to be urgently improved in the interest of nutritional and food security and enhancing income of small farmers. It is also necessary to mention that the progress of development work under National Horticulture Mission with many components, sanctioned by the Government of India about three years ago in West Bengal has been very slow in planning, implementation and monitoring. This programme was primarily targeted for income and employment generation of the poor farmers, particularly in the rainfed areas. Apart from the lack of overall planning on horticulture development in West Bengal by the Department of FPI & Horticulture and slow implementation of the programme of National Horticulture Mission in the State, the State Agriculture Universities (SAUs) have also not meaningfully contributed in the development programme through the network of the research stations in the different agroclimatic regions by providing models of remunerative farming systems with crop diversification including horticultural crops and imparting training and demonstration to the farmers for their socio-economic development which is a major mandate of the Agricultural Universities.

A comprehensive horticulture development plan including marketing and processing should be prepared for providing food and nutrition security, by the State-level Advisory Committee on Horticulture on this basis of detailed recommendations in various sections of this report.

The West Bengal State Agriculture Commission has been set up by the Government of West Bengal for the preparation of a comprehensive report on development of agriculture. The report is envisaged to cover, in addition to status and resources, the strategy, action plan and vision for enhancement of production to achieve economic development of the farming community. Horticulture, contributing 18 per cent of the GDP from agriculture occupying only about 10 per cent land, has an important role to play.

A. Fruits

Basic data

Available information on area and production of different horticultural crops are not based on actual annual field survey. The estimates may be realistic but it is essential to conduct an extensive survey.

1. Status

West Bengal with a total production of 23.02 lakh tonnes from 1.73 lakh ha in 2005-06 (Annual Report, 2005-06, Dept. of FPI & H) ranks eighth in fruit production in India. Major food crops are mango, litchi, banana, pineapple, guava, papaya, sapota and mandarin orange.

There has been a wide gap between targets and achievements in fruit production during Xth plan as may be seen from table.

Table 1: Targets in growth of area and production of fruits in West Bengal during Xth Plan

Year	Area ('000 ha)		Production ('000t)	
	Target	Achievement ('000 ha)	Target	Achievement
2001-2002	-	147.45	-	1985.50
2002-2003	180.00	152.20	1998.00	1785.60
2003-2004	190.00	160.99	2280.00	2016.081
2004-2005	200.00	166.29	2400.00	2128.28
2005-2006	215.00	172.69	2780.00	2301.70
2006-2007	225.00	-	2900.00	-

Source: Approach note on 11th plan. Economic Review 2005-06, 2006-07

District wise area and production have been shown in Annexure II.

2. Mango

Mango area extends mainly over two sides of the river Ganges on deep alluvial soil. West Bengal grows mango on an area of 70.093 thousand ha producing 5.13 lakh tonnes (2005-06). Number of varieties are above 150, of which 6-7 are commercial, viz. Fazli, Amrapali, Ashwina, Himsagar, Langra, Bombai, Lakhna, etc.

Table 2: Mango production in West Bengal.

Year	Area('000 ha)	Production('000 t)
2001-2002	65.40	585.00
2002-2003	66.38	228.75
2003-2004	67.76	405.96
2004-2005	69.13	460.75
2005-2006	70.09	513.34

Source: 1) Annual Report, 2003-2006, Dept. of FPI & H.
2) Economic Review, Govt. of West Bengal (2005-06, 2006-07)

Increments in area and production were low primarily due to non-availability of high land in mango belt. Major area is contributed by Malda, Murshidabad, North 24-Parganas and Hooghly. Malda accounts for 36.02 per cent area and contributes 29.2 per cent production while Murshidabad has 19.7 per cent area and produce 23.53 per cent fruits. Mango productivity in Murshidabad is better.

It is, however, difficult to estimate productivity since the proportion of juvenile and non-bearing young plantation is unknown and production is related to age and bearing sequence. Felling of old orchards and new plantation are going on simultaneously. Many have become victims to the development projects requiring highlands like roads, railways, industries and such other projects. A majority of plantations in Malda and Murshidabad have gone old and unproductive. Due to indiscriminate felling some of the varieties with rare qualities have been altogether lost. Orchards are usually sold out to harvesters much before flowering. The owner usually gets a small price and is not interested to spend on inputs. Consequently, the trees suffer and the bienniel bearing habit is transformed into irregular bearing. Again varietal treasure and clonal variation in mango have not been explored for improvement of production and marketing. Mango market in West Bengal is active from April to August.

A large quantity of mangoes comes from South and North India early and late in season before and after the West Bengal varieties arrive.

There was no facility for post harvest management, until very recently government created one in Malda. Packing, sorting, ripening and transport systems followed now are age old traditional type without any regard to the quality of produce. As a result post harvest loss is above 20 per cent. Except to Bangladesh, export of mango from West Bengal is negligible. The varieties grown in the State were selected primarily for table purpose. Although, production is very high none of the commercial varieties are preferred for processing except Fazli and Ashwina for making pickles and chutneys. Few other products are made in small quantities in home scale industries. Pulp is brought from Andhra Pradesh for making RTS

beverage and juice. Many of the varieties grown in the state might be very suitable for some other products but research and development work has not been taken up yet to explore this potentiality. There is also a demand for introducing exportable varieties with high keeping quality.

3. Pineapple

About 27 per cent of India's pineapple production comes from a concentrated area in Islampur sub-division of North Dinajpur, Siliguri sub-division and adjoining areas of Jalpaiguri district. The state ranks first in pineapple production. Trend of production has been shown in the next page.

Table 3: Trend in pineapple production

Year of production	Area ('000 ha)	Production ('000 t)
2001-2002	11.50	322.00
2002-2003	11.83	340.69
2003-2004	11.76	342.59
2004-2005	12.85	349.85
2005-2006	3.38	379.158

Source: Economic Review, Govt. of West Bengal, 2005-06, 2006-07

Pineapples are harvested in 7 to 8 months a year using calcium carbide for induction of flowering in off season. Density of planting has come up from 25000 to 35000 plants per ha. Further increase in the high rainfall area like North Bengal will reduce life of plantation and per cent of flowering. Size of fruits produced is ideal for fresh market and fetch high price in distant markets at Delhi, Kolkata and Patna, etc. Predominant variety is Ginat Kew. It has deficiency in colour, juiciness and flavour especially when harvested early for distant markets. Demand for processing is for smaller fruits of cylindrical shape which are economic for slicing.

Productivity of pineapple in West Bengal is quite good considering a portion of total area is young current year's plantation which would come to flowering next year. Availability of good planting material is a major constraint for expansion of area.

Cost of production and hence price level is so high that processors find it cheaper to import frozen (-18° C) juice in bulk from Thailand for preparing beverages.

Attempts made for export of fresh pineapples to Spain succeeded but the business did not stabilize for logistic problems.

There is a necessity for trying better processable varieties from other countries for utilizing the excellent potential of production in North Bengal.

4. Banana

Traditional Champa, Martaman and Kanthali are being gradually replaced with high yielding Giant Governor in irrigated plots. Banana growers in Nadia, Murshidabad and Hooghly districts have accepted this variety as it is high yielding and resistant to panama wilt. But sigatoka disease cause serious damage to the crop.

Table 4: Trends of production of banana

Year of production	Area ('000 ha)	Production ('000 t)
2001-2002	20.60	368.90
2002-2003	21.97	452.53
2003-2004	25.73	502.11
2004-2005	26.64	512.52
2005-2006	27.80	544.87

Source: Economic Review, Govt. of West Bengal, 2005-06, 2006-07.

Expansion of area in last two decades on banana was mainly with Giant Governor variety. In the recent years, tissue cultured plants of var. Grande Naine are being successfully cultivated in the traditional banana growing areas in the State with encouraging production and income. Marketing of banana is done as whole bunch. There is no facility for post harvest management like cutting of hands, washing, cooling, packing, storing, transportation and ripening. Consequently, a huge quantity is lost. Ripening is done by calcium carbide only and so quality loss is also of great significance. Banana is harvested almost throughout the year but September to January is the peak season when price falls low.

Banana puree is an important export item from India. This can be produced in bulk in this state also.

However, there is no banana processing unit in the state. A good quantity of bananas come from Maharastra, Tamil Nadu, Karnataka etc. in different seasons when demand grows up in the state.

5. Litchi

West Bengal ranks second in litchi production after Bihar. Farakka area of Murshidabad, parts of Malda and Nadia districts and Baruipur area of South 24-Parganas are major litchi production areas. The fruits appear in May and lasts for less than a month. Thereafter, fruits from Muzaffarpur and Uttarpradesh are sold in Kolkata upto the second week of June.

Bombai, Elachi and Muzaffarpur are the most important commercial varieties. But there are other good varieties viz. Kasba, Purbi, China, etc. planted in the Govt. Research Station (Zonal Adaptive Research Station) at Krishnanagar.

Table 5: Trends in production of litchi

Year of production	Area ('000 ha)	Production ('000 t)
2001-2002	5.85	61.43
2002-2003	6.36	63.92
2003-2004	6.55	55.67
2004-2005	7.16	69.91
2005-2006	8.05	74.92

Source: Economic Review, Govt. of West Bengal, 2005-06.
Annual Report, Deptt. of FPI & H, 2003-04, 2005-06.

Quality of fruit is very good. The fruits are highly perishable. Entire production is consumed as fresh fruit as the fruit is in high demand in the market. There is hardly any processing unit for production of juice, squash or dehydrated nuts.

Export is insignificant although there is good demand for fresh litchi in European market.

6. Guava

With the popularization of off season production by bending treatment guava is coming up as a major commercial fruit crop with extended availability in winter, spring and summer seasons.

Table 6: Trends in production of guava

Year of production	Area ('000 ha)	Production ('000 t)
2001-2002	7.35	121.27
2002-2003	8.27	126.94
2003-2004	9.00	133.78
2004-2005	9.37	140.89
2005-2006	9.89	152.99

Source: Economic Review (2005-2006). Annual Report. FPI & H Dept.

About 35 per cent increase in area and 26 per cent in production in 5 years indicate growing popularity of guava. The varieties like Khaja, Dudkhaja, Kafri, Kafri khaza are more popular than L – 49 or Safeda.

Baruipur area of South 24-Parganas, parts of Barasat sub-division in North 24-Parganas, Farakka area of Murshidabad are well known for guava production. Wilt is a serious problem in guava plantations.

Entire production of guava is consumed as fresh fruit in pre-ripe *(Dasha)* stage when colour develops but flesh is very firm. No unit produces pulp or juice of guava. However, jelly is produced in cottage and small scale. Huge quantity of ripe fruits are wasted in market which can be converted to pulp.

7. Mandarin orange

Darjeeling hills grow one of the finest quality mandarin orange. Orchards have been neglected for decades. Takda, Bijonbari, Mirik, Ambutia, etc. are famous orange growing areas. Many of the orchards are now on decline due to viral diseases and nutritional disorders, especially micro-nutrient deficiency and above all negligence.

Maize, ginger and other exhaustive crops are grown year after year in many orange orchards. Die back is a prevalent disease. Productivity of old orchards have gone down and in size of fruits is also small. Decline is rapidly destroying orchards. Fruits are carried on head load through steep slopes and then transported to Siliguri market by open trucks without any packaging. A good proportion is lost due to transport hazards.

Table 7: Production trend of mandarin orange

Year of production	Area ('000 ha)	Production ('000 t)
2001-2002	3.68	34.91
2002-2003	3.70	35.34
2003-2004	3.51	33.06
2004-2005	3.52	32.27
2005-2006	3.55	32.51

Source: Economic Review, Govt. of West Bengal, 2005-06, 2006-07

Area and production of mandarin orange have decreased during last 5 years. Low return to the farmers in the main reason for negligence to orchards and spread of the disease complex.

A part of the production is exported to Bangladesh and the rest is consumed within the state. Very small quantity is processed into squash and other products.

Mandarin orange market in West Bengal is dominated by supplies from Nagpur. Kinnow from other states meet a substantial part of requirement of mandarin.

8. Other fruit crops

Jackfruit, limes, lemons, etc. are other important fruit crops of West Bengal. In addition, a small quantity of minor fruits like ber, bael, jamun, jamrul, kamranga, karonda, tamarind, etc. are grown in the state. In Darjeeling hills a little quantity of pear, plum and peach are grown in home gardens.

Table 8: Area and production of other fruits (2005-2006)

Name of the Fruit crops	Area ('000 ha)	Production ('000 t)	Major production areas
Papaya	9.51	263.66	Nadia, North 24-Parganas, Murshidabad, Hooghly.
Jackfruit	10.88	160.10	Jalpaiguri, Coochbehar, Nadia, Murshidabad.
Other citrus	6.48	54.56	Throughout the state
Sapota	4.17	49.02	South 24-Parganas, Purba Medinipur
Temperate fruit	2.32	28.30	Darjeeling
Misc. fruits	6.58	48.28	Throughout the state

Source: Dept of FPI & Horticulture.

In jackfruit, bael, ber and jamun a lot of variations are available for selection. Production of these fruits is much below requirement and continuous supplies from other states is found in Kolkata market.

A small part of green papayas and karonda are used to make candies for use in bakery and confectionery industries. Value addition to minor fruits can be a major item for cottage industry.

9. Present and emerging problems

Six agroclimatic regions in West Bengal offer excellent scope for production of a large number of fruit crops. This opportunity has not been realized so far because of a number of constraints. Some are stated below.

Pressure on land in West Bengal is very high. Per capita available land is less than 0.07 ha and 80 per cent of holdings are smaller than 1 ha. Thus there is little scope for large scale plantation except in western part. Some area may be available in North Bengal also.

Non-availability of quality planting materials in required numbers is a major constraint for plantation of fruit crops. Quality control is an essential step as orchards are long term investment.

Fruit cultivation is in many cases looked as low input cultivation with one time major investment during establishment. Lack of input application and poor management practices have rendered many of the fruit orchards unproductive or irregular in bearing habits.

The system of selling out fruits to 'harvesters', even before flowering, makes the owners reluctant for investment on orchards. Consequently, production suffers. Fruit production is yet to be converted to an industry.

Lack of infrastructural facilities for postharvest handling, packaging, cooling, transport from farm to consumer, etc. results in huge loss to the tune of about 20 per cent fruits. Processing and value addition are almost unknown.

At a low rate of Rs.4,000 per tonne the value of 23.01 lakh tonne fruits is Rs. 920 crores but the expenditure on R & D is utterly negligible. There is need to increase the same substantially to achieve desired results.

Many of the mango as well as litchi orchards have overgrown their economic life and are now highly irregular. These are to be rejuvenated or replanted in phased manner.

The task of conservation of diversity in fruit varieties cannot be left to the farmers as is existing now. It is a research and development activity. Loss of germplasm due to uncontrolled felling is an important issue that requires immediate attention.

Varieties grown at present are mostly suitable for fresh consumption. Promising high yielding, regular, exportable or processable types should go in large areas for commercial growing instead of multiplicity of varieties.

Long gestation period of fruit orchards requires judicious planning for intercropping and financial support for generating income during non-bearing stage.

Institutional finance for establishing orchards has not gained popularity among fruit growers as expected. Hightech horticulture or dry land horticulture is out of reach or unknown to the fruit growers.

For expansion of area under fruits, rejuvenation etc., aggressive extension work is needed but at present extension activities among farmers is at a low key in absence of field workers. Many of the recommendations by research stations have not reached the farmers.

10. Some common field problems of important fruits experienced in West Bengal.

Mango:	Senescence of orchards, irregular production, mango hopper, shoot gall, early harvest, carbide ripening, gall psyllid, fruit borer.
Pineapple:	Heart rot, sunscald, early harvest.
Banana:	Sigatoka, stem borer, scarring beetle, panama disease, moko disease.
Guava:	Wilt, fruit fly, trunk borer.
Mandarin Orange:	Dieback, viral diseases and decline, micronutrient deficiency, seedling propagation, negligence
Litchi:	Mite, low production, high perishability.

Infrastructure – initiatives required in Agri-Export Zones.

Mango

(i) A pack house for mango has been established. It is necessary to popularize recommened postharvest handling among farmers and traders.

(ii) Two research projects on integrated management practices and control of shoot gall have been taken up by the BCKV. Adequate financial support will be required.

(iii) Trial consignment of 2.5 tonne mangoes were sent by the West Bengal State Food Processing and Horticulture Development Corporation, (WBSFP & HDC) to Singapore, Malayasia and London. Follow up actions are essential.

Pineapple

(i) Pineapple production is concentrated within a 100 km radius of Siliguri. An agri-export zone has been sanctioned for pineapple in this area. In addition a food park is being set up in Siliguri. High density planting is being extended. Government is organizing training programme of farmers in production and postharvest management.

(ii) Calypso Bengal Food Pvt. Ltd., a 100% EOU has started a partnership programme for pineapple production and processing with 700 farmers registered so far.

(iii) Research on product development from pineapple has been taken up by the Jadavpur University.

(iv) Perishable goods cargo handling complex at Bagdogra airport has been sanctioned.

(v) A quality control laboratory is being set up by the Uttar Banga Krishi Viswavidyalaya.

(vi) Projects in the pipeline
   (a) Postharvest handling cum auction centre for pineapple
   (b) IT based horticultural extension education for agri-business in North Bengal.

Litchi

(i) The AEZ covers litchi areas in Malda, Murshidabad, North and South 24-Parganas.

(ii) Intensive training programme are being conducted.

(iii) Research projects have been taken up at B.C.K.V on clonal selection and management projects.

(iv) A special fumigation chamber has been installed in the pack house at Malda and seven multipurpose cold storage are available in the zone for storage and transport of litchis.

Pack-house and multipurpose cold stores

(i) Pack-house at Malda has washing, storing, grading, waxing, packaging and storing facilities. In addition, refrigerated van for cool transport is also available.

(ii) 14 cold rooms have been created in 10 municipal markets and work is in progress in 6 municipal markets.

(iii) Multipurpose cold stores are being set up by the Zilla Parishads of Burdwan and Nadia.

(iv) WBSFP & Horticultural Development Corporation (HDC) is operating a refrigerated van.

(v) A perishable cargo handling complex at Kolkata airport is being set up.

Government horticultural farms

There are 11 horticultural farms in the state in 8 districts. The farms are required to be improved to act as growth centres involving training, conservation of germplasm, production of planting materials and demonstration of modern techniques for cultivation and postharvest practices.

11. Agri-Export Zones

Alongside, in order to optimize the potential of a few important horticultural products five Agri-Export Zones (AEZ) have been set up in the State viz.

a) **AEZ – Pineapple** covering the districts if Jalpaiguri, Coochbehar, Darjeeling and Uttar Dinajpur.
b) **AEZ – Litchi** covering the districts of Malda, Murshidabad, 24-Parganas (North).
c) **AEZ – Potato** covering the districts of Burdwan, Howrah, Hooghly and Paschim Midnapore.
d) **AEZ – Mango** covering the districts of Malda and Murshidabad.
e) **AEZ – Vegetable** covering the districts of 24-Parganas (North), Nadia and Murshidabad.

The AEZs are expected to train farmers, build up required infrastructure, encourage the setting up of processing units, ensure the marketing and export of products. The convergence and pooling of various existing schemes of the State Government in AEZs would allow the development of AEZs without the need for additional public resources. The Government is expected to act as a facilitator. The growth of the AEZs would be primarily through private investments and initiative.

12. Nurseries

There are a large number of small and medium private and government or institutional nurseries producing fruit plants in the state. Large commercial nurseries of fruit plants are few. In most of the nurseries no attention is paid to the selection of true to type, high yielding and disease free mother plants. The repeated propagation of a clone from a single mother plant has contributed to the decline in vigor and other adverse effects. Some unscrupulous nurserymen even sell seedling plants in place of grafts whenever the demand is very heavy. The Department of Fruit Processing Industries and Horticulture is the major buyer of plant material every year for distribution to the farmers on subsidized costs under various developmental programme. With the implementation of National Horticulture Mission (NHM) enormous quantity of planting materials of different fruits commercially grown in the state would be needed for orchard and plantation

development. It is mostly in these purchases that the farmers receive inferior materials.

For coconut, the Government has set up 'Seed Gardens' at Chandannager, however, their annual production is too low to meet the normal demand. Consequently, the seed nuts and seedlings from ordinary gardens come from neighboring states. A lot of coconut planting material comes from Andhra Pardesh and Kerala, despite the fact the Kerala plantations are ravaged with root wilt disease. There is no inter-state quarantine in operation today, and as such the spread of insect and disease from one state to other goes unchecked. Similar situations prevail in all other fruit crops. In cashewnut, seedlings are mostly raised and distributed. The low productivity of 2-3 kg nuts per tree is primarily due to this factor. Though NHM recommends cashew plantation in the drought prone area in Paschimanchal, thousands of cashew grafts are brought from Orissa every year.

In Darjeeling district, the citrus industry is on the verge of collapse. Most of the existing orchards are in a state of decline. Often new orchards are developed / developing with seedling plants of inferior quality. The complex disease and pest scenario in this region makes it impossible to find a suitable clone. It urgently necessary to raise rootstocks (Rangpur lime / Volkamariana) after proper virus indexing. Only the desired rootstocks should be utilized for budding. The scion bud should be collected from the Regional Research Station of Uttarbanga Krishi Viswavidyalaya (UBKV) or ICAR Regional Station located in the district (Citrus die back Research Station).

Though the state is reported to have more than 150 mango varieties, only 5-6 varieties are cultivated commercially. Wide variability was noted even within the same variety like 'Langra', 'Himsagar', 'Fazli', 'Lakshman Bhog', 'Golap Khas' and 'Amrapali'.

Superior clones for the mentioned varieties (available in the State Agricultural Universities (SAUs) and institutes of the state should only be used in developing the progeny orchard. The hybrid 'Amrapali' is very well acclimatized in the state and has been accepted by the growers for its regular bearing, late maturity, excellent quality and suitability for high density planting. Its area has increased by about 10,000 hectares in the last 10 years in different districts. However, quite a few plants have shown segregation clearly showing the characters of one of the parents 'Nellum'. Those plants should be identified and removed and in no case should be used as a mother plant. 'Amrapali' is suitable for raising only on a dwarfing rootstock. It has been observed that the nurserymen usually collect the mango stones whatever available in the locality and raised the rootstock for

grafting. When 'Amrapali' is grafted on rootstocks with vigorous tree characters like 'Fazli', 'Langra' or 'Himsagar', it may not be as dwarf as it should be on a dwarfing rootstock or even on 'Amrapali' itself. In the long run, the rootstocks raised from other varieties like 'Langra', 'Fazli'. 'Himsagar' which are also irregular in bearing habit may influence the bearing habit of 'Amrapali' and make it an irregular bearer (already noted in some orchards).

It is expected that litchi will be one of the main export earning fruit corps of the state. With the increasing demand of the fruit and creation of AEZ, the area under litchi particularly in Malda and Murshidabad districts is increasing every year by about 300 – 700 hectares. The planting materials available in the districts are very inferior in quality and mostly of the local variety 'Goothi'. Only selected clones of varieties 'Bombai', 'Bedana', 'China' and 'Muzaffarpur' should be used as mother plant. The international market demand is basically for small seeded and superior quality variety. It is urgently needed that small seeded good varieties from countries like China, Thailand and Australia are introduced and evaluated for their performance under West Bengal condition. These plants may be used in future as mother plants in the progeny orchards. Similarly, low land litchi varieties available in Thailand may be introduced in Malda. By widening the genetic base due to new introductions, harvesting period of litchi may be prolonged.

Guava is one of the fruit crops where the acreage increased many fold in the last five-years, particularly in the southern districts of West Bengal. It has a great potential in the western parts of the state. The interesting situation is that the guava growers of the state have not accepted the named variety of India like 'Sardar' or 'Allahabad Safeda'. The growers prefer the variety 'Khaja' (Bengal Safeds) because of superior quality, attractive fruit and responsive to bending treatment for crop regulation. Again, several types of 'Khaja' like 'Dud Khaja', 'Kafri Khaja', 'Mohamad Khaja', etc. are available. It is necessary to isolate the best type/s to be used as mother plant.

In banana, both 'Cavendish' and 'Martaman' are popular in the state. Lately 'Grande Naine' is being grown commercially in this State. Banana growers usually collect suckers of varying size and weight from any source which may resul in non-uniform growth, maturity and productivity. There are several dreaded diseases of banana which are easily transmitted through planting materials. It is necessary to develop modernized tissue culture laboratory, at least 2-3 in each of the banana growing district to cater the needs of quality planting materials. However, the price of tissue culture plantlets should be brought down to Rs. 4-5 per plant to make it attractive for the growers.

The vast western part of the states comprising Paschim Medinipur, Purulia, Bankura, Birbhum and parts of Burdwan have tremendous potentiality of growing many important fruit crops like sweet orange, mango, guava, jackfruit, bael, aonla, sapota, jamun and pomegranate. It is necessary to develop progeny orchard in these area with superior mother plants to cater the needs of planting materials for the region. Sweet orange, mandarin orange and alphonso mango could be grown commercially in this region. It is necessary to ensure availability of quality planting materials for these crops in the region.

Recommendations

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.

13. Task ahead in XI plan

Keeping aside 20% as wastage and 10% as outside trade and processing demand, the present product of 23.01 lakh tonnes fruits can cater 51 g per head per day for a population of 8.67 crores (1-10-07).

Object in fruit production is to provide for minimum of 60g fruit per head per day. Population of West Bengal as estimated on 1.10.07 is 8.67 crores (Economic Review, Govt. of West Bengal, 2006-07). At an average incremental rate of 1.33 per cent this will reach to 9.14 crores on 1.10.2011.

Minimum nutritional requirement is 60 g fruit per head per day.

Requirement for 9.14 crore population in 2011-12 at the minimum rate of 60 g per head per day will be 20.02 lakh tonne for the year.

At the present rate of wastage (20%) and demand for processing and outside trade (10%) quantity of fruits unavailable for consumption will be 8.58 lakh tonnes.

Therefore, production requirement in 2011-12 works out 28.60 lakh tonnes. Thus the anticipated shortfall will be 28.60 – 23.02 = 5.58 lakh tonnes.

As already discussed land for large plantation is not available in West Bengal except in the western part. Major strategy should be increasing productivity from the present level of 13.33 tonnes to 15.33 tonnes per ha and reduction of postharvest wastage from 20% to 15% by introducing improved technology in field as well as for handling after harvest. A modest target of expansion of area by 5,000 ha within 2011-12 may be achievable.

Anticipated scenario of fruit production and availability in the year 2011-12 after adoption of recommendations

(i)	Production at enhanced rate of 15.33 t/ha from the existing area of 1.7269 lakh ha	=	26.47	Lakh tonnes
(ii)	Additional production from juvenile orchards 5000 ha expansion of area @ 5t/ha	=	0.25	,,
(iii)	Total production in 2011-12	=	26.72	,,
(iv)	Requirement for processing and outside trade 10%	=	2.67	,,
(v)	Wastage at reduced rate of 15%	=	4.00	,,
(vi)	Total available for consumption as fresh fruits	=	20.05	,,
(vii)	Availability per head per day for 9.14 crores	=	60.10	gram.

Availability of high land and other requisites will not permit achievement of the target of 3 lakh ha expansion of area as shown in the approach paper of XI Plan by the Department of FPI & H.

During the year 2019-20 the population is anticipated to reach 10.16 crore in West Bengal at an average incremental rate of 1.33 per cent. Requirement of fruits will be as follows in the said year.

(i)	Anticipated population on 1.10.2019	=	10.16	crores
(ii)	Fruit requirement for consumption @ 60 g per head per day	=	22.25	Lakh tonnes
(iii)	Export and trans state trade (anticipated) 10%	=	3.18	,,
(iv)	Processing demand 5%	=	1.59	,,
(v)	Postharvest wastage 15% (reduced rate)	=	4.76	,,
(vi)	Total production requirement	=	31.78	,,

The target for increasing productivity should be set at 17.50 t/ha fruits in 2019-20. However, it will also be necessary to expand area under fruits by 12500 ha from the present area of 172.69 thousand ha. Total fruit production in the state may then reach (1.8519 X 17.5=) 32.40 lakh t. This can be achieved by judiciously implementing the existing schemes and the recommendations stated under strategy and action plan.

North Bengal: North Bengal is the fruit bowl of West Bengal contributing major part of mango, pineapple and the whole of mandarin orange. Area expansion, increasing productivity from existing areas and rejuvenation of orchards of all fruits are recommended. Some **special recommendations** are mentioned below.

1. Establishment of good nursery for production of certified budded plants of mandarin orange to be planted in hills.
2. Underutilized land in tea gardens and different other organizations can be brought under fruit crops.
3. Exhaustive inter-crops like maize should be replaced by legumes in orange orchards.
4. Passion fruit may be planted in large sale supported by a jam or squash making unit.
5. Video call centers in some areas for farmers for contacting experts.
6. Extensive training of farmers in production, plant protection and postharvest management.
7. Private entrepreneurs should be encouraged to establish multipurpose cold stores and processing units which may produce final as well as intermediate products.
8. Enhanced R&D activities by involving UBKV and its substations.
9. Research work for utilization of fruits like jackfruit.
10. High density multicrop system may be introduced.
11. NGO, self-help groups and women organization may be involved.

12. Home gardens with due nurture and care may be a major contributor in fruit production.

Coastal saline area: A large area in Purba Medinipur, South and North 24-Parganas are highly saline. The area is mostly monocropped and long duration *Aman* paddy is the predominant crop. Though vegetables are bring grown in small areas with available irrigation, major part of the saline area remains unutilized during other seasons.

1. Land shaping for raising a part of land and holding surface water in a pond dug for the purpose should be popularized for extensive vegetable cultivation, betel vine fishery and duckery for income and employment generation.
2. In saline soils coconut, sapota and cashewnut can be grown.
3. In more saline areas extensive plantation of local date palm for 'gur' industry may be planned.

Intensive fruit production in Western Zone: Purulia and Western part of the districts of Paschim Medinipur, Purulia, Bankura, Birbhum and parts of Burdwan constitute this region. The average rainfall is distributed from middle of June to August, though the average rainfall in the area is about 1300 mm.

The soil type in most parts in this zone is lateritic red soil, which not suitable for shallow rooted field crops except in low lands. Major ecological disadvantages that led the western lateritic belt of West Bengal into economic backwardness are highly eroded uncultivated vast upland (Tar), high temperature and hot desiccating wind during summer, intermittent drought spell during crop growth, low inherent soil fertility, poor water holding capacity and lack of irrigation facility. Despite these adversaries the farming system adopted by the farmers is rice based monocropping basically in quest of food security. Cultivation during winter season is insignificant in red lateritic regions due to paucity of water. However, the red lateritic belt of the State, which is not that suitable for shallow rooted crops can be utilized for deep rooted fruit trees, and intercrops in the rainy season for 3-4 years would improve the socio-economic condition of the growers.

The prospect of industrialization in this lateritic region is bleak due to several factors, while bringing more areas under horticultural crops by soil and water conservation may open the avenue for the development food processing industries together with ancillary units, in addition to income and employment generation, food and nutrition security of the poor small farmers.

The western tract has 73% of the State's land resource which is classed as "culturable waste and fallow land". A substantial portion of this region can be made into productive use by bringing the area under commercial fruit cultivation, which

will increase the total agricultural growth rate of the State without encroaching the land under field crop cultivation.

Table 9: Uncultivated land in different districts of West Bengal (2005-2006)

Districts	Culturable waste and fallow land '000ha (in thousand ha)
Bankura	8.34
Birbhum	4.20
Bardhaman	14.48
Paschim Medinipur	12.86
Purulia	13.12
Other districts	19.18
Total in W.B.	72.18

Source: Economic Review: 2006-07 Government of West Bengal.

The economic development of the western part of West Bengal through effective utilization of the un- or underutilized lands of the western tracts of the state by fruit cultivation will boost up the development of allied sectors in red lateritic zone of West Bengal. For sustainable development of fruit industry and for the socio-economic development of the growers, the following points will have to be considered:

1) Utilization of cultivable wasteland
2) Growing fruit crops in every home garden
3) Identification of cost effective technologies
4) Reduction of knowledge gap through training and visit programme
5) Establishment of collection centres and pack-house (with emphasis on reduction of packing cost)
6) Reduction of postharvest losses and development of fruit processing industries
7) Proper marketing facilities

Economic development – It is well documented that fruit crops are much more remunerative than field crops when grown scientifically, even though the initial cost of establishing fruit orchard is relatively high.
Employment generation – A hectare of well-managed orchard and intercropping can generate 400- 500 man-days of employment direct or indirect during pre- to postharvest period of crop growth.

Industrial development – No industrial development occurred in this region due to many factors. However, if this region could be brought under commercial fruit cultivation several small as well as large fruit processing industries can come up in the long run, which will benefit the local growers. Several other ancillary industries can also develop along side. Success in the development of horticulture in this region will attract the corporate investment, which will boost up the socio-economic status of the inhabitants.
Environmental benefit – Plantation of permanent fruit trees will check the soil erosion, add organic matter to the soil and gradually improve the soil health apart from the other benefit of growing permanent trees.
Nutritional security – Fruits are rich in nutrients and considered as protective foods. Growing fruits crops in this region will meet the nutritional requirement of the people of this region.

Production technology for Lateritic Zone: The farming system to be adopted in this region will be somewhat different from the other region. The technologies for scientific dry land farming (deep planting, larger pits, water harvesting, drip irrigation, etc.) high or location specific ultra-high density planting, use of organic manures and bio-fertilizers, integrated nutrient management, etc. will be followed here. Selection of fruit crops to be grown will be based on the soil and climatic conditions. Intercropping with rainfed vegetables during the gestation period will be an integral part of this programme. Emphasis will also be given on use of home and nutrition garden.

Besides, as a long-term strategy, watershed development and provision of protective irrigation in dryland are be taken up to improve the production and productivity of fruit crops in this region. Several rainfed pulses, vegetables and medicinal crops will also be grown as intercrop. Turmeric and ginger can be grown in the banks of the ponds or partially shaded lands. Diversification of crops, entrancement of soil fertility using organic matter (manure, crop residue, biofertilizer, etc.) and control of diseases and pests with biopesticide would reduce the cost of cultivation, promote better income and environment.

Fruit species to be grown: Several fruit species can be grown in this red lateritic belt of West Bengal, which have been identified through long-term research works conducted by State as well as university research stations. The following fruit species are recommended for the economic development of this region:

Table 10: Recommended fruit species with cultivars for lateritic zone

Sl No	Fruit crops	Cultivars
1.	Sweet orange	Mosambi
2.	Guava	Lucknow-49, Harijah, Allahabad Safeda
3.	Ber	Gola, Seo
4.	Mango	Amrapali, Alphanso, Himsagar, Ranipasand
5.	Pomegranate	Ganesh
6.	Mandarin /Kinnow	Nagpur Santra, Kinnow
7.	Lime / Lemon	Pati, Gandharaj, Seedless
8.	Underutilized fruits	
	a) Aonla	Banarashi, Chakayya
	b) Sapota	Cricket Ball, Kalipatti
	c) Custard apple	Balanagar, Mammoth

Table 11: Plant population per hectare

Sl No.	Crops	No. of plants	Plant population in ultra high density planting
1.	Amrapali mango, sweet orange, guava, mandarin, custard apple, kinnow	400	500
2.	Other mango cultivars	100	156
3.	Ber	278	400
4.	Lime/Lemon	625	625
5.	Anola, Bael, sapota, etc.	100	200
	Cashewnut	200	300

14. Enhancing production from existing area applicable in all areas

The fruit crop, being perennial in nature, require continuous care for sustainable production. Each fruit crop requires different types of care and management in different months of a year. However, followings are the basic aspects that to be attended.

a) Annual application of major and minor nutrients: Most of the farms are reluctant to apply manures and fertilizers every year.

(i) Manures and fertilizers to be applied every year and in split doses. The quantity of manures and fertilizers to be applied depends on the type of fruit crop, age and location where the crop is grown. Leaf nutrient standards coupled with soil analysis should be followed for determining the quantity of fertilizers to be applied to a particular crop.

(ii) A portion of nutrient should be applied after fruit set for increasing size and quality of fruits.

(iii) Manures and fertilizers should be applied in circular trench instead of broadcasting. The depth of trench should be 15 to 20 cm, width 30 to 90 cm and distance from the base of the plant be 60 to 120 cm in different fruit crops.
(iv) $1/3^{rd}$ of the applied nutrients should be from organic sources.
(v) In acid soils (Paschim Medinipur, Bankura, Purulia, Birdhum, part of Burdwan *i.e.* western part of West Bengal) lime should be applied. The quantity of lime varies from 100 g and 1000 g per plant/year in different crops and actual quantity should be applied after testing pH of the soil.
(vi) Micronutrients are not generally applied in fruit crops. But it is very important in most of the fruit crops for reducing fruit drop, increasing size and quality of fruits and maintaining general health of the tree. Micronutrients like Zn, B, Fe, Cu, Mn, etc. to be applied as foliar spray during fruit growth and growing stage of the plant, at least two times in a year to be sprayed. Micronutrients can be applied with the insecticides and fungicides but pH of the solution should known before spray.

b) Irrigation: Irrigation plays a vital role not only in fruit production but also to regulate the cropping in fruit crops like pomegranate, acid lime, guava, mango, etc. and vigour of the plant. Due to scarcity of ground water, drip irrigation in fruit crops is strongly suggested. Flood irrigation causes leaching loss of nutrients *i.e.* minimize the nutrient efficiency, accelerates weed growth and increases the production cost.
(i) Quantity of water to be applied varies in different fruit crops, stage of growth of plant and fruit and location (where the crop is grown).
(ii) In case of drip irrigation, the quantity of water is judged as per open pan evaporation or soil moisture depletion in a day.
(iii) Fertigation in all the fruit crops to be promoted in West Bengal for increasing the quality and quality of fruits.
(iv) Irrigation to be minimized or stopped at least two weeks before harvest of the crop.

c) Pruning and thinning of branches: It is considered to be one of the important cultural practices for increasing efficiency of the orchard.
(i) Pruning of disease, dried, criss-crossed, unproductive branches is necessary. Every year to maintain the health of the plant and to sustain the productivity of the crop.
(ii) Pruning of branches and shoots is considered to be one of the essential cultural practices in some fruit crops (like ber, pomegranate, grape, guava, etc.) for increasing the production and quality of fruits.

(iii) Pruning of shoots and thinning of branches should be done in such a way that the plants can get sufficient sunlight and allow air circulation inside the plant.
(iv) Severity of pruning depends on type of the crop and stage of plant.
(v) Pruning of shoots and thinning of branches in fruit crops is considered to 'art of beautification' that require specialized training.
(vi) Pruning should be done at dormant state of the plant and not in rainy season.
(vii) After pruning, the cut-end should be painted with cu-fungicide or Bordeaux paste.
(viii) Farmers are to be trained in pruning by the expert persons.

d) **Application of bio-regulators:** It has already been proved that application of bio-regulators will help to regulate the cropping, increase fruit set and size and improve the quality of fruits.
(i) Type of bio-regulator, doses and stage of application vary depending on crops.
(ii) Bio-regulators are applied during flowering to regulate the cropping or to increase the fruit set.
(iii) Bio-regulators are applied after fruit set for minimizing fruit drop and for increasing fruit size.
(iv) Bio-regulators are applied before harvest for improving the colour and quality of the fruit.
(v) In West Bengal, use of bio-regulator has been standardized in some fruit crops (like, mango, litchi, guava, sweet orange, etc.) while in others yet to be standardized.

e) **Use of mulching and rain water harvesting:** Mulching and rain-water harvesting are very important specially in Western part of West Bengal.
(i) Mulching the tree bases with grasses, leaves, polythene and farms waste during drier months of the year will be helpful to conserve soil moisture.
(ii) Rain-water harvesting through opening of semi-circular or circular trench help to catch the rain-water and top soils. It has already been proved that this technique is very helpful to improve the fruit production in laterite zone of West Bengal.

f) **Practice of tillage:** Light tillage in the orchard helps the soil to absorb maximum amount of water and allows little run-off, increases the infiltration capacity, increases aeration and reduces weed growth. The tillage should be practiced before onset of rain and again after cessation of monsoon.

g) **Weed management:** The orchard should be kept clean as much as possible. Weeding can be done by manually, mechanically or chemically as per situation.

h) **Floor management:** Growing of leguminous and cover crops in the orchard will increase soil fertility, reduce soil erosion and generate income. Type of intercrops to be grown depends on soil fertility, light interception and water availability.

i) **Rejuvenation of old orchards:** Productivity of old orchards can be increased by judicious pruning followed by manuring and fertilization, watering and plant protection measures.

j) **Plant protection:** All fruit crops are prone to pests and diseases attack. More than 50 to 80 per cent of the crop may be damaged by the pests and diseases if not controlled timely.

(i) Each fruit crop has specific pest and disease problem. Pesticides and fungicides to be sprayed accordingly.
(ii) Recommended dose and prescribed time of application should strictly be followed.
(iii) Integrated pest and disease management practices, wherever standardized, should be followed.
(iv) Insecticides and fungicides application must be stopped at least 2-3 weeks before harvesting. Bio-pesticides and fungicides should preferably be used.

15. Non-farm activities generating income at farm level

(i) The branches, which are available during pruning and thinning operation may be sold as fire wood for getting some income.
(ii) Bee keeping should be practiced in the orchard. It will not only generate an additional income but will also help in pollination and thereby increase the fruit production in many fruit crops.
(iii) Goatery and poultry inside the fruit orchard is considered to be the another important source of additional income which should be promoted wherever feasible. In this case the plant should be sufficiently tall and the plant canopy should be out of reach of the grazing animals. In the orchard of mango, jackfruit, litchi, etc, goatery could be practiced. Litter from the goat will be helpful to enrich the soil with the nutrients.
(iv) Nursery business at the orchard premises may be a good source of income. Good, healthy and high yielding plants in the orchard should be identified and used as a source of mother plants for generating planting material. Nursery business will not only provide income to the growers but also will generate employment for the local people.

(v) In the farm, rearing of cattle is an essential component for obtaining cow dung, utilizing farm waste and to earn income from milk. In this case biogas plant may be set up for lighting and gas. The by-product *i.e.* decomposed cow dung is more fertile than the ordinary cow dung.

(vi) Farm-scale preservation unit may be set up at the farm level for getting better price from the produce. Home-scale preservation unit should be promoted, wherever feasible.

(vii) The low-lying area of the farm (if available) may be converted to pond and utilized for pisciculture, duckery and as a water reservoir.

Recommendations

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 high-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. Mullti-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 11^{th} 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 clinies, 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, aonla, date palm, cashew, jackfruit, 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 alluvaial 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

1. Status and scope of development

Status and scope of development of vegetable crops in West Bengal has been featured through demographic features, status of cooperatives, percentage of advances to deposits of scheduled commercial banks, cropping intensity, etc.

Table 1: Some important demographic features of West Bengal as per 2001 census and projections up to 2020 (population figures in crore)

Items	2006-07 as on 1.10.07	Projections @ 1.33% compounded annually.	
		2011-12	2019-20
Total population	8.67	9.14	10.16
Urban population	2.45	3.47	3.86
Rural population	6.22	5.67	6.30

Note: The projections have been made on the basis of the following considerations:

i) Birth rate minus total death rate in 1981 was 33.2-11.0=22.2 per 1000 which has come down to 18.8-6.4=12.4 in 2005. For the purpose of projection of population average birth rate minus average death rate during 2001 to 2005 i.e. 19.9-6.6=13.3 has been taken into account (Economic Review, 2006-07).

ii) Presently, 28.26 % is urban population in West Bengal; however, as per IFPRI about 52% of developing world's population will be living in the urban areas in the coming decades. In this projection bench mark of 38% as per 1995 estimate worldwide has been kept, although projection for 1.10.07 in the Economic Review was only 28% urban population.

Source: i) Economic Review (2006-07), Govt. of West Bengal (as on 1.10.07);
ii) Proceeding of the International Workshop on Urban and Peri-urban Agriculture for Asian Countries, 29 June to 2 July, 2005, Bangalore.

Salient observations on the present and expected demography of West Bengal

(i) Rapid urbanization will significantly increase the demand of vegetables in the urban sector.

(ii) Rapid urbanization will have significant effects on the preference of different vegetables particularly that of exotic and lesser known vegetables.

(iii) It is necessary to develop and promote Good Agricultural Practices (GAP) in terms of intensified, cost-efficient and environment-friendly production packages aiming at high quality produce.

(iv) Adequate steps need to be taken to improve the supply chain and reduce of postharvest losses, including transport, marketing and small scale processing strategies.

(v) Adequate research and developmental back up for successful management and marketing of different exotic and lesser known vegetables like, sweet corn, baby corn, leek, bunching onion, welsh onion, broccoli, brussels sprouts, Chinese cabbage, spine gourd (kakrol), kartoli, ivy gourd, sweet pea, gherkin, sweet gourd, faba bean, lima bean, winged bean, sword bean, velvet bean, etc.

(vi) Livelihood support is needed to the marginalized farm families around the urban and peri-urban areas who lack the skill for securing other job opportunities.

(vii) Adequate recycling of sewage and urban solid waste to maintain environmental safety and supply of adequate organic matter for sustainable vegetable production.

(viii) Provision of employment to the huge agricultural and migrant unskilled laubours in the sorting and packaging, supply chain and retail shopping of vegetables in and around cities.

Table 2: Percentage of advances to deposits of scheduled commercial banks in West Bengal along with some major States in India (As on Friday of June, 2005)

Particulars	Percentage of advances to deposits							
	West Bengal	Gujarat	Maharastra	Kerala	Tamil Nadu	Punjab	Uttar Pradesh	All India
Rural	32.78	38.17	90.06	68.33	77.48	50.92	40.16	52.72
Semi-urban	27.17	31.00	54.26	46.89	68.54	34.06	36.47	44.86
Urban	60.48	55.08	96.88	79.48	111.96	58.82	35.70	73.95

Source: Economic Review (2005-06), Govt. of West Bengal.

Salient observations on credit – deposit ratios of banks

(i) Percentage of advances to deposits of scheduled commercial banks in West Bengal in rural areas (32.78%) is much below the National average (52.72%) as well as all the leading states.

(ii) Conspicuous difference in rural and urban sector in West Bengal in percentage of advances to deposits in comparison to both all India average and other leading states.

(iii) 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.

Table 3: Present feature of co-operatives in West Bengal

Type of societies	Number in 2004-05
Total credit societies	13743
• State and Central banks	18
• Land development banks	25
• Agricultural societies (excluding grain banks)	6893
• Grain banks	440
• Non-agricultural societies	6317
• Urban banks	50

Source: Economic Review (2005-06), Govt. of West Bengal.

The agricultural credit societies have to be involved particularly in special vegetable production zones in arranging credit to the vegetable growers as well as marketing of different agricultural inputs and produce.

Table 4: Feature of cropping intensity in West Bengal in last five years

Year	Cropping intensity (%)
1990-91	159
2000-01	168
2001-02	177
2002-03	178
2003-04	178
2004-05	177
2005-06	180

Source: Economic Reviews (2005-06 and 2006-07), Govt. of West Bengal.

Salient points

(i) Marginal increase in cropping intensity during last 5 years shows stagnation.

(ii) Adequate irrigation, crop diversification and marketing facilities need to be generated or provided to increase gross cultivable land under vegetable crops through increasing cropping intensity because it will be very difficult to increase the net area under vegetable crops in West Bengal.

2. Present and emerging problems of the vegetable sector

a) Most of the vegetable growers in the state are basically small and marginal farmers (93% farmers of West Bengal are small and marginal) with limited capability of generating capital inflow for vegetable farming.

b) No organized effort has so far been taken to increase the capital inflow from the bank sector in terms of short or medium term loan particularly for vegetable farming.
c) Non-involvement of the agricultural credit societies for disbursement of credit for vegetable farming as well as marketing of different inputs and produce.
d) Lack of organized marketing of vegetables for internal, inter-state and export market.
e) Lack of infrastructure support for postharvest handling of the produce in the farm as well as in market sector.
f) Lack of availability of the seeds of improved varieties of the tropical and indigenous vegetable crops namely, all cucurbits, brinjal, chilli, etc. So production of both open pollinated seeds of improved varieties and well adapted high yielding local varieties and hybrid seeds in the concept of seed village should be given top priority.
g) Hybrids of only tomato and cabbage assume 50-60 % acreage with meagre area coverage by the hybrids of other vegetable crops.
h) Vegetable cultivation in the vast red and laterite tract of the western part of West Bengal is basically rainfed.
i) Lack of dissemination of improved production technologies to the vegetable growers. High-tech vegetable production technologies are beyond the reach of resource poor farmers.
j) Declining organic matter levels and mining of nutrients causing deficiencies of certain secondary and micro-nutrients particularly in the areas of high cropping intensity which necessitates bringing up the packages of integrated nutrient management in vegetable crops.
k) Some of the disease and pest problems like, leaf curl virus in tomato, fruit and shoot borer in brinjal, bacterial wilt in solanaceous vegetable crops, mite and anthracnose in chilli, downy mildew in bitter gourd and cucumber, rot in pointed gourd, root knot nematodes in different vegetable crops, etc. still assume serious proportion. Appropriate plant protection measures preferably in the manner of integrated pest and disease management and surveillance of diseases in different vegetable growing zones are not adequate.
l) Lack of region specific research back up for organic farming package, lack of availability of organic inputs and at the same time lack of assured market are the main hindrance of implementing this farming system in concerted manner.
m) Lack of postharvest handling, grading, storing and pack house facilities lead to huge loss on one hand and transporting garbage in to and out of cities on the other.
n) Washing with filthy water, colouring with harmful chemicals and unhygienic handling, are hidden causes of many diseases.

3. Projections for production requirement and productivity in West Bengal

The production of vegetables in different countries of the world is shown in Table 5 and the projected vegetable production in West Bengal in 2011-12 and 2019-20 is presented in Table 6.

Table 5: Leading vegetable producing countries in the world

Country	Percentage world production
China	46.1
India	11.5
USA	4.7
Turkey	3.1
Italy	2.0
Egypt	1.8
Russia	1.8
Japan	1.6
Spain	1.5
Iran	1.5
All other countries	24.4

Table 6: Production requirement of vegetables including potato in lakh tonnes West Bengal

Sl No	Particulars	Year 2006-07	Year 2011-12	Year 2019-20
1.	Projected population (crores) growth @ 1.33%	8.67 (as on 1.10.2007)	9.14 (as on 1.10.11)	10.16 (as on 1.10.19)
2.	Requirement for balanced diet @ 300g per head per day	94.94	100.08	111.25
3.	Export demand (5%)	9.49	10.01	11.12
4.	Trans State trading and seed requirement (20%)	37.98	40.03	44.50
5.	Demand from processing industries (5%)	9.49	10.01	11.13
6.	Wastage (20%)	37.98	40.03	44.50
7.	Total production requirement including potato	189.88	200.16	222.50

Table 7: Present production and requirement scenario of vegetables and potato in lakh tonnes West Bengal

Present production (Estimate)	Vegetables	Potato	Total
2005-06	115.57	74.62	190.19
Estimated requirement 2006-07			189.88
2011-12			200.16
2019-20			222.50

A few very relevant points that emerge from the present scenario

(i) Our present scenario shows so much production that it apparently needs no further boost.

(ii) If the estimated figures shown above are taken as actual production of vegetables and potato, West Bengal produced 0.31 lakh tonnes more in 2005-06 than the requirement in 2006-07. The problem is therefore more of marketing the surplus than of deficit in production. In 2011-12 a small shortage of 9.97 lakh tonnes *i.e.* 5.2% of present production is anticipated. Similarly, shortage in 2019-20 will be 32.31 lakh tonnes *i.e.* 17% of the present production. Due to extreme pressure on land expansion of area may not be achievable. It is advisable to increase production by enhancing the productivity. The present productivity of 12.99 ton per ha (excluding potato) has to be raised to 14.50 ton per ha only to get a additional production of 13.44 lakh ton in 2011-12 from the present area of 8.90 lakh ha. This additional production will be sufficient to take care of the deficit. Similarly, in 2019-20 the target of productivity of vegetables (excluding potato) may set at 17.00 ton per ha. The additional production in the said year will be 35.69 lakh ton which would make good the anticipated shortfall.

(iii) Attempt may be made to reduce postharvest wastage to 15% by adoption of better handing techniques and modern storage systems.

(iv) An elaborate survey should be conducted in collaboration with the Agricultural Universities to document the base level data on area, production, consumption pattern and domestic market destination for different vegetables and potato.

(v) Adequate data based market intelligence for export and intra-state trading of vegetables.

(vi) Present area under vegetables and potato may not be reduced because of unpredictability of the quantum of produce due to various factors.

Percent increase in area, production and productivity of vegetable crops in India and West Bengal

Table 8: Area, production and productivity of vegetable crops including potato in India during the last five years

Year	Area ('000 ha)	Production ('000 ton)	Productivity (t/ha)
2000-01	6250.10	93849.90	15.02
2001-02	6155.70	88622.00	14.40
2002-03	6094.70	84815.30	13.92
2003-04	6308.90	93165.00	14.77
2004-05	6755.60	101433.50	15.01
Percent increase during the half-a-decade	8.1%	7.5%	-.06

Source: National Horticulture Board, Horticulture data base, 2005

Table 9: Area, production and productivity of vegetables excluding potato in West Bengal during last five years

Year	Area ('000 ha)	Production ('000 ton)	Productivity (t/ha)
2001-02	838.79	10252.96	12.22
2002-03	874.87	10635.95	12.15
2003-04	859.86	10918.85	12.70
2004-05	868.41	10996.62	12.66
2005-06	889.84	11556.74	12.99
Percent increase during the half-a-decade	+6.09	+12.71	+6.30

Source: Dept. of FPI and Horticulture, Govt. of West Bengal

Table 10: Features of area, production and productivity of potato in West Bengal in last 25 years

Year	Area ('000 ha)	Production ('000 ton)	Productivity (t/ha)
2000-01	299.7	7673.1	25.6
2001-02	299.8	7882.4	26.29
2002-03	349.3	6902.5	19.76
2003-04	308.4	7621.6	24.71
2004-05	320.6	7106.6	22.16
Percent increase during 25 years	+63.94	+72.25	+23.05
Percent increase during the last 5 years	+7.0	-10.9	-15.5

Source: Economic Review (2005-06), Govt. of West Bengal.

Note: Calculation in the last row based on the difference between 2004-05 and 2000-01 (base year)

Table 11: Top ten States in present production and productivity of vegetable including potato

State	Area ('000 ha)	Production ('000 ton)	State	Productivity (t/ha)
West Bengal	1189.00	18106.00	Tamil Nadu	28.88
Uttar Pradesh	840.90	15792.40	Kerala	23.14
Bihar	816.60	13349.10	Uttar Pradesh	18.78
Orissa	655.90	8045.60	Chandigarh	17.00
Tamil Nadu	215.30	6218.30	Punjab	16.88
Gujarat	331.50	4867.90	Pondicherry	16.60
Karnataka	367.20	4382.90	Bihar	16.35
Maharastra	372.20	4044.40	West Bengal	15.23
Andhra Pradesh	254.40	3461.90	Jharkhand	15.18
Jharkhand	223.60	3394.90	Gujarat	14.68
All India total	6755.60	101433.50	Average	15.01

Source: National Horticulture Board, Horticulture data base, 2005

Table 12: Comparative statement for productivity of different vegetables in the world, India and West Bengal

Vegetable	Expected productivity (t/ha) source (range)	Average productivity in the world (t/ha)	Average productivity in India (t/ha)	Average productivity in West Bengal (t/ha)	Highest productivity in the world (t/ha)
Tomato	60-80	26.69	14.07	17.16	70.45(USA)
Brinjal	40-50	17.48	16.08	18.03	34.70(Japan)
Chilli(green)	30-40	14.40	9.18	5.80	44.50 (Spain)
Okra	15-20	6.47	9.59	10.93	17.78 (Jordon)
Peas	18-20	8.35	9.14	5.97	20.00 (Lithuania)
Muskmelon	30-40	20.95	20.48	-	45.33 (Cyprus)
Different gourds	25-30	12.97	9.72	10.70	41.33 (Israel)
Cucumber	40-50	16.98	6.67	-	67.67 (Korea)
Watermelon	30-40	27.13	12.75	11.75	40.96(Spain)
Cabbage	30-40	21.10	21.43	26.53	40.96(Spain)

Cauliflower	35-40	18.36	17.14	25.38	42.59(Japan)
Onion	40-50	17.53	10.34	12.65	45.25(Newz eland)
Garlic	15-20	12.37	4.17	-	60.33 (Korea)
Average			12.37* 11.69**	14.55	

Note: * Average with muskmelon.
** Average without muskmelon.

Salient observations on productivity of vegetables

(i) Present productivity of vegetable crops in West Bengal higher than that of all India average. (it is still higher as muskmelon is not commercially grown in the State).

(ii) Present productivity of vegetable crops excluding potato is 14.4t/ha which is above the national average but below that of some other states.

Table 13: Area and production of different vegetables in West Bengal (2005-06)

Sl No.	Vegetable crops	Area ('000 ha)	Production ('000 t)	Productivity (ton per ha)
1.	Tomato	49.96	857.18	17.15
2.	Cabbage	74.71	1982.68	26.54
3.	Cauliflower	65.64	1666.15	25.38
4.	Peas	21.67	129.38	5.97
5.	Brinjal	152.90	2757.44	18.03
6.	Onion	17.51	221.67	12.66
7.	Cucurbits	164.72	1763.07	10.70
8.	Lady's finger	65.77	718.94	10.93
9.	Radish	35.73	392.27	10.98
10.	Other vegetables	241.23	1067.97	4.43
11.	Total	889.84	11556.75	12.99
12.	Potato	354.50	7462.50	21.05

Source: Economic Review 2006-07

Proposed production target

(i) It was shown earlier that area under vegetable crops in West Bengal increased by only 6.03 % and productivity increased by only 5.92 % during last 5 years.

(ii) In the present situation it would be justified to increase the total production only by productivity increase, keeping the area same.

(iii) Specific road map should be framed for marketing of the excess production of vegetables.

Table 14: Proposed production and productivity target of vegetables excluding potato up to 2020

Year	Area ('000 ha)	Productivity ('t/ha)	Production ('000 ton)
2005-06	890	12.99	11556.75
2011-12	,,	14.50	12902.68
2019-20	,,	17.00	15127.28

4. Projections on vegetable seed production in West Bengal

Table 15: Present requirement of vegetable seeds in West Bengal (2005-06)

Crop	Area ('000 ha)	National level (%) of hybrids	Requirement of hybrid seeds at national average (ton)	Requirement of open-pollinated seeds (ton)
Tomato	49.95	60.0	4.49	4.00
Cabbage	74.71	50.0	11.20	11.20
Cucumber, Bottle gourd, Ridge gourd, Bitter gourd, Pumpkin, etc.	164.71	35.0	200.00	574.00
Okra	65.77	25.0	150.00	500.00
Watermelon,	16.10	25.0	14.08	45.00
Brinjal	152.9	22.0	4.00	23.72
Cauliflower	65.64	15.0	2.95	16.73
Chilli	66.00	10.0	2.00	14.85
Radish	35.73			357.00
Peas	21.66			1949.00
Hyacinth and other beans	19.42			485.00
Onion	17.51			52.53
Sweet potato	25.79			
Elephant foot yam	11.26			
Taro	15.22			
Others	87.41			
Total area	889.41			
Total requirement			388.72	4033.02

Table 16: Land requirement, seed production cost and generation of mandays for the production of projected quantity of hybrid seeds in West Bengal

Crop	Projected total hybrid seed productio n (tonne)	Per acre average			Total requirement for the projected production		
		Production of seed (kg)	Production cost (Rs.)	Mandays required	Land (acre)	Cost of production (Rupees in lakhs)	Mandays (in ,000)
Tomato	4.49	25.00	30,000	600	180	54.0	108
Cucumber*	50.0	60.0	45,000	450	850	382.0	383
Bottle gourd*	50.0	170	20,000	150	300	60.0	45
Bitter gourd*	50.0	100.0	25,000	160	500	125.0	80
Ridge gourd*	50.0	100.0	30,000	480	500	150.0	240
Watermelon	14.08	60.0	15,000	170	240	36.0	41
Okra	150.00	300.0	15,000	180	500	75.0	90
Brinjal	4.00	50.0	32,000	500	80	16.0	40
Chilli	2.00	60.0	1,10000	1500	35	33.0	53
Capsicum**	0.50	15.0	40,000	550	34	14.0	19
Total requirement					3219	945.0	1099

Note: *Projected requirement of cucumber, bottle gourd, bitter gourd and ridge gourd is 200 tonne (pumpkin hybrids are mostly not available).

** Anticipated requirement, cost of production is excluding the cost of poly house.

***Hybrid seed production requirements for cabbage and cauliflower are not full proof in India, so their production projections have been excluded.

**** Most of the mandays required for emasculation and hand pollination are not full and mainly operated on contractual basis by the skilled workers

Table 17: Land requirement, seed production cost and generation of mandays for the production of projected quantity of open-pollinated seeds in West Bengal

Crop	Projected total productio n (tonne)	Per acre average			Total requirement for the projected production		
		Production (kg)	Production cost (Rs.)	Mandays required /acre	Land (acre)	Cost of production (Rupees in lakhs)	Mandays (000)
Tomato	4.00	28.00	18,000	360	145	26.0	53
Cucumber*	80.0	70.0	30,000	270	1150	125.0	310
Bottle gourd*	119.0	200	15,000	100	595	89.0	60
Bitter gourd*	125.0	125.0	20,000	100	1000	200.0	100
Ridge gourd*	100.0	130.0	20,000	180	770	154.0	138
Pumpkin	150.0	135.0	15,000	100	1200	180.0	120
Watermelon	45.00	70.0	12,000	100	650	78.0	65
Okra	500.00	350.0	12,000	100	1430	172.0	143

Brinjal	23.72	70.0	20,000	280	340	68.0	95
Cauliflower**	12.54	90.0	21,000	250	140	30.0	35
Chilli	14.85	80.0	50,000	600	185	93.0	112
Radish	357.00	200.0	15,000	200	1785	267.0	357
Peas	1949.00	450.0	18,000	200	4330	780.0	866
Hyacinth bean***	225.00	230.0	30,000	180	980	294.0	180
Cowpea	210.00	180.0	22,000	200	1170	257.0	234
French bean***	50.00	280.0	25,000	200	180	45.0	36
Onion	52.53	225.0	35,000	250	235	83.0	59
Amaranth ****	20.0	50.0	25,000	225	400	100.0	90
Palak ****	250	160	15,000	150	1565	234.0	24
Total requirement					18250	3275	3077

Note: *Projected requirement of open pollinated seeds of cucumber, bottle gourd, bitter gourd, ridge gourd and pumpkin is 574.00 tonnes and individual requirement has been projected as per anticipated spread of the crop

**Anticipated 75% of the total requirement of 16.73 tonnes constitutes early and mid early varieties whose seeds can be produced here

*** Anticipated quantity of the seed requirement for different beans of the projected requirement for hyacinth bean, cowpea, French bean and other beans

**** Of the unspecified vegetable crops, 10,000 hectare each for amaranth and palak have been taken into consideration

Table 18: Requirement of total land and recurring expenditure for the production of projected quantity of hybrid and open pollinated seeds in West Bengal

Type of seed production	Total land requirement (acre)	Total cost of production as recurring expenditure (Rs in lakhs)
Hybrid	3219.0	945.0
Open pollinated	18250.0	3275.0
Total	21469.0	4220.0

Requirement of infrastructure apart from irrigation facility for initiation of seed production venture in West Bengal: At least one unit each of temperature and humidity controlled godown (400 sft with air conditioning and dehumidification), seed extraction unit with water supply, compost and vermicompost shed (15x10 ft.x3 = 450 sft. and Nursery sheds with polyethylene sheet and shade net of 1000 sft area for at least 5 clusters along with marketing net work will be required. This may cost 100 lakh rupees.

Table 19: Total projected cost involvement for consorted seed production programme in West Bengal

Cost	Projected requirement (Rupees in lakhs)
Non-recurring cost for development of infrastructure in seed production zone	100.00
Cost of seed production as recurring expenditure	4220.0
Total projected budget	4320.0

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	Priortised 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	*Phytophthora* + 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 subarban areas need to be 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, Bahrampur 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/ F_1 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 acomplished 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. **High-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 High-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 entomo-pathogens 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 apparantly 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.

5. Specific action plan for the period upto 2019-20

Estimated population of West Bengal on 1.10.06 was 8.67 crores and production of vegetables including potato in 2005-06 was 190.19 lakh tonnes. Considering 20 per cent wastage, another 20 per cent for outside state trading and seeds and 10 per cent for processing and exports around 50 per cent of production *i.e.* 95.09 lakh tonnes were available for consumption. This works out 303 g per head per day. But consumption in West Bengal is only 125 g (50^{th} National Sample Survey Bulletin No. 402). This speaks of high pressure on food grains. It is difficult to cope up with the rising demand of food grains but the pressure can be offloaded by supplementing with vegetables. The pressure on land is also very high and the farmers are mostly small and marginal. In quest of food security farming system is predominantly rice based. Under this situation instead of depending on expansion of area it is advisable to enhance productivity of vegetables excluding potato from 12.99 t per ha to at least 14.50 t per ha by 2011-12. In 2019-20 the target of productivity should be 17.0 tonnes per ha. At the same time measures may be taken to increase vegetable consumption to 300 g per head per day by wide spread aggressive campaign.

Most important issue in vegetable production sector is the low farm gate price and glut in the market in season. This problem has to be addressed with top priority.

(i) Distant market within the country or outside are to be made accessible to vegetable farmers for disposal of excess produce at remunerative price. Agri-Export zone in vegetable is to be organized effectively in the interest of sustained development of vegetable production in the state.

(ii) Stress on coverage of larger areas with hybrids.

(iii) Increasing availability of proven hybrid seeds or seedlings at low cost.

(iv) Prepositioning all inputs especially for vegetables in specific seasons.

(v) Expansion of irrigation coverage through judicious use of water.

(vi) Popularisation of small tools and implements specially designed for small vegetable plots as found in the State.

(vii) Encouraging high-tech vegetable cultivation. Some of the measures recommended are introduction and popularization of (i) high-tech nursery for production of healthy seedlings, (ii) protected cultivation under controlled weather in polyhouses, (iii) drip / sprinkler irrigation and fertigation, (iv) off season vegetable production especially in hill areas, (v) precision farming of high value vegetable crops like coloured capsicum, celery, lettuce, etc. in polyhouses with good ventilation around periurban areas. This should be developed as clusters for facilitating bulk marketing and exports.

(viii) Home garden is an important component in the farming system in the areas surrounding a home, particularly in rural areas. It is not only provide nutritious food year round to the family but with planned and managed home garden would generate additional from excess production. Livestock, poultry and fishery are also important components in a home garden if areas are available to accommodate them in the home garden. A small home garden can easily be maintained by the women in the family.

(ix) Large area of 'diara' (dry river bed) land available in West Bengal for cultivation of crops, particularly vegetables should be utilized for income and employment generation

(x) A shift from chemical intensive farming to organic farming of vegetables is an urgent need for various reasons.

(xi) Training of farmers and farmers' sons / daughters in vegetable production technology with stress on plant protection and postharvest handling including grading.

(xii) Increasing availability of packhouse facilities near cities and towns. It should be equipped with washing, grading, pre-cooling and storing facilities. There may be 1 to 2 such centres in each of the 15 production zones mentioned earlier. These pack house may serve as training centres and input distribution points.

(xiii) Research and development activities necessary have been already explained in the foregoing discussions. At a conservative estimate of Rs. 3000 per tonne of vegetable the value of annual produce is Rs.5430 crores. But expenditure on R & D is negligible.

(xiv) Excess production and arrivals in the market in peak season and crashing down of price of perishable vegetables keep the growers in a poverty trap. It is necessary to strengthen the hands of farmers and enhance his investment ability. The markets where growers sell their produce are at present buyers markets. The buyers/ traders form coterie and dictate price. This must be reversed. The growers should be able to quote the price of his produce and not compelled to dispose of at low price since the commodity is highly perishable and cannot be tarried back. The farmer is used to getting only 30 to 35% of the consumer price. This should increase up to 45 to 50 per cent. There are 30 lakh vegetable traders and retailers who carry, grade and sell to consumers. The price escalates at each stage of handling and onwards movement. It is necessary to develop procedural steps to properly handle, hygienically pack, store and sell the produce at distant markets at higher prices or even export in an organised manner.

(xv) Clusters of seed villages for production of OP and hybrid seeds may be organised in the western districts through cooperatives, public and private sector agencies. This will be backed by technical training, parent material supplies and marketing arrangements.

(xvi) Dry land horticulture technology including water harvesting structure for growing suitable fruit crops and vegetables as intercrops wherever possible has to be introduced in western zone. This can be coupled with small irrigation schemes carefully drawn in the catchment areas of rivers, rivulets and perennial waterways.

(xvii) In saline areas of the sunderbans special techniques for raising land by land shaping scheme or alternating lap channels and raised beds for vegetable growing may be popularised.

(xviii) Setting up of at least one Bioresource Centre for the conservation of available genetic diversity in vegetables and a laboratory for testing the pesticide residue under the supervision of the State Agricultural University are felt necessary in the interest of sustained vegetable production in the State.

(xix) In order to encourage specific market driven and export oriented quality vegetable production it is necessary to ensure flow of more credit as short and medium term loans.

(xx) Declaration of 15 special vegetable production zones. The zones have been already mentioned under Research and Development Activities (para 2). Logistic support and infrastructure viz. roads, packaging stations, multipurpose cold stores, transport, processing facilities and market intelligence service should develop in such zones. In those 15 zones all inputs like seeds, fertilizers etc. as detailed in the aforesaid para should be made easily available in season.

(xxi) Integrated plant nutrient management system (IPNS) and Integrated pest management system (IPM) and non-pesticidal management (NPM) are to be popularized through trainings, demonstrations and other extension methods.

(xxii) Adequate postharvest management facilities like cool chain and processing into value added products in clusters of vegetable production and special vegetable production zones have to be created by providing incentives.

C. Floriculture

Preface

Agriculture is the mainstay of the economy of West Bengal. However, the crop growing and production are very much dependant on the vagaries of nature. The horticultural crop production in the state is also affected by erratic rainfall, floods, droughts, etc. Marginal and small land holdings constitute the major bulk of the operational holdings. These cultivators face the problem of fragmentation of land holdings due to family circumstances which adversely affect the efficient use of land resources and create obstacles for application of high cost inputs in cultivation. As a result the returns per unit area are not very high. This situation promoted the initiation and development of commercial floriculture in West Bengal on account of appreciably high economic returns per unit area.

However, commercial floriculture is not alien to West Bengal. The state has a long tradition of growing flowers of different types comprising the high value cut flowers on a low scale and sizable production of low value loose flowers of different types for worshipping and decoration purposes. West Bengal ranks third in India with an area of 17,886 hectares of land under floriculture (Government of West Bengal Report, 2005-2006). More than 50,000 flower growers are engaged in commercial flower growing and ornamental plant production. A few lakh workers are engaged in trading of these floricultural products. West Bengal is supplying flower, foliage and pot plants to different domestic markets in India. It has exported flowers like gladiolus, chrysanthemum, tuberose, orchids, etc. on a very small scale to Sharjah in the Middle-east, Holland, U.K. and Singapore. West Bengal is the main outlet for export of dry flowers to foreign countries from India.

It is opined that West Bengal is not proceeding in the right direction at the right pace for development of commercial floriculture in the state. On the contrary, though some improvement has been noticed in recent years, yet considering the pace of development of commercial floriculture in many other states of India, it is a matter of great concern that very soon West Bengal may lose this position to others unless some concrete steps are taken with priority. A whole hearted effort, is necessary to ameliorate the dismal situation regarding the procurement and distribution of export quality plant materials of recent cultivars and new flowers, to develop a chain of greenhouses for

growing plants and flowers extensively under protected condition, to establish cool chain from the production site to the destination markets and departure terminals; to develop flower markets with infrastructures like cold storage, grading and packaging facilities and also to develop data base on production and marketing of floricultural products, etc. These are some of the measures to be taken to keep pace with the development in other states and also to remain in the commercial floriculture business.

1. Present status

As stated earlier, areawise West Bengal holds the third position in India with an area of 17,886 hectares of land under floriculture. However, out of 18 districts only 6 districts viz. Nadia, Purba and Paschim Medinipur, Howrah, Darjeeling and North 24-Parganas cover the major part of floriculture area and production of the state. The areas under flower cultivation in different districts of West Bengal during 2005-2006 were as follows:

Table 1: Districtwise area under flowers

Name of the Districts	Area in hectares
1. Nadia	5,057
2. Purba Medinipur	4,578
3. Paschim Medinipur	2,269
4. Howrah	1,590
5. Darjeeling	1,443
6. North 24-Parganas	1,175
7. Hooghly	517
8. South 24-Parganas	361
9. Burdwan	163
10. Jalpaiguri	157
11. Birbhum	147
12. Murshidabad	133
13. Uttar Dinajpur	94
14. Malda	88
15. Bankura	62
16. Coochbehar	52
17. Purulia	-------
18. Dakshin Dinajpur	-------
Total --	17,886 hectares

Source: Department of FPI and Horticulture, Government of West Bengal, (data of 2005-06)

The survey conducted by the Govt. of West Bengal in 2005-06 had revealed that hardly there was any commercial floricultural activity in the two districts of West

Bengal i.e. Purulia and Dakshin Dinajpur. The areas covered under different flowers and the amount of flower productions during 2002-06 were as follows:

Table 2: Area and production of flowers in West Bengal

Sl. No	Name of flowers	Area (in thousand hectares)				Production				
		2002-03	2003-04	2004-05	2005-06	Unit	2002-03	2003-04	2004-05	2005-06
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1.	Rose	1.24	1.38	1.49	1.59	Crore Spikes	16.22	17.93	18.17	18.01
2.	Tube Rose	1.87	2.71	2.81	2.54	Crore Spikes	30.43	43.66	44.50	46.12
3.	Gladiolus	1.66	1.83	1.88	2.06	Crore Spikes	23.55	26.08	26.96	29.35
4.	Chrysanthemum	0.36	0.40	0.44	0.52	Thousand MT	0.43	0.49	0.52	0.59
5.	Marigold	3.26	4.10	4.24	4.04	Thousand MT	26.29	33.10	33.79	32.48
6.	Jasmine	0.32	0.44	0.46	0.58	Thousand MT	0.42	0.59	0.69	0.77
7.	Seasonal flowers	2.99	4.25	4.32	4.02	Thousand MT	4.72	7.46	7.65	6.24
8.	Others	2.17	2.22	2.28	2.54	Thousand MT	1.90	1.94	2.02	2.21
	Total	13.87	17.33	17.92	17.89					

Total spikes in 2005-06 is 93 crore and rest of flowers is 42.2 9thound and tones.
Source: Economic Review, Govt. of West Bengal, 2006-2007

Due to increased urbanization, land prices are escalating day by day and land availability is shrinking. As a consequence, vertical growth of buildings are noticed. Due to paucity of land for gardening, the residents of these high rise buildings have no other alternative but to depend on pot plants for interior and exterior decoration. Hence, nursery business in West Bengal is enjoying a quantum jump during the last two decades or so. More than 5000 nurseries of varying sizes and capacities are situated in close vicinity of Kolkata spreading over 24-Parganas, Medinipur, Howrah, Hooghly and Nadia and also in Kalimpong, Darjeeling, Siliguri and Jalpaiguri districts. These numerous nurseries are engaged in production of plant materials of different forms of flowering, foliage and other types of ornamental plants. But unfortunately most of these nurseries are small in size (1 or 2 bighas or even smaller) and are working not in an organised way. Most of these nurseries do not maintain the required quality standards of the products. They do not follow the modern techniques of propagation and neither have the required infrastructure facilities like tissue culture arrangement, propagation chambers fitted with mist propagation facilities, etc. However, all these nurseries are providing employment

to thousands of workers for production of plants and their marketing. West Bengal has become a hub for trading of these nursery plants to all over India due to low cost plant materials.

On the contrary, the scenario regarding the flower seed production and their marketing is in very poor condition. The flower seed production sector needs immediate attention and patronage from the state government.

Though West Bengal is the main outlet (>70%) for export of dry flowers, yet it is not the major producer. Most of the supply is coming from other states of India. There is ample room for augmentation in production of dry flowers locally within the state.

For production of quality plants and flowers, greenhouse cultivation is a must. The plants growing under greenhouses are getting the protection from ultra-violet radiation, hails, strong winds, high rainfall, very low temperature and frost, pests and diseases. In the flower market, both domestic and export, only quality plants and flowers, free from any blemishes are preferred and fetch premium prices. Unfortunately, greenhouse cultivation of flowering, foliage and other types of ornamental plants in West Bengal is still in a fledgling stage and needs immediate attention. Modern greenhouses are required on an extensive scale to get increased production of quality plants and flowers.

In spite of having more or less congenial agro-climate and strategic location, West Bengal has failed to reach the desired level in commercial floriculture due to lack of suitable agro-technologies for high-tech commercial flower growing and modern nursery management. Deficiencies in active support from the Govt. of West Bengal is a major reason for this slow progress in commercial floriculture. Very recently, the state government has started paying attention for the development of commercial floriculture. Local flower growers, nurserymen and entrepreneurs have not been able to utilize the services of the financial agencies like NHM, NHB, APEDA to the fullest extent for the development of commercial floriculture in West Bengal.

2. Opportunities

(i) In general, the agro-climatic conditions of West Bengal are congenial for commercial cultivation of different high value flowers. The ambient minimum/maximum temperature varies from 4^{O} to 40^{O}C. The rainfall and light intensities are ample for cultivation of all types of flowers. Except a few pockets, soil condition is also suitable for commercial cultivation of flowers.

(ii) West Bengal has a long tradition of growing high value cut flowers like rose, gladiolus, tuberose, chrysanthemum, dahlia, lilies, carnation, gerbera,

anthurium, bird of paradise, etc. It is also one of the leading growers of loose flowers like marigold, balsam, jasmine, annual chrysanthemum, seasonal flowers, hibiscus, tagar, etc.

(iii) A part of North Bengal, especially the areas at the foothills of Himalayas comprising Darjeeling, Mirik, Kurseong, Kalimpong, Mongpoo and adjoining areas upto Siliguri and parts of Jalpaiguri, Coochbehar and Uttar Dinajpur can be suitably used for commercial cultivation of different types of high value cut flowers and foliage plants. Depending on the particular location, one can select orchids (especially *Cymbidium, Dendrobium, Vanda, Phalaenopsis,* etc.), lilies (Asiatic hybrid, Oriental hybrid, *Lilium longiflorum* hybrids) , carnation (standard and spray types), gerbera, alstroemeria, calla lily, gladiolus, Dutch iris, bird of paradise, freesia, rose, chrysanthemum, anthurium (flowering and foliage types), gypsophilas, lisianthus, agapanthus, etc. can be grown successfully with a little care and attention. These areas are also highly suitable for cultivation of different types of cacti, succulents and foliage plants. Other parts of West Bengal can also be utilized to grow different types of high value flowers and ornamental plants.

(iv) With the development of road and transport, cultivation of different types of flowers, foliage and other types of ornamental plants in pots can be undertaken in some suitable areas of West Bengal for supply to different flower markets at Kolkata, Haldia, Asansol, Durgapur, Malda, Siliguri, etc. Hotels and corporate offices will be the main customers.

(v) As the ambient temperature is moderate in most part of West Bengal, greenhouse cultivation for production of quality plants and flowers can be initiated on a large scale by slight alteration of internal environment inside the greenhouses.

(vi) Bamboos are easily available for use as a structural material for construction of low cost polyhouses for cultivation of flowers and other high value plants. By growing these high value plants under low cost greenhouses, these plants can be saved from the inclement weather conditions.

(vii) Arrangements can be made with the paper mills to manufacture suitable packaging materials required for long distance transhipment of high value cut flowers and delicate plants. The Institute of packaging, Kolkata can be of immense help in this regard.

(viii) Literate unemployed youths and SHGs can be suitably trained for taking up commercial cultivation of flowers and ornamental plants as profession.

3. Constraints

(i) Database on the areas under cultivation of individual flowers, manpower employed in cultivation of flowers and ornamental plants, and annual turnover is yet to be created. Similarly no reliable data are available regarding the exact

number of nurseries existing in West Bengal, their areas, manpower and business turnover per year. An effective system of registration of these flower growers and nursery men has to be introduced.

(ii) Absence of reliable market data base to evaluate the annual turnover and also to assess the annual requirement of different floricultural products viz. seeds, plant materials, cut flowers, loose flowers, dry flowers, pot plants, etc.

(iii) Information on suitable flowers and their cultivars for a particular location or at least district wise to initiate commercial cultivation of flowers is not available for the entrepreneurs and growers. Lack of information, faulty selection of cultivars and sites have adverse impact on flower cultivation and trade.

(iv) Absence of proper facilities for protected cultivation of flowers and ornamental plants and the existing dependency on open air cultivation is resulting low production of inferior quality plants and flowers.

(v) Lack of facilities regarding procurement of suitable plant materials of export quality flowers / cultivars which have very good demand in the international and domestic markets has adversely affected the expansion of market of quality flowers.

(vi) There is no linkage among the growers in the districts of the State mainly due to lack of active Flower Grower's Co-operative in West Bengal which could establish co-ordination among the growers regarding planning and production of floricultural products, sharing of technologies and marketing, etc.

(vii) As the flowers are highly perishable commodities, cold storage facilities at the production or collection sites, refrigerated vans for long distance transportation and storage facilities at the wholesale markets are very much essential to keep the flowers fresh. Available facility is also underutilized due to lack of extension activities.

(viii) Absence of organized and proper marketing facilities causes enormous loss of flower and income of growers and traders. Even the biggest flower market of West Bengal i.e. the Mallick Ghat Flower Market at Kolkata do not have the required infrastructure facilities like modern cold rooms for storing of flowers, grading and packaging facilities for high value cut flowers.

(ix) There is no firm buy back system for the flower growers to ensure a remunerative income.

(x) Inability for taking risk by the marginal and small flower growers leads to adoption and practicing of substandard traditional crop growing system with age old cultivars.

(xi) High-tech commercial floriculture for production of quality plants and cut flowers requires high initial investment. But the flower farming in West Bengal is dominated by marginal farms (>70%) followed by small (>20%) and medium farms (about 10%). Hence, there is acute shortage of resources for initiating high-tech floriculture. National Horticulture Mission (NHM) and

National Horticulture Board (NHB) should provide necessary support to flower growers in the production of quality flowers in a cluster approach through cooperatives.

(xii) There is no crop insurance facility for the flower growers. As most of the flowers are being grown outdoor, the flower growers are very much vulnerable to crop losses.

Recommendations

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 hastle 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

The State West Bengal is situated in the heart of extremely fertile Gangetic delta and bestowed with six agroclimatic zones ranging from the temperate to the tropical. The south-west monsoon chiefly determines the weather and rainfall throughout the state. The average rainfall is 1750 mm which has helped to have excellent reserves of surface and underground water (Table 1).

Table 1: Soil and climatic parameters of different agroclimatic zones in West Bengal

Area	Temperature (0C)		Rainfall (cm)	Soil
	Min.	Max.		
Hilly zone	1.9	24.2	220-400 (high relative humidity)	Light acidic, deficient in micronutrient
Terai zone	10.5	31.1	300 (high relative humidity)	Light, acidic
Alluvial zone	10.0	38.0	120-150 (moderate to high relative humidity)	Deep loam, neutral
Red & lateritic zone	9.0	45.0	110-130 (low relative humidity)	Red, acidic, low water holding capacity
Coastal zone	15.0	27.6	150-200 (moderate to high relative humidity)	Acidic to alkaline, good water holding capacity

West Bengal has the potentiality to produce a wide range of spices and plantation crops. The state is now a leading producer of horticultural crops in the country. However, high population pressure is a serious threat to agriculture. The land holding is gradually becoming less and the number of small and marginal farmers are increasing. Adoption of modern agricultural practices are becoming difficult. For example, the traditional plantation crop tea is losing its past glory very fast. However, the status (strength and weakness) and future strategies for improvement of spices and plantation crops are outlined below. The area, production and productivity are presented in Table 2.

1. Plantation crops

Table 2: Area and production of plantation crops (2005-06)

Sl.No.	Crop	Area in '000 ha	Production in '000 mt	Productivity
1	Coconut	30.562	4007.392 (lakh nuts)	131.13
2	Arecanut	10.236	19.116	1.87
3	Betelvine	19.148	139.486	7.27
4	Cashewnut	9.711	9.569	0.99

Source: The Business of Bounty, Department of FPI & H, Govt.of West Bengal Annual Reports 2003-04, 2004-05 & 2005-06

a) **Coconut:** Coconut is cultivated in seventeen districts of West Bengal of which Murshidabad, Purba Medinipur, Howrah and South 24-Parganas constitute 79% of the total production in the state. About 50% of total production of coconut in the state is consumed locally. Almost 70% of the production is harvested at tender stage due to huge demand of coconut water. There are about 34 coir units which manufacture bristle, mechanized fibres, coir ropes and coir products including rubberized coir. There are many small scale industries engaged in the manufacture of coir rope and coir yarn. The coir industry provides employment to nearly 3140 people in the state.

Recommendations

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:** Arecanut is grown almost in all the districts of the state of which Jalpaiguri and Coochbehar enjoy the major share in area. The contribution of 24-Parganas (North) is appreciable. The most uncared plantation crops mainly grown as homestead crop.

Recommendations

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:** Cashewnut, a premier cash crop has high demand both in domestic and foreign markets. The nuts are rich in protein, calcium, phosphorus, unsaturated fats, vitamins (B1, B2, D and E) low in carbohydrate and saturated fats. The major districts are West and Purba Medinipur, Bankura, Purulia, Birbhum and small pockets in Burdwan. The present productivity is very low (1.0 t/ha). The existing plantations produce small sized nuts due to seedling plantation of non descriptive origin and poor management practices. The available small processing units remain inoperative during most of the months of a year due to non-availability of raw nuts. The West and Purba Medinipur districts together contribute about 80% of the area and dominated by small and marginal farmers mainly tribals (Santhals and Lodha). Commercial utilization of cashew apple is essential. Organic cashew has a demand in USA and EU. Organic cashew segment is expected to grow at a pace of about 15%.

Recommendations

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: The crop is highly labour intensive and particularly suitable to small holdings. Once established it becomes a perennial source of employment and cash flow for day to day requirement of farmers. Betelvine is grown in all the districts of the state except Purulia of which the major area is shared by Purba Medinipur, Howrah, 24-Parganas (South), Paschim Miedinipur and Nadia. The leaves are exported to Bangladesh, Nepal, Mayanmar, Pakistan, Indonesia, Malaysia and Thailand.

Recommendations

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: Tea is cultivated in the 'hills and terai' area of the State mainly as estate crop. The crop has also shown its potentiality even in the plains (Gayeshpur, Nadia) and in the Purulia hills. In the last two decades it is also being grown in small and medium holding in Dinajpur district, mainly to supply green leaves to the processing units. However, the tea industry of the state is facing stiff challenges due to traditional outlook.

Recommendations

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:** Bamboo is termed as 'Green Gold' for its numerous uses and enhanced value addition. Bamboo is capable to address four major global challenges: shelter security, livelihood security, ecological security and food security. Bamboo assumes special significance as an ideal substitute for traditional timbers. It is important as soil stabilizer, an effective carbon sink and help to counter the green house effect. It is still grown as unorganized plantation crop.

Recommendations

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:** The palmyra palm (*Borassus flabellifer*) is known as 'Tree of Life' with over 800 various uses. The palm is usually found growing almost wild throughout the state with domination in the dry part of the state. Tender fruit, leaves and sap tapping (toddy) are very common. It is an important economic palm in tribal areas of the state. Its fullest exploitation is essential for economic development of the rural mass.

Recommendations

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.

2. Spices

Spices are high value and low volume commodities of commerce in the world market. The fast growing food industry world over depends largely on spices as taste and flavour makers to create variation in their product line. Health conscious consumer in developed countries prefer natural colours and flavours of plant origin to cheap synthetic chemical substitutes. Thus, spices play more important role in the food industry world over. The estimated demand based growth rate for spices in the world is around 3.2%, which is just above the population growth rate. Share of export in total production varied from a mere 2% in garlic to above 60% in black pepper.

The country is producing around 3.02 lakh tonnes of spices from 25 lakh hectares of land. The contribution of West Bengal to the spices is 4.21% in terms of area and 5.7% in terms of production of spices in the country (Table - 3).

Table 3: Area and production of spices in West Bengal (2005-06)

Crop	Area		Production		Productivity (kg/ha)	
	'000 ha	%	'000 mt	%	W.B.	India
Chilli (Rabi Bhadoi)	59.888	8.14	65.136	5.9	1903	1608
Ginger	11.213	11.43	83.150	21.20	7415	3969
Turmeric	17.040	10.57	30.319	4.23	1779	4446
Fenugreek	1.687	-	0.966	-	572	1269
Black pepper	0.185	0.07	0.547	0.687	296	310
Garlic	2.632	1.81	22.865	3.47	8687	4550
Coriander	9.693	2.5	10.146	3.1	1046	873
Black cumin	0.840	-	0.680	-	810	-
Fennel	0.404	1.76	0.165	0.59	407	1208
Large Cardamom	2.980	10.03	0.856	13.38	287	156
Total(including other spices)	108.5	4.21	216.7	5.68	-	-

Source: Govt. of West Bengal and Directorate of Arecanut & Spices Development (DASD), Ministry of Agriculture, Govt. of India, 2007.

West Bengal has the advantage of growing various spices all over the state. The state produces chilli, ginger, turmeric, fenugreek, coriander, black cumin, fennel,

pepper, garlic, ajowan, cardamom, ajmund. The production of spices is insufficient even to meet up the demand of the state (produces only about 1/3rd of the total requirement). There are at present 133 processing units in the state. Raw materials are brought from outside the state. Production of spice products is possible even at homescale thus creating rural employment opportunity.

Chilli is a commercial crop of the state and is usually grown as rabi crop in the districts of Coochbehar, Uttar Dinajpur, Dakshin Dinajpur, Jalpaiguri, North-24 Parganas, South 24-Parganas, Purba Medinipur, Paschim Medinipur and also substantially in the districts of Murshidabad, Nadia and Burdwan. Chilli is also grown as Bhadoi crop and is concentrated in the districts of Murshidabad, Nadia, Coochbehar, Jalpaiguri, North 24-Parganas, Paschim Medinipur and Purba Medinipur. The varieties are not high yielding, mainly of traditional type.

Ginger is also a commercial crop of the state and is cultivated mainly in the districts of Darjeeling, Jalpaiguri, Dakshin Dinajpore, Paschim Midnipur and Purba Medinipur. West Bengal has 11213 hectares producing 83150 tonnes of ginger which is about 11.43% in area and 21.20% of the total area in the country. The yield obtained is also very high. The predominant variety is 'Gorubathan'. Although the variety does not conform to international standard because of high fibre, it is more tolerant to rhizome rot disease compared to improved varieties with less fibre and also tolerant to cold. It should not be totally replaced with other high yielding varieties; the variety Gorubathan needs to be protected. However, improved varieties should also be introduced in the state. The GIS study indicated that the most suitable areas for ginger are North 24-Parganas, South 24-Parganas, Nadia, Hooghly, Murshidabad, Bardhaman, Howrah, Birbhum, Malda and Darjeeling. It is advisable to produce seed ginger locally rather than transporting from other places to avoid transport diseases.

Turmeric grown in small pockets in many districts of West Bengal in an area of about 17040 hectares producing about 30319 tonnes. Even though, the area is about 10.57% of the total area under turmeric, the production is a meager 4.23% of the country with productivity (1779 kg/ha) far below the national average of 4446 kg/ha. Turmeric is concentrated in the districts of Murshidabad, Jalpaiguri, Coochbehar, Uttar Dinajpur, Dakshin Dinajpur, Nadia, North 24-Parganas, Paschim Medinipur, Purba Medinipur. The turmeric grown is of inferior quality with low curcumin content. Replacement with high yielding varieties is essential.
The seed spices particularly coriander, fenugreek, black cumin, fennel, ajowan are gaining importance in the state. The problem remains with availability of seeds of high yielding varieties in time.

Coriander as leaf has a tremendous potentiality and needs to be looked into.

Black pepper is cultivated in West Bengal in about 185 hectares having a productivity of about 3 q/ha. If efforts are made to cultivate black pepper in tea estates in Coochbehar, Jalpaiguri and Darjeeling districts under the shade trees, at least 2 crores of planting materials could be planted in the tea garden (200 shade trees/ha). As the major area of tea gardens in West Bengal is in warm humid climate and agro-climate conditions of many districts are suitable for black peaper cultivation on suitable support, there is immense scope of increasing the cultivation of this high value crop with proper planning and implementation. Historically, Coochbehar was exporting black pepper to Bhutan and neighbouring countries even in 16th Century during the rule of King Nara Narain of Coochbehar. The yield of black pepper is high, the area under this crop is too low to draw definite conclusions. This indicates the promise for increasing the productivity without actually increasing the area.

Growing of black pepper needs to be made mandatory on arecanut and coconut plants and also on shade plants available in tea gardens.

Scattered cultivation of spices like curry leaf, cassia is found in the State which need to be commercialized. Tree spices constitute a group of diverse crops where the product of commerce is predominantly used as spice. Clove, nutmeg, cinnamon, tamarind and *Garcinia* sp. (comboge, kokum etc.) are the predominant tree spices. The exact area and production are under these crops are not available for West Bengal. But these crops can be grown in coconut and arecanut gardens in warm humid areas of the State. Tamarind cultivation can be promoted as an avenue trees on high ways and villages and can add to the income of the communities. It is also a very suitable crop in arid and semiarid areas. Tamarind is assuming a lot of importance for its industrial uses besides being a popular spice. Several improved varieties of tamarind are also available.

Large cardamom is commercially grown in parts of Darjeeling district with an area of more than 2000 ha. The crop is affected with virus diseases which seriously affect growth and production of the crop.

Recommendations

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 rhizhomes 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 recommendede: (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 he 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

Importance and scope

Herbs are staging a comeback and herbal 'renaissance' is taking place all over the globe. The herbal products today symbolize safety in contrast to the synthetics that are regarded as unsafe to human and environment. Although, herbs had been prized for their medicinal, flavouring and aromatic qualities for centuries, the synthetic products of the modern age surpassed their importance, for a while. However, blind dependence on synthetics is over and people are returning to the naturals with the hope of safety and security.

1. Medicinal plants

Over three-quarters of the world population relies mainly on plants and plant extracts for health care. More than 30% of the entire plant species at one time or other are used for medicinal purposes. The annual global production and marketing of raw materials of medicinal plants is likely to touch US $ 5 trillion by 2050.

It has been estimated that in developed countries, such as, United States, plant-drugs constitute as much as 25% of the total drugs, while in fast-developing countries, such as China and India, the contribution is as much as 80%. Thus, the economic importance of medicinal plants is much more to countries like India than to the rest of the world. These countries provide two-thirds of the plants used in modern system of medicine and health care system of rural population depends on indigenous systems of medicine.

2. Aromatic plants

Aromatic plants possess odorous volatile substances which occur as essential oil, gum exudates, balsam and oleoresin in one or more parts, namely, root, wood, bark, stem, foliage, flower, fruit and seed. The world of essential oils has since then come out from the narrow field of definition to a wide variety of applications in flavours, disinfectants, oral hygiene, tobacco, pharmaceuticals and in almost all spheres of human activity. In the worldwide flavour and fragrance market, essential oils constitute about 17 per cent. The estimates of World production of essential oils

vary from 40,000 to 60,000 tonnes per annum. The demand for spice oils is placed at 2,000 tonnes per annum.

Essential oils and aroma chemicals constitute a major group of industrial products. These oils form indispensable ingredients of the necessities in many spheres of human activity. They are adjuncts of cosmetics, soaps, pharmaceuticals, perfumery, confectionery, ice-creams, aerated waters, disinfectants, tobacco, agarbatis and a host of related products.

Out of a total about 1,500 species of aromatic plants which serve as a source of raw materials for the perfumery, information on the chemistry and properties of essential oil of only 500 species is known in some details at present. Of these about 50 species find use as commercial sources of essential oils and aroma chemicals.

The majority of the natural perfumery materials are obtained from scented parts of the plants. The essential oil yielding crops of major importance and commercially cultivated in India are *Artemisia pallens* (davana oil), *Cedrus deodara* (ceder wood oil, *Cinnamomum zeylanicum* (cinnamon leaf oil), *Citrus* spp. (petitgrain oil), *Cymbopogon flexuosus* (lemon grass oil), *C. martini* var. *montia* (palmarosa oil), *C. winterianus* (Java citronella), *Eucalyptus citrata* (eucalyptus leaf oil), *E. globulus* (eucalyptus leaf oil), *Mentha arvensis* (Japanese mint oil), *M. citrata* (bergamot oil), *M. piperita* (peppermint oil), *Pelargonium graveolens* (geranium oil), *Pimpinella anisum, Santlum album* (sandal wood oil), *Vetiveria zizanioides* (vetiver oil), etc.

3. History of medicinal and aromatic plant cultivation and pharmaceutical industries in West Bengal

Organized plantations of medicinal and aromatic plants were first started in undivided Bengal during the British period. Cinchona plantations were done in Darjeeling district in the year 1864 for extracting quinine as a remedy against malaria which was very severe in most parts of India particularly in the eastern region including Bengal, undivided Assam etc. The plantations occupy an area of 9,100 acres. In addition to Cinchona, Ipecac, Digitalis and Dioscorea were also planted later for commercial exploitations of emetine, digitalin and diosgenin respectively, important constituents used for the treatment of dysentery, female ailments and steroids including oral contraceptives. Apart from plantations, arrangements were made for extraction of active compound from the plants and preparation of medicine. Since malaria is no longer a major disease in India and synthetic quinine is cheaper than natural product, the Government of West Bengal considers the plantation economically unviable. Dhaka Ausadhalaya and Sadhana Ausadhalaya were pioneers in the production and commercialization of herbal

drugs and cosmetics. In the early part of the last century late Sir P.C. Roy emphasized the need of pharmaceutical industries in India, based on indigenous plants. Messers Bengal Chemical & Pharmaceutical Industries was established and a number of very effective medicines from herbals were manufactured which are still popular. In order to promote herbal medicine and commercially important natural product of pharmaceutical value, Government West Bengal established 'West Bengal Phytochemical and Pharmaceutical Development Corporation' with a manufacturing unit of phytonol, phytofresh, agro-chemicals of herbal origin. It failed to cope with the commercial processing units of herbal medicines in quality, quantity and price. Messrs Dabur and Emami, the pioneers in commercialization of herbal medicines and cosmetics are also based in West Bengal. In the last two decades, a number of phytochemical manufacturing units, mostly of medicinal and cosmetic values have been established in West Bengal.

In spite of sound traditional knowledge and application of herbal medicine in Ayurvedic System of Medicine as an age old practice in health care and specially well known preparations of drugs from botanicals in undivided Bengal by traditional 'Aushadhalya' (ayurvedic pharmacy houses), the growth of industry based on plants in this part of the country has been slow and unorganised compared to that in many other states of India.

Institutions imparting education on Indian Systems of Medicine and Homeopathy recognized by the West Bengal University of Health Sciences include two Ayurvedic Colleges and ten Homeopathic Colleges which are engaged in teaching and research.

4. Commercial values of medicinal plants, plant based drugs and essential oils

The economic values of medicinal of plants, plant based drugs and essential oils which are being exploited commercially through out the world depend upon a number of factors:

(i) The values of medicinal plant species in market depends on its scarcity and rarity in wild condition e.g. *Rauvolfia serpentina*, *Gloriosa superba*, *Swertia chirayita*, *Ipomoea digitata* etc. Here lies the scope of cultivation of the medicinal plants in West Bengal.

(ii) There are certain therapeutically active constituents produced from plant sources such as digoxin, digitoxin which could not be produced synthetically, for which value of digoxin bearing plants are naturally on the higher side.

(iii) The cost involved in isolation and purification of an active principle is an important factor for expansion of herbal industry. For example, a tonne of leaves of *Catharanthus roseus* is required to obtain1gm of alkaloid – vincristine - the active principle of drug for blood cancer.

(iv) Introduction of a new synthetic drug into market would take about 10-20 years and expenditure in the scale of about US $ 100-300 million for pharmaceutical and clinical research and development is not uncommon (Abelson, 1990), whereas plant based drug would require comparatively much lesser time and expenditure than that of any synthetic drug.

5. Commercial importance phyto-pharmaceuticals

Since 1947 the plant based modern drugs in West Bengal was mostly confined to quinine, emetine for last 5-decades. Bulk production of plant based modern drugs have become an important segment of phyto-pharmaceuticals in India as well as in West Bengal.

Some of the phyto-pharmaceutical which are produced in India include morphine, emetine, codeine, papaverine, thebaine, quinine, quinidine, digoxon, caffeine, hyoscine, hyoschamines, xanthotoxin, psoralen, colchinene, rutine, berbesinse vinblastine, vinceristine, nicotine, strychnine, brucine, ergot alkalioids, senna glycosides, pyrethroids, podophyllotoxin resin, steroid compounds, etc. phyto-pharmaceuticals for which technology has been developed for undertaking large scale production include.

L-dopa from *Mucuna pruriens*. ajmaline, ajmalicine form *Rauvolfia serpentina*, vinblastin and vincristine from *Catharanthus roseus*; β-acetyl glycyrrhetic acid from *Glycyrrhiza glabra*. Medicinal plant based drug industries have started facing and will face in future dwindling supply of raw materials from natural resources. So promoting cultivation of medicinal and aromatic plants which are extensively used by the industries will help to solve the problems of the industries.

In this perspective cultivation of narcotic yielding plants such as *Nicotiana tabacum*; *Cannabis sativa*, *Papaver somniferum* the sources of nicotine, cannabin, morphine etc. respectively can be taken into consideration in the districts of North 24 Parganas , Nadia, part of South 24 Parganas, Jalpiguri , Burdwan, Coochbehar, Malda, for tobacco cultivation and cannabis and papaver in Bakura, Birbhum, West Midnapur, and Purulia with proper guidance and control of the Department of Narcotics.

6. Status of medicinal and aromatic plants in West Bengal

In India as well as in West Bengal 800 plant species are used in traditional systems of medicine, out of which about 450 plant species are utilized in different formulations. The plants used in alternative medical practices such as folk medicine, home remedies, household treatment, naturopathy, tantra therapy, amchi and tribal medicine in the State are awaiting the touch of modern knowledge.

It is essential to promote scientific awareness on the importance and uses of medicinal plants from the Gram Panchayat level as a remedy in many common diseases and ailments at a low cost and without any harmful effects. The cultivation of medicinal and aromatic plants is a national concern. National and State Medicinal Plant Boards listed 92 medicinal plant species. In view of the increasing demand of medicinal and aromatic plants globally, basic information on these crops in West Bengal, including proper identification of species and cultivars, their cultivation, management and plan for extraction and uses are of utmost importance. A strong linkage of growers with the pharmaceutical industries is also very important for utilization and commercial cultivation of these crops.

In spite of immense scope of commercial cultivation of major medicinal and aromatic plants in different agro-climatic zones of West Bengal from the hills to the coastal area for supply of genuine plant species to the expanding domestic industries of herbal medicines and cosmetics and the enormous export markets, very little effort is being made to promote organized cultivation of these plants in West Bengal except by a few NGOs. If taken up seriously it would not only provide support of raw material to the industry and develop a chain for regular supply to the export market but also promote employment and income to the small farmers.

The discovery of hallucinogenic use of morning glory (*Ipomoea* sp) has stimulated further studies on *Datura, Cannabis, Papaver* and *Revia* as these drugs are very much in demand. Recently, steroidal sapoginous substances have also attracted phytochemists to pay more attention on researches and commercialization of these plant groups.

Many plants used for medicinal purpose are also treated as aromatic plants and *vice versa.* Plants used in Indian traditional medicine, cosmetics and herbal nutriceuticals should be an important sector of export trade in the global market with organized planning and implementation of the programme by promoting cultivation of these plants and maintaining the quality standard.

a) Major stakeholders in the State

The major stakeholders are: (i) drug manufacturers, (ii) traders in herbs and crude drugs, (iii) medical practitioners, (iv) cultivators and collectors, (v) Ayurvedic, Unani, Siddha and Homeaopathy colleges, hospitals and research institutes, (vi) consumers of Ayurvedic and other systems of traditional herbal medicines.

b) Medicinal plants in major habitats

Wetland medicinal plants: It is estimated that there are more than 140 species of aquatic vegetation of which 40 species of herbs have medicinal value. The most commonly used marsh and wetland herbs are *Bacopa monnieri* (Brahmi), *Hygrophila spinosa* (Kulekhara), *Enydra fluctuans* (Hingchey), *Marsilea quadrifolia* (Susni), *Ipomoea aquatica* (Kalmi), *Acorus calamus* (Bach), *Euryle ferox (*Makana), etc. It is estimated that the wetlands of West Bengal cover about 8.5% of the National Wetland Areas.

Medicinal plants in uplands: Under this category there are trees, shrubs, climbers, and herbaceous species which are growing wild as good floristic components of West Bengal. The most concentrated floristic composition is in Darjeeling hilly region, in the Terai belt and also in the lateritic region of the districts like Paschim Medinipur, Bankura, Purulia. The common trees of medicinal value are *Azadirachta indica* (Neem), *Terminalia arjuna* (Arjuna), *T. bellirica* (Baera), *T. chebula* (Myrobalan, Haritaki), *Emblica officinalis* (Aonla), *Aegle marmelos* (Bael), *Holarrhena pubescens* (Kurchi), *Saraca asoca* (Asoke), *Oroxylum indicum* (Sona), *Alstonia scholaris* (Chatim), *Murraya koenigii* (Bursunga), *Strychnos nuxvomica* etc.

Medicinal plants in the Himalayan region: Species of *Aconitum, Berberis, Podophyllum, Swertia, Nardostachys, Valeriana, Picrorhiza, Gentiana,* etc. are important and widely used medicinal plants from the Himalayan region. Many species of orchids in this region are also used for their medicinal values.

Medicinal plants according to their growth habits: (i) The climbers which are mostly used for medicinal purpose are *Tinospora cordifolia* (Gulancha), *T. sinensis* (Padma gulancha), *Piper longum* (Pipul), *Abrus precatorius* (Kuch), *Gymnema sylvestre* (Gurmarh), *Tylophora indica* (Antamul), *Aristolochia indica* (Iswarmul), *Hemidesmus indicus* (Anantamul), *Asparagus racemosus* (Satamuli), etc.

(ii) The shrubby species are *Adhatoda zeylanica* (Basak), *Barleria prionitis* (Jhanti), *Phlogacanthus thyrsiflorus* (Rambasak), *Plumbago zeylanica* (Chita), *P. rosea* (Rakta chita), *Rauvolfia serpentina* (Sarpagandha), *Withania somnifera* (Aswagandha), *Psoralia corylifolia* (Babchi), *Calotropis gigantea* (Akanda), *Solanum* spp., *Datura* spp.

(iii) The herbaceous plants are *Andrographis paniculata* (Kalmegh), *Ocimum tenuiflorum* (Tulsi), *Catharanthus roseus* (Nayantara), *Eupatorium ayapana* (Ayapan), many species of *Mentha* (Pudina) etc.

Trade markets of medicinal plants in West Bengal: In West Bengal, the two major markets dealing with herbs and crude drugs are located in Kolkata and Siliguri

Kolkata market

The wholesale herbs and crude drugs market in Kolkata is in Barabazar area and restricted within 1 sq km radius. About 90% of the major trading units lie within this area. From the later half of the 19th century upto 1980's the market was gradually expanding. It was an important centre for trade of medicinal plants collected from North-east India, Nepal and Bhutan. For the last 15-20 years the growth of the market has become almost stagnant with about 75 retailers and wholesellers. Only 5-10 traders from Kolkata are regular exporters. Importance of Kolkata market has been considerably reduced because of the expansion of the herbal markets in Delhi and Mumbai.

Siliguri market

Siliguri market is another centre of medicinal plants, herbs and crude drugs trade. There are about 7-10 wholesale traders. The market is mostly dependent upon plants/parts collected from North-east states, Nepal and Bhutan.

7. Constraints in marketing of medicinal and aromatic plants and crude drugs

(i) The items available in the market are sold by trade name only and have no authentic list and no scientific name corresponding to those of trade name. An authentic publication is needed for the expansion of trade on medicinal and aromatic plants and crude drugs in West Bengal.

(ii) Traders are not confident of the quality of the products they sell and in most cases they quote cheaper rate mainly because of deterioration of quality due to storage. However, herbals and crude drugs have their specific shelf-life depending on the storage condition, beyond which the efficacy decreases.

(iii) Adulteration/ substitution are also common in the trade of medicinal plants.

(iv) Lack of state level inventory of medicinal and aromatic plant species in trade, and absence of an identification handbook/ manual for the common cultivars are major constraints for scientific development in herbal industry.

(v) There is need for awareness about trade restriction and conservation laws. Till date the State Forest Department has no authentic data on Non-Timber Forest Products (NTFPs), nature of the products and quantum available.

(vi) It is also true that the institution imparting education in Ayurvedic system of medicine and treatment and also the relevant organizations of the Government of India and the State on research and development of herbal medicine have not created any visible impact to popularize ayurvedic medicine in health care

among the people of West Bengal, especially among the low income group living in rural areas. These people are in distress because of the large escalation in the cost of allopathic medicine and method of diagnosis of the ailments. From the over all situation of health care in the country as well as in the State, low cost highly effective Ayurvedic system of treatment should be the major programme of health care in West Bengal.

Recommendations

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 Panchyat 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-medica (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 Gls.
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

West Bengal is one of the India's largest producers of Horticultural products, but the processed food industry in the State is relatively untapped. The growth potential for food business in West Bengal, however, is very promising. In recent times, factors such as changing food consumption patterns, increased spending on value-added fruit-vegetable products, increase in income levels, rapid urbanization, increasing number of women joining the workforce and changing life styles have brought about a marked shift among consumers for packaged food items in West Bengal. Consumption of packaged foods in urban areas have gone up several folds. The market is booming.

Horticultural production in West Bengal is expected to double in the next decades if the process of development continues and there is an urgent need for food processing technologies and packaging equipment, especially in areas of value-added fruit and vegetable processed products. Ready-to-eat/serve snacks and convenience foods segment, which is growing at the rate of 20 percent, also offers good potential. Business in handling, packaging and storage equipment sector for horticultural-products also offers good prospects in West Bengal. West Bengal continues to suffer from huge wastage in the absence of proper postharvest handling/storage, preservation

and cold chain infrastructure. The existing storage and handling system for fresh horticultural produce in West Bengal is traditional and there is an urgent need for modernization and creation of infrastructure to reduce large-scale wastage. It is estimated that 20-25 percent of the total production of fruits and vegetables in the State are now wasted every year due to inadequate infrastructure.

Facilities that could be created to all the important production centres as well as in large markets include postharvest handling infrastructure viz., humidified storage equipment for fresh produce; sorting and grading equipment; technology to reduce microbial contamination; cooling systems, cargo transport air-conditioning and refrigeration systems for railways; refrigerated containers/trailers; and vans for transport of perishable products. Reduction of loss would mean increasing food availability.

The State Government would require adequate support for establishing cold chain facilities and modern markets, including setting up of Terminal Markets and creating modern humidified storage facilities at the Ports and the Airports also. Development of cold chain infrastructure is essential to harness the potential of the horticulture sector in distant both global and domestic markets. If West Bengal has to become a top exporter and processor of horticultural produce, it is essential to have a high quality cold chain system in place.

West Bengal has an enormous marketable surplus for fresh horticultural produce mainly fruits and vegetables including potato. Support to the growing organized retail sector through efficient supply chain systems could also boost domestic consumption, encourage value addition and reduce loss.

1. Present and emerging problems

a) **Background and present status:** The production of horticultural crops will have significance only when they reach the consumer in good condition and at a reasonable price. There is a considerable gap between the gross production and net availability, due to heavy postharvest losses of horticultural produce. Therefore, it is necessary to develop an integrated approach right from production to postharvest management and processing. The proposed approach will have three objectives viz. a) ensure increased income and employment for all sections of the rural people; b) be economically sustainable; and c) contribute to the food and nutrition security of the people of West Bengal.

   There has been a phenomenal rise in production of horticultural crops in India in general and West Bengal in particular since independence. West Bengal is the leading vegetable producing state in India, eighth largest producer of fruits and sixth in the area of floriculture.

Table 1: Area and production of horticultural crops (2005-06)

West Bengal	Area ('000 ha)	Production ('000MT)
Fruit	172.69	2301.70
Vegetable (excluding potato)	889.84	11556.75
Flower	17.89	54.29 (and 93.48 crore spikes)
Potato	354.5	7462.00

Source: Economic Review Govt. of WB, 2006-07

Available data indicate that India produces about 150 million tonnes of fruits and vegetables and is considered to be the second largest producer in the world. Unfortunately, unlike other horticulture rich countries, average Indians do not get the basic daily requirement of fruits and vegetables and our Human Development Index is very low. This is because a considerable amount of this valuable produce is lost due to improper postharvest management and lack of processing facility. Reduction of loss can increase food availability substantially. To achieve our target of a hunger free India and reduce poverty, emphasis needs to be given to loss reduction that is essential to make available more fruits and vegetables and give better economic return from the existing level of production.

Prices of seasonal fruits and vegetables fluctuate greatly and during the period of maximum availability the prices are not remunerative to the farmer. At other times, these commodities are so highly priced that the ordinary consumer finds it beyond his purchasing power. Another problem is that fruits and vegetables are not uniformly available throughout the country and some areas suffer from inadequate supply even when there is a glut in other parts. Marketing, storage and packaging of both fresh and processed products would play a vital role in price stability of perishable horticultural produce. A massive thrust to food processing and storage will add value to the product. It will increase the income of farmers, create employment, and foster rural industrialization. The demand for processed food is likely to multiply significantly.

Horticultural production is not fully utilized in the state for various reasons. In a good season there may be a local glut, particularly of fruit, but because of insufficient transport facilities, lack of good roads and poor or no availability of suitable packing materials. Moreover, the surplus cannot be stored for a few more days for sale in the off-season because of inadequate infrastructure particularly cold storage facilities. Thus the cultivators do not get a good price for their produce during the glut and a large quantity is spoiled. At present 20-25 % of horticultural produce is wasted prior to reaching the consumer in the

state. During the periods of rains losses of produce increase further because of enhanced perishability and poor transport facilities.

Table 2: Location and capacity of cold stores

District	Total No. of cold storage	Total capacity in Qtl.	Potato cold storage		Multipurpose	
			No.	Capacity (Qtl.)	No.	Capacity (Qtl.)
Hooghly	133	16067206	129	15948206	4	119000
Burdwan	102	12908052	93	12308050	9	600000
Paschim Medinipur	56	9750490	53	9599740	3	150750
Bankura	41	5852687	40	5802687	1	50000
Jalpaiguri	25	3121000	17	2843000	8	278000
Birbhum	16	1415664	14	1360664	2	55000
Kolkata	8	70000	0	0	8	70000
Coochbehar	12	1611263	12	1611263	0	0
Murshidabad	11	538330	8	453330	3	85000
Howrah	9	629195	5	458195	4	171000
Uttar Dinajpur	5	553600	4	503600	1	50000
North 24-Parganas	5	309999	3	247999	2	62000
Nadia	3	169608	2	136608	1	33000
Malda	3	122480	1	40000	2	49257
South 24-Parganas	2	49257	0	0	2	49257
Purba Medinipur	1	99000	1	99000	0	0
Darjeeling	1	5300	0	0	1	5300
Total	433	53273129	382	51412342	51	1860787

Source: Economic Review, Govt. of West Bengal, 2006-07

Two approaches are necessary for minimization of postharvest losses

(i) Creation/expansion of humidified cold storage facilities specially meant for fruit, vegetable, flowers and others in the producing regions, as also in the major urban consuming centers, to ensure supply of these commodities throughout the year through cold chain management system and marketing infrastructure.

(ii) Processing fruits and vegetables into various products. Demand for processed food rising with increasing urbanization, rise in middleclass purchasing power, change in food habits and the dying out of the practice of making preserved products in individual homes, i.e. dehydrated foods, pickles etc. Moreover, there is considerable demand for some of these products in foreign markets.

b) **Growth of fruit and vegetable processing:** There are at present 378 licensed fruits and vegetable processing units in the state, however, the actual capacity utilization is still less than 40%.

c) **Strength in production of raw materials in relation to processing**

(i) Wide diversity in agro-climatic conditions permitting the production of a wide range of fruits and vegetables in West Bemgal.
(ii) High export potentiality of the processed products compared to export of fresh produce.
(iii) Extended harvesting season for the export oriented fruits and vegetables.

d) **Weaknesses of the fruit and vegetable sub-sectors for which processing sector has not developed as yet**

(i) Processing industries have no control over raw material production. They depend mainly on market procurement.
(ii) Availability of right quality of raw material at required time and at right price is most uncertain.
(iii) Supply of at least one third of the requirement should be assured.
(iv) Units are mostly under cottage and home scale.
(v) Less than 2% of the fruits and vegetables are processed.
(vi) Shortage of production of varieties amenable to processing.
(vii) Inadequate infrastructural facilities for pre and postharvest management of horticultural produce.
(viii) Lack of integrated cold chain, inadequacy of roads, power, etc.
(ix) High cost of packaging materials as well as for processing.
(x) Seasonal availability of raw materials.
(xi) Taxes on processed food in the country is among the highest in the world.

e) **Overcoming the weaknesses of fruit and vegetable processing in West Bengal**

(i) ***Seasonality:*** The seasonality of the production of some of the major fruits and vegetables can be overcome by setting up multi-product processing unit with little additional cost. The unit should plan a product mix so as to operate 8-9 months a year.
(ii) ***High price of processed fruit products:*** Because of high cost often processed product is beyond reach of many. The cost of processed products can be lowered if the productivity of raw materials increases and grading is done at producers' end. Besides, the cost of materials required for packaging the processed as well as fresh products should be reduced to make the product cost effective to the major consumers.

(iii) ***Dependence on a few markets for exports:*** India mainly exported processed fruits and vegetables to Saudi Arabia, US, Netherlands, Kuwait, Germany, UK, Egypt, Sri Lanka, UAE, Turkey, Spain, France, Indonesia, former Soviet Union. With economic reforms initiated in the country, more and more advanced technologies are being imported. As a result, the markets for fresh as well as processed products are expanding and finding outlets in the countries of Europe as also in North America.

(iv) ***Inadequate infrastructure:*** Infrastructure for handling of perishable fruits and vegetables, has been inadequate. Recently, initiative has been made in the state to develop the requisite infrastructure, improvement in the Port facilities, setting up of quality testing labs, cold chain facilities etc. Significant improvement in the infrastructural facilities is likely to boost up postharvest handling activities.

(v) ***Lack of varieties suitable for processing:*** Entire production of fruits and vegetables is for consumption as fresh and not for processing. In spite of abundant production, mango pulp is brought in West Bengal from Andhra Pradesh for making RTS beverage in tetra pack, because of low consistency and high fibre in local varieties. The size and shape of pineapples is not what is advantageous for canning. Potatoes have less solid and tomatoes less TSS than what are needed for processing at competitive cost. Introduction of process able varieties has started but it is again dependant on growth of demand from industry side. Farmers cannot produce first and wait for industry to come later.

(vi) ***High cost of raw materials:*** Because of the low productivity and lack of grading at the producers' level, the cost of raw materials for processing in West Bengal is high as compared to developed countries. Therefore, the productivity needs to be increased and grading at the producers' level has to be resorted to.

f) Processed fruit and vegetable products: Major processed products that can be manufactured from raw materials available in West Bengal include fruit pulp, fruit juices, ready to serve beverages, canned fruits and vegetables, jams, chutneys, pickles and dehydrated vegetables. In the recent years, frozen fruits and vegetables, juices, concentrates, canned and dehydrated mushrooms, vegetable curries in retortable pouches etc. are being produced. Other processed products in the country for domestic and export markets are aseptically processed and packed fruit pulp; papain from papaya latex, oleoresin from spices and crude drugs from medicinal plants; spice powder and pastes, potato powder and potato wafer. Capsaicin and oleoresin from chilies, individual quick freeze (IQF) fruit and vegetable products etc. However, in spite of abundance of raw materials West Bengal's share in processed product market is very low.

g) **Location of processing units:** Usually the processing centers are located near the production centre. However, it is possible to set up primary processing units in the production centre and secondary processing units near to the consumption centre, which will reduce the transportation cost. A few production belts are indicated below:
Mango – Nadia , North 24-Parganas, Malda and Murshidabad
Banana –Nadia, Hooghly and North 24-Parganas
Litchi – South 24-Parganas and Murshidabad
Pineapple – Siliguri and Jalpaiguri
Guava – North 24-Parganas, South, 24-Parganas and Nadia
Mandarin Orange – Darjeeling hills.
Potato – Burdwan and Hooghli
Onion – Balagarh region of Hooghly
Tomato – North 24-Parganas, Nadia, Murshidabad, Jalpaiguri. and Coochbehar.
Vegetables – Nadia, Murshidabad, North and South 24-Parganas
Besides the availability of raw materials, the other factors to be considered while selecting the location include availability of power, water, trained workers, bank credit, road connection, transport facilities, plant and machinery etc.

h) **Land and land development:** The entrepreneurs will need suitable land with all infrastructure facilities for setting up the unit. It should be located in a place with open surroundings and well connected by roads. The site should have assured supply of water and power. It should be away from the vicinity of poultry farms, cattle farms, etc. The cost of land development such as fencing, levelling, construction of internal road, digging of bore well etc. may be included in the project cost.

i) **Technology:** The technologies for manufacture of different products may be available from State Agricultural Universities, BCKV and UBKV and also from Central Food Technology Research Institute (CFTRI), Mysore. In some cases technologies have to be imported from foreign countries like Italy, Germany, USA, etc.

j) **Quality standards:** Fruit Products Order (FPO), 1955 of the Govt. of India provides for the area requirements, annual production limit, sanitary requirements, technical staff requirements, minimum requirements of equipments and machinery etc.
The quality of processed products from India is not rated high in the international market and as such, sometimes face rejection. Standardization of manufacturing process, packaging, sanitary and phyto-sanitary certification is

necessary. This can ensure safety of the products. In the context of WTO agreement, India has to adopt the standards of CODEX Commission on food products. The Commission has recommended the use of a system called Hazard Analysis Critical Control Point (HACCP). All the manufacturers of fruit products have to follow Good Manufacturing Practices (GMP), Good Packaging Practices and Good Environmental Practices. Acquisition of ISO 9000/14000 and HACCP certification by manufacturers would be essential requirement. The quality of the processed product should meet the requirement of the importing countries.

k) **Markets for fresh fruits and vegetables:** It is necessary to introduce cooperative marketing. Cooperative marketing is where a group of farmers associate to market their produce together. Societies help the growers to standardize the product, to improve grading and packing, to develop old markets and find new one, to disseminate crop and market information and to advertise the product of the members. The success of cooperative marketing societies dealing with different fruit crops in our country like HOPCOMS at Bangalore can be translated in West Bengal also.
This society should have a network throughout the state of West Bengal with infrastructural facilities for postharvest handling, packaging, and storage and even with its own retail shop in every town.

l. **Packaging techniques for fruits and vegetables:** Packaging of fruits and vegetables is undertaken primarily to assemble the produce in convenient units for marketing and distribution; at present very little or no infrastructure exists in the state. Packaging will add to the value and cost of commodity, convenient for transport and marketing both domestic and export.

(i) ***Requirements of packaging:*** The package must stand up to long distance transportation, multiple handling, and the climate changes of different storage places, transport methods and market conditions.
The package must be capable of protecting the product from the transport hazards, preventing the microbial and insect damage and minimizing the physiological and biochemical changes and losses in weight. Traditional forms of packages like bamboo baskets, wooden boxes and gunnysacks are widely used. Considering the long term needs, other alternatives like corrugated fibre board boxes, corrugated polypropylene board boxes, plastic trays / crates / wooden sacks, moulded pulp trays / thermoformed plastic trays and stretched film and shrink wrapping may have to be considered depending on the nature of the products.
A great variety of materials are now used for the packing of perishable commodities. They include wood, bamboo, rigid and foam plastic, solid cardboard and corrugated fibre board. The kind of material or structure

adopted depends on the method of perforation, the distance to its destination, the value of the product and the requirement of the market.

Pallets are widely used for the transport of fruit and vegetable packages, in all developed countries to reduce labour cost in handling and transport. Mechanized handling is very rapid; through high stacking, storage space can be more efficiently used and pallets encourage the introduction of standard package sizes.

Reduction of moisture loss from the product is the major quality of packaging materials. A solution to moisture loss problems from produce appeared with the development and wide distribution of semi permeable plastic films. Airflow through the ventilation holes allows hot fruit or vegetable to slowly cool and avoid the buildup of heat produced by the commodity in respiration. Holes are also important in cooling the fruit when the packages are placed in a cold storage, especially with forced air-cooling. Ventilation holes improve the dispersal of ethylene produced.

The function of cushioning materials is to fix the commodities inside the packages and prevent bruising from vibration or impact during transport. Some cushioning materials can also provide packages with additional stacking strength. The cushioning materials used vary with the commodity and may be made of wrapping papers, fibre board (single or double wall), moulded paper pulp trays, moulded foam polystyrene trays, moulded plastic trays, foam plastic sheet, plastic bubble pads, fine shredded wood, plastic film liners or bags.

(ii) ***Controlled and Modified Atmospheric Packaging (CAP and MAP):*** Modified atmosphere packaging is the method for extending the shelf-life of perishable and semi-perishable food products by altering the relative proportions of atmospheric gases that surround the produce. Controlled Atmosphere (CA) refers to a storage atmosphere that is different from the normal atmosphere in its composition, wherein the component gases are precisely adjusted to specific concentrations and maintained throughout the storage and distribution of the perishable foods. In Modified Atmospheric Packaging (MAP) unlike CAPs, there is no means to control precisely the atmospheric components at a specific concentration. Modified atmosphere conditions are created inside the packages by the commodity itself and / or by active modification.

(iii) ***Vacuum packaging:*** Vacuum packaging offers an extensive barrier against corrosion, oxidation, moisture, drying out, dirt, attraction of dust by electric charge, ultra-violet rays and mechanical damages, fungus growth etc. This technology has commendable relevance for tropical countries with high atmospheric humidity. If some of the product cannot bear the atmospheric pressure due to vacuum inside the package then the packages are flushed with inert gases like nitrogen and carbon dioxide after evacuation.

(iv) ***Edible packaging:*** The package with an edible film or coating, which forms a thin continuous layer of edible material, is an integral part of the food, which can be eaten as a part of the whole food product. Selection of material for use in edible packaging is based on its properties to act as barrier to moisture and gases, mechanical strength, physical properties, and resistance to microbial growth. The types of materials used for edible packaging include lipids, proteins and polysaccharides or a combination of any two or all of these. Many lipid compounds, including vegetable fats, have been used in the formulation of edible packaging for fresh produces because of their excellent moisture barrier properties. Research and development effort is required to develop edible films and coatings that have good packaging performance besides being economical.

Improved packaging would become more essential as international trade expands after globalization. Standardized packaging of sized and graded produce that will protect the quality during marketing can greatly aid transactions between producers/sellers and consumers / buyers. Better packaging should be of immediate value in reducing waste. Much background research on packaging of perishable products and flowers is needed simulating the actual handling conditions expected during marketing.

2. Training for human resource development

a) To impart knowledge on the technical skills in various aspects of fresh produce, preservation and processing of fruits and vegetables.

b) To generate employment potential in food processing sector.

There is need to train the unemployed/under employed youth and growers including housewives in scientific pre- and postharvest management including processing and preservation. The object is to harness the widely expanding horizon of job opportunities in the area. Extension personnel engaged in horticultural developmental activities either in government sector, State Agricultural Universities (SAUs) and Krishhi Vigyan Kendras (KVKs) may be deployed for training growers/producers and also in maturity determination, grading and packing standards for all commodities. There is need to improve packing, method of handling during transport and marketing. Application of correct techniques can reduce the losses by about 70 to 80%.There is also need to improve the skill in handling of preservation equipments of various capacities, working in hygienic manner, maintaining sanitation, preparation of preserved products ,identification of spoilage and application of remedial measure.

Washing vegetables with unclean water for colouring by carcinogenic chemicals at different markets and unhygienic handling should be stopped by creating awareness among farmers and traders.

The SAUs and KVKs may be involved in setting up of processing units and other postharvest management activities. Technology dissemination is possible by organizing awareness programme by conducting group meeting, workshop and training programmes.

3. Low cost methods of preservation

Since most of the commercial methods of storage and processing are expensive and beyond the means of the small and marginal farmers, it is necessary to adopt low cost methods. In this respect the following techniques are suggested:

a) Pusa zero energy cool chamber

It is a double brick-wall structure, the cavity is filled with sand and walls of the chamber are soaked in water. Even unskilled labour can build the chamber, as it does not require any specialized skill. The cool chamber can reduce the temperature by 10-15 °C and maintain high humidity It may be tried in low humidity seasons in western tract where evaporation rate is high.

b) Solar drying

Vegetable: Most of the leafy vegetables rich in nutrients can be preserved successfully by solar energy. A low cost solar drying chamber made of black polyethylene has been found effective in drying the leafy vegetables. Even though the drying process causes loss of considerable amount of nutrients, a substantial amount is still left in the dried vegetables to meet nutritional requirements.

Fruits: It has often been found that during the season of glut a huge quantity of fruit is piled up. In order to avoid wastage the fruits can be solar dried or the fruit pulp can be dried in the form of fruit leather or slab/ bar and utilized gainfully for the benefit of local people.

c) Home scale processing

Most of the fruit and vegetables juice or pulp can be preserved successfully by bottling them and preserving either by addition of chemical or by application of heat, thereby it can be stored for a long time.

d) Whole tomato concentrate

It is a simple and low cost technique of processing tomato. The whole tomato is crushed in a container and the volume is reduced to one third by boiling. The final product is filled in bottles after addition of permitted preservatives.

4. On- farm storage

In a tropical country like India a tremendous amount of quality deterioration of horticultural produce takes place immediately after harvest due to lack of on-farm storage facilities.

5. Low cost environment friendly commercial size cool chamber

Considering the acute energy crisis and the non-availability of abundant cool storage facility, low cost / low energy environment friendly commercial size (6-8 ton capacity) cool chambers have been developed utilizing the same principle of evaporative cooling. It is also a double brick-wall structure, the cavity is filled with sand and walls of the chamber are soaked in water from an overhead tank. The floor is made of wooden planks and the bottom of the chamber is provided with air ducts through which air is drawn with the help of an exhaust *fan* fitted at the center of the roof. The fan can be run for a predetermined time with the help of a sequential timer. This chamber reduces the temperature and maintains high humidity throughout the year and increases the shelf life and retains quality. The commercial size cool chamber has proved useful for the storage of citrus, banana, potato, tomato etc. and during the rainy season onion can be stored if water supply is stopped in the big cool chamber This chamber can also be used as a pre-cooling chamber, for mushroom growing and storage of bio-fertilizers.

6. Packing stations/primary processing

In our country perishable fresh fruit and vegetables are marketed immediately after harvesting without primary processing and adequate packaging. Huge quantities of inedible material are transported to the market and carried out as garbage. Therefore, it is necessary to establish packing stations at nodal points to streamline the marketing of fresh horticultural produce. The present practice of transporting cauliflower results in shipment of 50% to 60% inedible parts, which ultimately end up as garbage. By adopting the technique of primary processing the inedible parts are removed at the packing station and used as cattle feed and/or producing value added products. Similarly, other vegetables such as peas, leafy vegetables, etc. can also be primarily processed at packing stations so that inedible parts are removed before being sent to the metro-city markets in unit packs. The traditional practice of shipping whole banana-bunches along with stem and leaves results in 15% additional load, all of which ends up as solid waste Throughout the world, bananas

are shipped in hands; therefore primary processing of banana into hands followed by shipping in crates is advocated.

7. Minimal processing

Minimally processed fruits and vegetables are cleaned, peeled, cut, sliced, packaged and/or lightly processed. These foods are in great demand because of their convenience. All fruits and vegetables need not be minimally processed. Instead of buying a whole fruits and vegetable like pineapple, jackfruit, watermelon, pumpkin, ash gourd, yam, etc. a consumer with a small family would prefer to buy suitably sliced, peeled and packed material. It is well known that preparation of vegetables consumes a substantial portion of valuable time for cooking. In addition, it generates a considerable amount of waste that creates disposal problems for the housewives. If the vegetables are available in ready to cook form, a large number of working women in metro cities will be greatly benefited. While supplying minimally processed vegetables, maintenance of quality and hygiene are of topmost priority. The demand for minimally processed vegetables in metro cities is likely to multiply significantly in the coming years. This will provide an opportunity for employment generation.

8. Appropriate packaging

The existing practice of packaging and marketing fruits and vegetables in bamboo baskets, wooden boxes and gunny bags adds to the freight to the extent of 15-25%; in addition it promotes 5-10% spoilage. The bamboo baskets, wooden boxes, straw, leaves, newspapers, etc. used for packing as well as the spoilt produce finally end up as garbage. Environment friendly corrugated fibre board box (CFB) with ventilation does not generate any garbage, as it can be recycled. The technologies suggested are preventive methods that will reduce solid waste generation and help to maintain better sanitation, health and hygiene in Indian cities. In addition it will alleviate poverty by generating more employment and preventing migration of labour from production centres.

9. Palletisation

Loading and unloading are very important steps in the postharvest handling of fruits and vegetables which are often neglected. One of the problems in our country is the non-introduction of pallets in the trading of fruits and vegetables which would considerably reduce postharvest loss. All the subsequent handling operations become very easy once the boxes are placed on the pallets.

10. Pre-cooling

Palletization followed by pre-cooling considerably enhances the shelf life of horticultural crops by reducing the physiological, biochemical and microbiological

deterioration. Pre-cooling not only increases the shelf life but also maintains the quality.

11. Cold/cool chain

One of the important reasons for the advancement in the trade of fruits and vegetables in developed countries is the adoption of cold chain in handling and storage of fruits and vegetables. The maintenance of low temperature at different stages of handling by means of a cold chain results in reduction of losses and retention of quality of fruits and vegetable and their products. The basic cool/cold chain facilities comprise of pre-cooling unit, refrigerated container or van, cold storage or frozen storage, etc. If it is not possible to introduce the cold chain facility based on refrigeration at all stages in our country, attempts should be made towards the development of cool chains by adopting the principle of evaporative cooling and other non-conventional methods of cooling.

12. Mobile pre-cooling unit

It is well known that the same pre-cooling unit can be used for different types of fruits and vegetables, by minor adjustments of temperature. The mobile fleet/unit should consist of pre-cooling unit mounted on a trailer or rake as need be. It should also have a refrigerated container, generator set, so that the equipment may be used throughout the year moving from place to place.

13. Support to floriculture

West Bengal has the potential for growing quality flowers because of its ideal climatic conditions. Floriculture plays an important role in the state economy. The main flowers cultivated in West Bengal are rose, marigold, tuberose, lily, gladioli, carnation, anthurium, gerbera and orchids. All the flowers grown in West Bengal have great demand both for domestic market and export trade. Postharvest handling support like attractive packaging, grading, cooling, cool transport form the basis of floriculture industry. Absence of such activities has restricted the growth of floriculture in West Bengal and held it back in traditional system. Centres with facilities of post harvest management should be established in major flower growing zones in the State.

14. Mobile processing unit

It is often found that there is surplus of production of a particular fruit or vegetable resulting in a glut in the market and price may fail to realize the cost of harvest and transport to the market. A mobile processing unit can make semi-processed products like juice, pulp, etc. and dispatch it in a refrigerated container to a processing factory for further utilization into different fruit products. This would result in confidence building among the farmers.

15. Bulk aseptic packaging

Aseptic packaged food can be defined as specially packaged foods in which the products are sterilized and are then packaged in sterile packaging materials under an aseptic environment without re-heating for sterilization. Bulk aseptic packaging plays a significant role in the fruit and vegetable processing industry. In most of the developing countries this technology is widely used. There is a tremendous potentiality of using bulk aseptically packed pulp/juices not only in the consumers market but also in the institutional market in the near future because of improved taste, less packaging cost, reduced energy consumption and above all convenience. In the processing industry, fresh whole fruits and vegetables are not always required except where the slices/pieces are canned, frozen or dehydrated. Most of the fruit and vegetable-based food products viz. juice, jam, ketchup, sauce, soups, etc. are prepared from the pulp. One of the greatest advantages of using bulk aseptically packed pulp is to avoid handling of fresh fruits and vegetables because they are not only highly perishable in nature but produce lots of garbage. In addition, a considerable amount waste is generated in terms of peel, seed, pomace, etc. which could be utilized for value added products. It is advisable to establish one or two bulk aseptic packaging unit in close proximity to production centres of selected fruits and vegetables.

16. Frozen food

Freezing has been a major factor in bringing convenience foods to home, restaurant, and institutional feeding establishments because, freezing if properly done, preserves food without causing major changes in their size, shape, texture, colour and flavour. At present, no form of food preservation is as well suited to provide maximum convenience as freezing. Although dehydrated food can offer convenience, they require reconstitution and heating. Frozen tropical fruits and vegetable has very good market. The state may encourage frozen fruit and vegetable industry using slices, dices, etc. for exports and institutional market. In general, freezing preservation is considered to be a method that delivers a product comparable in nutritional quality to the fresh product. Massive freezing and storage programme during period of abundance and distribution during period of scarcity could be a possible solution to price stability in horticultural produce.

17. Potential of indigenous fruit processing

West Bengal has abundant availability of indigenous tropical and sub-tropical fruits that are underutilized. Most of these fruits viz. Aonla *(Emblica officinalis),* Bael Fruit *(Aegle marmelos),* Jamun *(Syzygium cuminii),* Kokum *(Garcinia indica)* Passion fruit (*Passiflora edulis),* etc. are grown organically even under adverse agro-climatic conditions. All these fruits are known for their therapeutic/medicinal and nutritive value and have excellent flavour and very attractive colour. Health

conscious consumers avoid chemicals and synthetic foods and choose therapy and nutrition through natural resources. It is difficult to market these fruits in fresh form in the international market under the present situation. Therefore, they should be processed into acceptable products so that the growers get a remunerative price. Some of these fruit products are being manufactured at present on a small scale. Unfortunately, in spite of such favourable possibilities no systematic approach has been made to utilize the potential of the minor indigenous fruits, on a large scale. Organized orchards and systematic collection of the raw material is of utmost importance. Instead of trying to compete in a market where other countries are already established and are far ahead we may break new ground and create markets for the indigenous fruit products where practically no other country can compete with us. Processed products from durian, ram butan in Thailand are examples.

18. Waste utilization

One of the reasons for the food processing industries based on horticultural produce not being very viable in our country is non-utilization of the valuable waste accumulated during handling and processing. The huge quantity of fruit and vegetable waste generated in the packing station and fruit processing factories can also be gainfully utilized for making value added products, thereby reducing the price of processed products. By doing so the processed food products of daily use of the common man would be well within their budget and food processing would become a popular and viable industry. In addition by utilizing the waste at the right time the problem of disposal of solid waste from the food factory could be solved to a great extent. For example citrus fruit peel could be used to extract oil, pectin etc. and then converted to animal feed.

19. Retail outlet

No useful purpose would be served by building up infrastructure right from harvest till handling, storage, processing and transportation, unless a proper retail outlet is made. Since considerable deterioration takes place at the retailers end due to non-availability of ideal conditions for marketing of fruits and vegetables, a number of companies have started retail marketing of perishables among many other commodities. It is absolutely necessary to see that the organized retailers should draw the raw materials from the farmers at remunerative price and without affecting small shopkeepers and vendors.

20. National Horticulture Mission

The main objective of National Horticulture Mission (NHM) is to provide overall development of horticulture by increasing production, adoption of postharvest management, processing and marketing in order to reduce postharvest losses.

After all very high investments are needed to create or to develop necessary infrastructure in this sector including setting up of R&D laboratories and pilot scale plant in the agricultural universities, as well as for setting up/expansion/modernization of existing food processing industries. Appropriate policies and schemes for development and transfer of new technologies of postharvest management and processing of fruits and vegetables need to be finalized and implemented to prevent the enormous loss of perishables in the State. Besides, the concept of supply chain management should be followed in this sector for over all development. The specific gains from supply chain management are

(i) Employment generation.
(ii) Minimizing loss in transport, storage, etc.
(iii) Value addition.
(iv) Increasing sales.
(v) Application of advanced technology.
(vi) Investment of capital in agriculture and agroindustry.
(vii) Knowledge dissemination among chain partners about markets, technologies, etc.
(viii) Better risk sharing among partners.
(ix) Better control of safety and quality of products.
(x) A strong linkage from back to front end.

Recommendations

Specific action points that emerged from the elaborate foregoing discussions are mentioned below.

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

The multipurpose project of the National Horticulture Mission (NHM) has been in operation in West Bengal since 2005-06. However, the Department of FPI and Horticulture has not fully utilized the opportunity as evident from the slow rate of expenditure and implementation of the many important components of horticultural development, for which fund had been sanctioned by the Govt. of India. Since horticulture (fruits, vegetables, flowers, plantation crops, spices, medicinal plants, postharvest management, etc.) is a major programme for intensive and remunerative farming of the poor small and marginal farmers in West Bengal (over 90% of the farmers are small holders) for improving their livelihood, food and nutrition security and employment generation even in strees areas, horticultural development should be taken up a priority.

There is a demand for a huge quantity of planting materials of fruits, vegetables and flowers for expansion and implementation of the programmes on horticultural development in the state including those of the NHM and other agencies like Panchayats and NGOs, and production by individual farmers. Lapses in orchard establishment and management with perennial fruit and plantation crops would jeopardize the objectives of the programme and result in disappointment of the farmers.

A number of farms under the Department of FPI and Horticulture are lying underutilized for years in spite of the increasing importance of horticultural crops in the farming system of West Bengal. There is immense scope to utilize these farms for establishing centres of demonstration and training on the management of commercial horticultural crops, propagation and nursery management, seed production and postharvest handling of the produce for providing opportunities of income generation

The maladies and lapses due to indiscriminate use of chemical fertilizers and highly toxic pesticides on all types of crops including vegetables extensively grown in the state on deterioration of soil fertility, decline in production, soil and environment pollution, decline in nutritive value, shorter storage life and serious health hazard, apart from the high input cost in cultivation, are adversely affecting the farmers of the country including West Bengal. The socio-economic conditions and livelihood of the farmers are becoming worse due to increase in the cost of cultivation, absence of minimum support price and lack of adequate market facilities, often temporary storage facilities of the unsold produce are not available. As the organically produced horticultural crops are free from chemical toxicity and have better nutritive value, taste, color and aroma (many of which are consumed fresh), there is an increasing demand of these crops both in domestic and export markets. The processing industry also offers premium price for the organic produce. The Department FPI of Horticulture, Agricultural Universities and KVKs should establish model organic farms with

horticultural crops only or in rotation with field crops for the purpose of demonstration and training on the more remunerative organic farming systems.

In view of the prevailing lapses in disorganized markets, absence of support price and postharvest management and handling of highly perishable horticultural crops, particularly fruits, vegetables and flowers and dearth of facility of temporary storage in the wholesale markets dominated by powerful agents, the growers of the state are suffering from economic depression and the small holders continue to remain poor with miserable livelihood for decades though the cost of cultivation has increased manifold due to adoption of intensive cultivation practices by small farmers.

Because of the disastrous consequences of cultivation of genetically modified (GM) Bt cotton on farmers in several parts of the country, on the contamination of germplasm, adverse human health effects, higher cost of cultivation with no additional benefit, the State Agriculture Commission in its interim report has recommended a ban on open field trials and cultivation of GM crops in West Bengal. Some GM vegetables including brinjal and field crops are awaiting approval of the Genetic Engineering Approval Committee (GEAC) for testing in cultivators' field and commercial cultivation.

The specific recommendations and action plan for the sub-sections of Horticulture are presented under the respective subheads, namely fruits, vegetables, plantation crops and spices, floriculture, medicinal and aromatic plants and postharvest management of Horticulture.

General 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 uplifment of the rural people in particular.