Present status and perspective plan for horticulture development in Nagaland

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The North-eastern region comprises of eight states viz., Assam, Arunachal Pradesh, Meghalaya, Manipur, Mizoram, Nagaland, Tripura and Sikkim lying between 21.5^{o} N - 29.5^{o} N latitudes and 85.5 ^{o} E - 97.3 ^{o} E longitudes. It has a total geographical area of 262180 Km^{2} which is nearly 8% of the total geographical area of the country. In the whole of NE region, about 35% area is plain and the remaining 65% area is under hills. Whereas in Assam, plains account for 84.44% of its total geographical area and the remaining 15.56% area is under hills. Net sown area is highest in Assam (34.12%) followed by Tripura (23.48%), however, Arunachal Pradesh has lowest net sown area in the region. About 0.5 million hectare area is under shifting cultivation in the NE region. Out of 4.4 million hectare net sown area, roughly 1.4 million hectare lies in hilly sub region and at least 1.3 million hectare suffer from serious soil erosion problem.

Although the region is very rich with respect to natural resources viz. land, water and biodiversity but their over exploitation and extraction with poor replenishment has become a point of concern for their sustainability and future availability with serious impact on soil health and biodiversity. In addition to natural hazards the large scale interference due to traditional system of shifting cultivation and increased population pressure has enhanced the process of degradation and desertification.

NAGALAND AND ITS HORTICULTURE

Nagaland comprises of 11 districts lying between 25^{0} 60$^{'}$ to 27^{0} 40’ North latitude and 93^{0} 20’ to 95^{0} 15’ East Longitude is one of the culturally vibrant state of North East India. The State is bounded by Assam in the north and West, Arunachal Pradesh in the North, Myanmar in the East, Manipur in the South and more or less parallel to the left bank of mighty Brahmaputra. The state is best known for its suitable natural conditions. About 50% of the total areas have economic cultivable land and the mainstay of the people of the State is land based, i.e. Agro-horticultural activities. However, not even 25% of the State’s total areas have been brought under economic cultivation and thus, the potentialities of the land in the State remains untapped.

Nagaland has total geographical area of 16579 sq.km with a total population of 19.0 lakhs. Out of 248354 ha net sown area, roughly 99980 ha is under shifting cultivation. The state receives an average rainfall of 1800 mm with the temperature range of 4 – 35^{0}C. The soil of the state is acidic to strongly acidic in reaction. The low pH is basically due to the leaching of the bases under the influence of high rainfall. The soils are, however rich in organic matter.

The total area covered by horticultural crops in the state has been estimated at 42897 ha (2008-09). The fruits grown in the state range from tropical and sub-tropical

fruits like banana, papaya, pineapple and citrus to temperate fruits like apple, pear, peach, plum, strawberry and even certain nut fruits. The state has rich diversity of different vegetable crops and both indigenous tropical vegetables and temperate vegetables are grown to a considerable extent. The major vegetables grown in the region are cabbage, cauliflower, tomato, knol-khol, radish, carrot, French bean and different cucurbitaceous crops. Among the flowering plants anthurium, roses, lillium, alstromeria, heliconia, and zantedeschia are introduced in the state. Tuber and rhizomatous crops like sweet potato, colocasia, ginger and turmeric grow abundantly in the state, while plantation crops like cashew nut, black pepper have been introduced recently in the state. Apart from these, underutilized crops like passion fruit, kiwi fruit, chow-chow and others are grown in some areas.

Table 1. Area, production and productivity of fruits and vegetables (2008-09)

State	Fruits			Vegetables		
	Area (000' ha)	Production (000' tones)	Productivity (t/ ha)	Area (000' ha)	Production (000' tones)	Productivity (t/ ha)
Nagaland	19.27	191.33	9.93	16.51	132.63	8.03
North east	337.41	3086.74	9.15	396.61	4202.18	10.60
India	**6100.9**	**68465.5**	**11.2**	**7980.7**	**129076.8**	**16.2**

Area, production and productivity of different horticultural crops

No systematic and accurate estimate of area and production of different horticultural crops in the state are available. The estimate made by various sources also varies considerably.

Out of the total area under different fruit crops in the state, the maximum area of about 3900 hectare is under citrus only. Area wise second most important crop is pineapple that covers about 3700 hectare, while the banana occupies 2700 hectare. Other important fruit crops of the state are plum (985 ha), lemon (850 ha) and papaya (670 ha). Besides, a number of other crops like kiwi, apple, cashew nut, straberry and indigenous minor fruits etc are growing in some areas. However, no reliable estimate is available about the area under these crops.

Table 2. Cropwise area and production of major horticultural crops in Nagaland

S. No	Crop	Area (Ha)	Production (mt)	Productivity (t/ha)
1	Khasi mandarin	3900	28000	7.18
2	Lemon	850	1600	1.88
3	Papaya	670	5600	8.36
4	Plum	985	7750	7.87
5	Banana	2700	59000	21.85
6	Pineapple	3700	57500	15.54
7	Ginger	3000	32000	10.67
8	Cabbage	1350	13500	10.0
9	Chillies	3500	24000	6.86

10	Tomato	680	4000	5.88
11	Cashewnut	350	137	0.39
12	Cardamom	3050	2190	0.718

Source: statistical handbook of Nagaland 2008

Out of total area under different vegetable crops, the maximum area of about 1350 hectare is under cabbage only. Area wise second most important crop is tomato that occupies 680 hectares. Besides, vegetables like French bean, carrot, cauliflower, cucurbits and a number of locally available leafy vegetables are also grown in different parts of the state.

Ginger, chillies and cardamom are the major spice crops of the state. Among the spices, chilli occupies the maximum area of 3500 hectare followed by ginger (3000 ha) and cardamom (3050 ha). Off late, black pepper and turmeric are gaining popularity in some of the districts of Nagaland.

Distribution of important minor fruits and vegetables

A large number of edible local fruits and vegetables are distributed naturally/wild between humid tropical to temperate altitude of Nagaland and many of them are grown for home consumption as well as commercial purpose.

Table 3. Underutilised horticultural crops of Nagaland

Name of crops	**Botanical name**	**Availability (District wise)**
Fruits		
Crab apple	*Malus spp*	Kohima, Mokokchung, Wokha
Gooseberry (aonla)	*Emblica officinalis*	Throughout the district
Star gooseberry	*Phylanthus acidus*	Dimapur
Fig	*Ficus auriculata*	Kohima, Mokokchung and Peren
Walnut	*Juglans regia*	Phek, Kohima and Zunheboto
Nagatenga	*Rhus semialata*	Throughout the district
Naga peanut	*Fermiana colorata*	Kohima, Phek
Raspberry	*Rubus ellipticus*	Throughout the district
Wild Jackfruit	*Artocarpus chaplasha*	Dimapur
Naga tenga	*Myrica farquhariana*	
Mango steam	*Garcinia lanceafolia,*	
Crab Apple	*Malus baccata*	
Rattan cane	*Calamus tenius*	Mon, Zunheboto and Mokokchung
Vegetables		
Indian Pennywort	*Centella asiatica*	Throughout the district
Common buckwheat	*Fagopyrum esculentum*	Throughout the district
Mechinga	*Zanthoxylum acanthopodium*	Mokokchung, Kohima and Wokha

Tree tomato	*Cyphomandra betacea*	Throughout the district
Chow chow	*Sechium edule*	Throughout the district
Tree bean	*Parkia roxburghii*	Dimapur, Kohima and Mokokchung
Naga king chilli	*Capsicum chinense*	Kohima, Dimapur, Peren and Mon
Spring onion	*Allium spp*	Throughout the district
Houttuynia	*Houttuynia cordata*	Throughout the district
Ginseng (tuber)	*Panax ginseng*	Tuensang
Yew (tree)	*Taxus baccata*	Kohima, Phek and Mon
Winged Bean	*Phaseolus tetragonolobus*	All districts
Mucuna	*Mucuna Pruien*	
Jack bean	*Canavalia rosea*	All districts
Sword bean	*Canavalia gladiata*	

SWOT ANALYSIS

Strength

- Agroclimatic conditions suitable for horticultural crops
- Wide range of indgineous horticultural crops
- Vast land available for horticultural crops
- Use of family labour
- Soil is rich in organic matter
- Adequate rainfall
- Availability of manpower
- Organic production system

Weakness

- Poor infrastructure (roads, power and water) in rural areas
- Lack of knowledge on scientific cultivation
- Poor quality planting materials
- Inadequate irrigation facilities
- Poor marketing linkages
- Old and unproductive orchards (seedling origin)
- Low productivity
- Low yielding varieties, pest and disease incidence
- Poor transport and communication facilities
- Lack of post harvest infrastructure
- Fragmented land holding
- Low investment
- Poor involvement of stakeholders

Opportunities

- Introduction of high yielding varieties
- High density planting method in banana, guava and pineapple
- Introduction of budded plants of khasi mandarin
- Supply of quality planting materials
- Establishing small and medium scale processing unit
- Protected cultivation of vegetables
- Green house cultivation for cut flowers
- Waste land may be utilized for promotion of horticultural crops
- Introduction of drip irrigation technology
- Farmer's right and protection of plant varieties
- Integrated pest, disease and nutrient management
- Moisture conservation techniques
- Post harvest management
- Scope for crop diversification

Threats

- Genetic erosion of indigenous varieties
- Soil erosion and depleting soil fertility
- Higher input cost
- Shifting of young people to other business
- Stray animals
- Fluctuation in market price

PHYSIOGRAPHY OF THE STATE

Climate and rainfall

The weather in Nagaland does not follow the pattern as observed in other places and show large spatial and temporal variability due to the presence of hill and mountain ranges on the synoptic system. The State falls under monsoon zone. The annual rainfall varies from 2000 to 2500 mm. However, the state receives considerable amount of rainfall during pre-monsoon (March-May) and post monsoon (October-November). With an annual huminity of 70 to 80% the average temparature ranges from 10^0C to 25^0C. The average bright sunshine hours received in the state is 2-5 hours during monsoon and 7-8 hours during winter. The topography is mostly hilly. Nagaland has three distinct climate zones. The agro-climatic condition of the State is excellent for growing all types of fruits, vegetables, flowers, spices and condiments, agromatic and medicinal plants, plantation crops, etc., ranging from temparate to tropical crops under rain fed conditions.

Table 4. Agro-climatic zones of Nagaland

Agro-Climatic Zones	Approximate elevation range (a.m.s.I)	Important Horticulture crops that can be grown	Important growing areas
Foothills & Lower Hills (Fertile alluvial lateratic soils)	500 – 2500 ft.	Sub- tropical crops like pineaaple, mango, ber, guava, citrus, banana, date, coconut, etc.	Dimapur, Jalukie, Tizit, Medziphema, Peren, Baghty, Bhandari, Meluri, Tuli, Tsurangkong, Wakching, etc.
Mid-hills (Loamy, lateratic soil)	2500 – 5000 ft	Stone fruits like plum pear, peach, almond, aonla, mango, banana, passion fruits, etc.	Kohima, Peren, Mon, Wolkha, Tseminyu, Changtolemba, Kiphere, Mangkolemba, etc.
High-hills	5000 – 9000 ft	Temparate fruits like apple, cherry, walnut, chestnut, pear, plum, persimmon, apricot, kiwi, etc.	Pfutsero, Chentang, Zunheboto, Helipong, Longkhim, Shanmatore, Chenmolo, Aboi, etc.

Soils

Soils of Nagaland have developed *in situ* on various types of rocks. The dominating parent materials are gneiss and granites, underlined with chlorite-quartz schist. The soils are acidic in nature and mostly alluvial and black loam rich in organic matter with pH ranges from 4.5 to 6.5. Growing of fruit tress, plantation crops, medicinal & aromatic plants, flower and vegetables of different varieties in the hill slope could be a viable alternative to jhuming and check soil erosion.

Land Holding and Land Use Pattern

The horticultural practices in state is still primitive and yet to see modernization and mechanization. 38% of the total area cultivated in the State falls under jhum and only 4% falls under permanent and irrigation fields. With the total area of about 16, 57,900 hectares of land, about 80% falls under hilly terrain and only 20% comes under gentle slope and plain area and only 2.59 % of the total area is under horticulture. Due to repeated jhuming of short duration cycle in the hills, the soil is subjected to heavy soil erosion as a result of which the fields are reduced and soil become very poor. Therefore, in order to bring this jhum land into Horticulture Development, it is proposed to bring more area under Area Expansion for Horticultural crops in order to convert the hilly areas into a settled permanent cultivation like fruits, vegetables, flowers, medicinal & aromatic plants.

Table 5. Land use pattern of Nagaland

Sl. No	Categories	Area in ha	Percent	Remarks
1	Forest Land Own by Government	1, 00,420.0	6.05	The land under Jhum may be higher than forest area since at one time or other the forest land (7,52,012.0 ha) has subjected to jhuming
2	Forest Land Own by Villages	7,52,012.0	45.36	
3	Area under Jhum Shifting Cultivation	6,10,350.0	36.81	
4	Permanent Field area (Irrigation)	58,000.0	3.5	
5	Area under Town, Villages, Roads, etc.	1,12,1180.0	6.77	
6	Area under Permanent Orchards	25,500.0	1.51	
	Total	**16,57,900.0**	**100.00**	

Table 6. Total Number and Area of Operational Holdings

Sl. No	Size	Number	Percent	Area (In ha)	Percent
1	Marginal holding (Below 1.0 ha.)	13298	9.40	8542	0.88
2	Small holding (1.0 to 2.0 ha.)	21403	15.12	29962	3.10
3	Semi-medium holding (2.0 to 4.0 ha.)	26203	18.52	76063	7.85
4	Medium holding (4.0 to 10 ha.)	47191	33.35	296908	30.77
5	Large Size (10.0 ha & above)	33411	23.60	555711	57.40
	Total	**141506**	**100.00**	**968186**	**100.00**

DECADAL GROWTH OF HORTICULTURE IN NAGALAND

The total area under horticultural crops (fruits & vegetables) in the state is around 42.9 thousand hectare, which is around 2.59 % of the total geographical area of the state and it gives a total production of 327.13 thousand tones with a productivity of 7.63 t/ ha. The area under fruits has been increased from 13.6 thousand hectares in 1996-97 to 19.27 thousand hectares during 2008-09 with a production of 168.9 and 191.32 thousand tones respectively. However, the area under vegetables has decreased during the same period. Under Horticulture Technology Mission cultivation of citrus, pineapple, passion fruit and banana through area expansion has been promoted by the Department of Horticulture, Govt. of Nagaland during 2004-10. Besides, mango, litchi, kiwi is focused during 2009-10. Under integrated development of horticultural crops, The Horticulture Department, Govt. of Nagaland has covered 137 ha of large cardamom, 57 ha of passion fruit, 144 ha of citrus, 57 ha of betel vine, 56 ha of pineapple, 28 ha of cashew, 28 ha of ginger, and 49 ha of kiwifruit. The floriculture is gaining popularity in the state. However, this sector is basically based in urban areas of the state. During 2009-10, anthurium, roses, lillium,

alstromeria, heliconia, gerbera, and zantedeschia were grown in Hi-tech green houses in 4 districts of the state.

Table 7. Growth of fruits and vegetables in Nagaland during 1997-2008

States	Area Prod Yield	Fruits (000' ha, 000 t and t/ha)			Vegetables (000' ha, 000 t and t/ha)		
		1996-97	1999-2000	2008-09	1996-97	1999-2000	2008-09
Nagaland	A	13.6	19.4	19.27	19.3	20.9	16.51
	P	168.9	232.3	191.32	188.4	235.7	132.63
	Y	12.42	11.97	9.92	9.76	11.13	8.03
NEH region	A	249.0	270.4	337.41	359.80	367.9	396.61
	P	2315.2	2337.7	3086.74	3270.50	4051.8	4202.18
	Y	9.30	8.65	9.15	9.09	11.01	10.60
India	A	3579.5	3796.8	6100.9	5515.2	5993.0	7980.7
	P	40458.4	45496.0	68465.5	75074.6	90830.7	129076.8
	Y	11.30	11.98	11.2	13.61	15.16	16.2

Research infrastructure

The ICAR is carrying out horticulture research in the state through its ICAR Research complex at Jharnapani. In addition Nagaland University through its constituent college School of Agriculture Sciences and Rural Development, Medziphema and Central Institute of Horticulture, Medziphema are also contributing horticulture research and development. Eight Krishi Vigyan Kendras (KVKs) in the state are also providing research back-up support towards popularization of improved technology and development of skilled manpower for various horticultural programmes.

Progress of Research

Concerted research efforts have been made to identify a large number of improved varieties and production technologies of fruits, vegetables and tuber crops including potato and plantation crops suitable for the state.

Fruit Crops

- Assam lemon is one of the most important fruit crops of the state. The time and method of propagation of Assam lemon was standardized. Maximum survival percentage (88-92%) in cuttings planted during June to August in polybags was under net shade house condition was recorded.
- Rooting and survival percentage of semihard wood cuttings of passion fruits were tested in different rooting medium comprising different combinations of soil,

riverbed sand, cattle manure, poultry manure, pig manure and vermicompost. The medium comprising of soil and vermicompost at 1:1 ratio gave the maximum survival percentage of 85-90% in the month of September under mist house condition.

- Different varieties of passion fruits were tested in Nagaland condition and Variety Kaveri recorded the maximum yield of 2.56 kg/ vine, which was almost double the yield recorded in local in local cultivars.
- Different banana cultivars were tested in Dimapur condition of Nagaland and the highest yield of 24.67 kg/bunch was recorded in Robusta, followed by 23.10 kg/bunch in Jahaji.
- Effect of different mulches like black polythene, transparent polythene, paddy straw, banana thrash, etc. on growth and yield of banana was studied. Maximum bunch weight of 29.46 kg and yield of 57.35 t/ha was recorded in black polythene mulch. However, improvement in soil fertility and nutrient status in terms of available phosphorus and potassium was noticed with organic mulches (paddy straw and banana thrash.
- Effect of bunch cover on maturity and fruit yield was studied in banana var. Jahaji with two types of polythene *viz.*, transparent and blue coloured. In both the treatments maturity period reduced by 21 days and fruit yield increased by 23.46 and 17.63 %, respectively as compared to control.
- A number of papaya varieties were tested in Jharnapani condition. Among all the varieties Pusa Delicious was found to be the best variety.

Vegetables and tuber crops

- Fertilizer doze for tomato was standardized. FYM @20 t/ ha + NPK @ 100: 60: 60 kg/ ha was the best treatment for obtaining higher yield (329.26 q/ ha).
- Effect of exogenous application of growth hormone and micro nutrients on tomato was studied. The maximum yield of tomato (340.10 q/ ha) was observed with 100 ppm NAA and 250 ppm boron treatment compared to control (256.46 q/ha) when two filiar spary was given at 30 and 60 days after transplanting.
- The response of organic and inorganic manures was assessed on the morphological trait and yield of cabbage head. Maximum yield (342.65 q/ha) of cabbage was obtained with the application of pig manure (10 t/ha), which was significantly higher compared to recommended dose of NPK (286.61 q/ha) and vermicompost (292.13 q/ha).
- Response of different organic manures (with or without inoculation) for optimum growth and yield of French bean var Contender was evaluated. Maximum pod yield (134.69 q/ ha) was obtained with FYM + *rhizobium* inoculation followed by pig manure + *rhizobium* inoculation (127.58 q/ ha).

- A number of sweet potato varieties were tested for Nagaland condition. Gouri was found to be the best variety of sweet potato with an yield of 30.8 t/ ha.

Spices

- Seventeen varieties of ginger were tested and Nadia was the best variety with an average yield of 275 q/ ha.
- Nine varieties of turmeric were tested and Megha Turmeric-1 was found to be best variety with an average yield of 320 q/ ha.

THE VISION FOR HORTICULTURE DEVELOPMENT IN NAGALAND

The total area under horticultural crops is around 42897 ha during 2008-09 which is about 17.27 % of the net sown area of Nagaland. The state is characterised by different terrain, wide variability in slope and altitude, land tenure system and cultivation practices. The transport and communication system is poorly developed. As a result the majority of the area in the state is still inaccessible. The horticulture production system in the state is mostly rainfed, monocropped and at subsistence level. Therefore, proper crop planning for each of the district is very essential.

Table 8. Districtwise crop planning for Nagaland

S.No	District	Altitude (m MSL)	Major crops
1	Dimapur	140-600	Mandarin, lemon, pineapple, banana, litchi, chillies, tomato, ginger, leafy vegetables, cabbage, cauliflower, bhindi, and cashew nut
2	Kohima	600-3048	Mandarin, lemon, papaya, pineapple, peach, plum, banana, ginger, turmeric, pepper, chillies, beans, chowchow, cucurbits, leafy vegetables, brinjal, tree tomato, lilium
3	Mokokchung	150 -1650	Mandarin, lemon, passion fruit, banana, pineapple, litchi, ginger, cucurbits, tomato, colocasia, papaya, kiwi, chillies, sweet potato, tapioca, pepper, cashewnut, tea, leafy vegetables, cardamom, citronella
4	Mon	180 - 1625	Mandarin, mosambi, banana, papaya, passion fruit, pineapple, guava, colocasia, tapioca, chowchow, leafy vegetables, beans, chilli, brinjal, tomato, pepper, ginger, turmeric, cardomom
5	Phek	520 - 2900	Mandarin, passion fruit, lemon, papaya, guava, banana, chillies, colocasia, cucurbits, tapioca, ginger, turmeric, tomato, leafy vegetables
6	Tuensang	800 - 3500	Mandarin, banana, pineapple, tomato, ginger, chilli, large cardamom, cabbage
7	Wokha	110-1970	Passio fruiut, mandarin, pineapple, banana, potato, chillies, lilium, arecanut, tea

8	Zunheboto	600-1852	Pineapple, mandarin, banana, passion fruit, papaya, mango, lemon, guava, chowchow, tapioca, colocasia, chillies, beans, tomato, ginger, turmeric, pepper, leafy vegetables
9	Kiphere	896	Mandarin, passion fruit, pineapple, papaya, plum, banana, mango, colocasia, chowchow, tomato, cabbage, chillies, tree tomato, leafy vegetables, ginger, turmeric, cardomom
10	Peren	800 - 2500	Mandarin, lemon, papaya, banana, passion fruit, guava, wild mango, colocasia, cabbage, chowchow, turmeric, ginger, chillies, brinjal, pepper
11	Longleng	1066	Passion fruit, papaya, lemon, pomello, mandarin, plum, guava, giner, turmeric, pepper, tomato, colocaisa, tomato, brinjal, cabbage, chowchow, leafy vegetables, chillies

Issues and strategies for horticulture development

Development of fruit sector

Presently with an average productivity of 8.33 t/ ha, the state produces a total of 151.30 thousand tones of fruits from an area of 18.16 thousand hectare. The first priority is to raise the per hectare productivity to the all India average of 11.2 t/ ha through adoption/ development of suitable agro-techniques so as to achieve 225.0 thousand tonnes by 2020. **The following strategies may be adopted to achieve the target.**

- Gradual replacement of old citrus orchard with elite planting materisls adopting appropriate technologies for better productivity with quality fruits.
- Gradual replacement of existing system of planting of pineapple and introduction of double raw system of planting with appropriate technologies.
- Area expansion programme on guava, peach, strawberry, litchi, kiwi, apple etc may be taken up in a phased manner.
- Establishment of disease free root stock and scion block of elite varieties of identified fruits for production of quality planting materials.
- Creation of infrastructure for in-situ water harvesting for live saving irrigation of identified fruit crops.
- Demonstration on farmer's field for each of the identified technologies suitable for different fruits may be conducted in each block of the districts.
- Capasity building of officers, field level functioneries and farmers.

Development of vegetable sector

A similar approach outlined under fruit sector shall be followed to achieve the above. To meet the need of growing population, the total vegetable requirement by 2020 would be about 200 thousand tones as per ICMR recommendation. **The following strategies may be adopted to achieve the target.**

- Replacement of low yielding varieties with high yielding/ hybrids of identified vegetables.
- Additional area to the tune of 2 thousand hectares shall have to be brought under vegetable cultivation in next ten years coupled with productivity enhancement upto the national average of 16.2 tones/ ha against the present productivity of 8.03 t/ ha.
- Seed production of Breeder's and certified seeds of identified vegetables may be taken up in a phased manner.
- Development of organic packages of practices for identified vegetables
- Collection, characterization, development of packages of practices and maintenance of colocasia and such other tuber crops of Nagaland

Development of spices sector

Among the various spices, the state is known for its quality chilli (Naga chilli) and ginger. The average productivity of ginger and chilli is higher than the national average. The soil and climate of some of the districts are also suitable for turmeric cultivation. **Considering the above strength the following strategies may be taken up**.

- Considering the higher demand in national and export market, the area under ginger and and Naga chilli may be increased to 5000 hectares each in next ten years.
- 2000-3000 hectares area may be brought under turmeric cultivation with a variety like Megha Turmeric-1, which contains 6.8-7 % curcumin
- Creation of processing and packaging facilities on private-public partnership mode for preparation of value added products.
- Identification of suitable varieties having different procesing qualities
- Development of organic packages of practices for these crops to meet up the export demand.
- Capacity building
- Considering the importance of the spices in Nagaland, a mission oriented programme specifically for spices may be launched.

Development of floriculture, medicinal and aromatic plant sector

Due to varied agro-climatic situations within the state, the state may be a potential area for growing of a number of flower crops as well as medicinal and aromatic plants.

The sector has already received a boost under Technology Mission programme. During 2009-10, anthurium, roses, lillium, alstromeria, heliconia, and zantedeschia were grown in Hi-tech green houses in 4 districts of the state. Two cold storage units have been established in Kohima and Mokokchung for the promotion of floriculture. Aloe vera, Scanted geranium, Alpinia spp., Pinex spp, Garcinia spp. Are some of the important medicinal and aromatic plants of Nagaland. The growers of the state are now approaching ICAR to provide them the technological back up to address the issue of quality growing techniques, better varieties, pest and disease control, measure to increase shelf life, packaging etc. Considering the positive environment in respect of Floriculture and Medicinal & Aromatic plants in the state the following strategies may be taken up.

- Strengthing the research on Floriculture and MAP in ICAR Complex at Jharnapani
- Establishment of high tech nurseries for supply of quality planting materials of different flowers, other floricultural items and medicinal and aromatic plants.
- Systematic investment in protected cultivation for identified floriculture items in larger areas.
- Establishment of demand driven pack house facilities for sorting, grading, pre-cooling, packaging, storage etc in the production catchment.
- Capacity building

Development post harvest management sector

The post harvest losses of almost all the farm produce in the state is very high due to near zero facility for their handling, processing, value addition, packaging and even organized marketing. Due to inaccessibility and transportation bottleneck restricticting timely linkage between production site and market, the post harvest losses particularly fruits and vegetable crops becomes very high ranging between 30-50 %. Banana recorded the highest monetary loss of Rs. 2.58 crores, followed by pineapple (2.40 crores/ year) and ginger (1.28 lakhs/ year) per year due to losses during handling and marketing. This has reflected the drainage of hard earn revenues due to non-adoption of appropriate post harvest management and lack of storage facilities in the state.

Use of appropriate pre and post harvest practices for horticultural crops is vital for the success of the crops and to provide good return to the growers. Unfortunately this is the weakest spot in the entire region. Value addition should be given top priority for the crops like pineapple, oranges, ginger, chilli and turmeric etc. To improve the situation, the following strategies may be taken up in a phased manner.

- Good Agricultural Practices should be adopted starting from nursery raising till harvesting. A massive plan and programme may be iniated in this direction in a phased manner. This will help in improving the quality of the farm produces as well as in reducing the post harvest losses.
- Establishment of pack house facilities with washing, sorting, grading, pre-cooling, waxing, drying, packaging, storage etc in production catchment in

the identified locations for few selected crops having good national and international market.

- Procurement of mobile fruit and vegetable processing van and refrigerated van for primary processing of identified fruits and vegetables in the farmer's field.
- Setting up of small and medium scale processing units in identified location for preparation of semi-processed and fully processed products inprivate-public partnership mode.
- Capacity building

Future thrust for Research and Development

1. Collection, characterization and conservation of germplasm

There is need for extensive survey of the state and collection of all the germplasm available in the state. These germplasm should be characterized on morphological and molecular basis and conserved at one place. These germplasm should be utilized in strategic breeding programme involving high yielding national / exotic varieties.

2. Identification of area specific major horticultural crops

There is need to identify the few important horticultural crops for different districts of the state. The infrastructure facilities for commercial cultivation, marketing, export and processing / value addition for identified crop should be developed in that part of the state, for example, pineapple for Dimapur district. There is also need to identify the high yielding varieties and hybrids of selected crops for different agro-climatic zones of the state.

3. Post harvest management and processing:

The state is lacking in trained personnel with sound knowledge of post harvest management of produce. There is also need for integrated research for post harvest handling, packaging, transportation, storage and quality control of perishable commodities. There is need to establish processing units to formulate value added products of excess produce.

The basic infrastructure facilities like pre-cooling units, packing and grading shed, short and long term cold storage facilities, refrigerated containers, storage and phytosanitary facilities at *mandi* are lacking in the state. Therefore, there is urgent need to create basic infrastructure facilities to boost the horticulture in the state.

4. Establishment of Agricultural Technology Information Centre (ATIC)

There is a need to establish ATIC in different districts of the state. KVKs in each district may be strengthened in this direction for appropriate dissemination of technologies to the farmers. Once this setup is in operation, the information through

Internet connectivity may be provided in respect of demand, supply, price market outlook, knowledge of consumers' preference, marketing channels and practices.

5. On-farm trials / frontline demonstration (FLD):

The farmers of the state are not aware about the recent technologies of horticulture. Therefore, there is need to conduct demonstration / FLD as much as possible at farmers' field in the identified crops to convince the farmers about the efficacy of measures in enhancing the productivity of identified crops. Apart from this the extension personnel should try to bring the maximum number of farmers to demonstration plots, organize farmer's day, fair and yield competition, distribute leaflets / bulletins to the farmers.

6. Training to farmers/extension functionaries:

Non-availability of trained manpower is one of the major problems of the state as horticulture requires highly skilled personnel for grafting, pruning, orchard management and also for vegetables and ornamental plants. Therefore, the farmer as well as extension functionaries should be given training from time to time in respect of recent advances in horticulture. The entrepreneurship should also be generated by providing training to entrepreneur for overall development of horticulture in the state.

7. Hi-tech horticulture:

High-tech horticulture is the deployment of any technology, which is modern, less environment dependent, capital intensive and has the capacity to improve the productivity and quality of horticultural crops. Adoption of this technology in horticultural crops is necessary to ensure the nutritional security of future generation. Hi-tech horticulture includes micro propagation, micro irrigation, fertigation, high density planting, protected cultivation (greenhouse / polyhouse cultivation), organic farming, mechanization and use of remote sensing.

8. Research on under utilized crop:

There is need for research on under utilized/lesser known horticultural crops for their commercialisation, because these crops are grown at very large scale, in some or other parts of the region. For example Naga chilli, which is grown in Nagaland at large scale, is becoming popular in other states also. Likewise, there are number of other crops which need immediate attention from the researchers.

9. Crop diversification:

Crop diversification is prime area of cropping system. While giving emphasis on one or two crops, the other crops should also be taken into account to make horticulture sustainable. For example, after ginger and turmeric, which are heavy nutrient feeder, leguminous vegetables like cowpea, pea etc may be grown to maintain the fertility of the soil. Similarly, agri-horti-silvi-pastoral system or multistorey system and agroforestry will be more successful in hilly areas.

The other points which may be taken in to consideration for developing the horticulture industry in the state are -

- Introduction of export quality horticultural crops suitable for the state. For example Kiwi, strawberry, guava etc.
- Technology for the low cost vegetable seed production.
- Production of quality seeds (conventional/hybrid) and planting materials.
- Working out the dynamics of production constraints.
- Furtherance of research on development of models of multiple cropping including high-density cropping in fruit crops.
- Intensification of research on weeds and water management including drip system.
- Improvement of shelf life and product diversification
- Development of floriculture and establishment of at least one flower village near urban center supported with modern sales center near city and linkage with APEDA for export.
- Establishment of biotech unit (tissue culture lab) for production of disease free planting material of important crops like citrus, banana and ornamentals etc.