# POST HARVEST MANAGEMENT AND VALUE ADDITION OF HORTICULTURAL CROPS IN NORTH EASTERN INDIA: ISSUES AND STRATEGIES

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The North Eastern Hill region offers scope for cultivation of a wide variety of horticultural crops such as fruits, vegetables, flowers, tuber crops, spices and plantation crops because of its diversities in topography, altitude and climatic conditions. The fruits grown in this region range from tropical and sub-tropical fruits like banana, papaya, pineapple, jack fruit and citrus to temperate fruits like apple, pear, peach, plum, strawberry and even certain nut fruits. The region has rich diversity of different vegetable crops and both indigenous tropical vegetables and temperate vegetables are grown to a considerable extent. Among the flowering plants special mention may be made about the orchids, where about 600 species are reported to occur in the region alone. The other commercial flowers of the region are marigold, tuberose, gladiolus, gerbera and chrysanthemum. Recently rose, gerbera, anthurium and liliums etc. are introduced in the region. Tuber and rhizomatous crops like tapioca (cassava), sweet potato, *Dioscorea*, colocasia, ginger and turmeric grow abundantly in the region, while plantation crops like tea, coconut, arecanut, cashewnut have considerable impact on the economy of the tropical and sub-tropical parts. The region is the big reservoir of medicinal and aromatic plants. Besides, many other indigenous fruits and vegetables like prunus berry, tree bean, tree tomato, edible bamboo etc. are found in the hilly terrains that can be explored for processing and value addition.

**Potential Horticultural Crops of North Eastern Region**

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| Assam | **Fruit**: Banana, Jackfruit, Pineapple, Papaya, Assam Lemon, Orange, Litchi, Guava, Mango, Sapota etc.<br>**Vegetables:** Potato, Tomato, Brinjal, Chilli, Capsicum, All Cucurbits, Cole Crops, Radish, Carrot, Peas and Beans, Drumstick, Okra, Lettuce, Tuber Crops, and other leafy greens etc.<br>**Spices**: Ginger, Turmeric, Chilli, King Chilli, Coriander, Onion, Garlic, Vanilla, Black Pepper, Seed Spices<br>**Plantation crops:** Coconut, Arecanut, Cashewnut, Betelvine, Tea, Rubber, Coffee etc.<br>**Flowers**: Marigold, Tuberose, Gladioli, Gerbera, Bougainvillea, Mussaenda, Tuberose, Chrysanthemum, Dahlia, Orchids etc. |

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| Arunachal Pradesh | **Fruit**: Apple, Orange, Banana, Pineapple, Papaya, Lemon, Litchi, Cherry, Peach, Pear, Plum, Almond, Walnut, Chestnut, Kiwifruit etc.<br>**Vegetables:** Tomato, Brinjal, Chilli, Cucurbits, Cole Crops, Peas, Beans, Sweet Potato, Yams and Other Leafy Greens etc.<br>**Spices**: Cardamom, Black Pepper, Ginger, Chilli, Vanilla, Saffron etc.<br>**Plantation crops:** Large Cardamom, Black Pepper, Tea, Coffee etc.<br>**Flowers**: Chrysanthemum, Gladiolus, Lilium, Anthurium, Foliage, and Succulent Plants, Orchids etc. |
| Manipur | **Fruit**: Pineapple, Khasi Mandarin, Passion Fruit, Kachia Lemon, Banana, Papaya, Kiwifruit, Strawberry, Prunus Berry, Peach, Plum etc.<br>**Vegetables:** Tomato, Brinjal, Chilli, Capsicum, All Cucurbits, Cole Crops, Radish, Carrot, Peas and Beans, Okra, Leafy Greens, Moroi Nakopi, Tree Bean, Tree Tomato, Tender Bamboo Shoots, Tuber Crops etc.<br>**Spices**: Ginger, Turmeric, Chilli, King Chilli, Coriander, Onion, Garlic etc.<br>**Plantation crops:** Tea, Rubber, Cashewnut etc.<br>**Flowers**: Roses, Marigold, Gladioli, Gerbera, Bougainvillea, Anthurium, Lilium, Orchids etc. |
| Meghalaya | **Fruit**: Banana, Pineapple, Orange, Passion Fruit, Lemon, Guava, Mango, Jackfruit, Strawberry, Prunus Berry, Peach, Pear, Plum etc.<br>**Vegetables: Potato,** Tomato, Brinjal, Chilli, Capsicum, All Cucurbits, Cole Crops, Radish, Carrot, Peas and Beans, Okra, Leafy Greens, Tuber Crops etc.<br>**Spices**: Ginger, Turmeric, Chilli, Black Pepper etc.<br>**Plantation crops:** Arecanut, Betelvine, Rubber etc.<br>**Flowers**: Carnation, Lilies etc. |
| Mizoram | **Fruit**: Banana, Orange, Pineapple, Grape, Papaya, Passion Fruit, Strawberry etc.<br>**Vegetables:** Tomato, Brinjal, Chilli, Cucurbits, Cole Crops, Peas and Beans, Okra, Leafy greens, Tree Bean, Tuber Crops etc.<br>**Spices**: Ginger, Turmeric, Chilli, Black Pepper etc.<br>**Plantation crops:** Oilpalm<br>**Flowers**: Anthurium, Roses, Chrysanthemum, Bird of Paradise, Orchids etc. |
| Nagaland | **Fruit**: Pineapple, Khasi Mandarin, Passion Fruit, Banana, Peach etc.<br>**Vegetables:** Tomato, Brinjal, Chilli, Capsicum, All Cucurbits, Cole Crops, Radish, Carrot, Peas and Beans, Okra, Leafy greens, Tender Bamboo Shoots, Tuber Crops etc.<br>**Spices**: Cardamom, Ginger, turmeric, chilli, King Chilli, Black Pepper etc.<br>**Plantation crops:** Cashewnut etc.<br>**Flowers**: Roses, Marigold, Gladioli, Gerbera, Bougainvillea, Chrysanthemum, Dahlia, Orchids etc. |

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|---|---|
| Tripura | **Fruit**: Litchi, Banana, Papaya, Mango, Pineapple, Orange, Lime, Bael, Jackfruit etc.<br>**Vegetables:** Tomato, Brinjal, Chilli, Capsicum, All Cucurbits, Cole Crops, Radish, Carrot, Peas and Beans, Okra, Leafy greens, Tree Bean, Tuber Crops etc.<br>**Spices**: Ginger, Turmeric, Chilli, Coriander, Onion, Garlic etc.<br>**Plantation crops:** Coconut, Arecanut, Cashewnut, Tea, Rubber etc.<br>**Flowers**: Roses, Marigold, Gladioli, Bougainvillea, Chrysanthemum, Dahlia, Orchids Tuberose etc. |
| Sikkim | **Fruit**: Orange, Passion Fruit, Banana, Guava, Papaya, Jackfruit, Litchi, Kiwifruit, Strawberry etc.<br>**Vegetables:** Potato, Tomato, Brinjal, Chilli, Capsicum, All Cucurbits, Cole Crops, Radish, Carrot, Peas and Beans, Okra, leafy greens, Sweet Potato, Tree Tomato etc.<br>**Spices**: Cardamom, Ginger, Turmeric, Chilli, Coriander, Onion etc.<br>**Plantation crops:** Tea, Rubber etc.**Flowers**: Orchids, Rhododendron, Rose, Ferns, Gladiolus, Anthurium, Lilium etc. |

**Strength of North Eastern States for Growth of Processing Sector**

- Due to its diverse agro-climatic conditions, it has a wide-ranging and large raw material base suitable for processing industries. Presently a very small percentage of these are processed into value added products.
- Availability of wide range of underutilized fruits, vegetables and spices which can be used for making value added products.
- Prevalence of organic production system yielding horticultural produce with zero residual toxicity.
- Comparatively cheaper workforce can be effectively utilized to setup large low cost production units for domestic and export markets.
- Liberalized overall policy regime, with specific incentives for high priority food processing sector, provides a very conducive environment for investments and exports in the sector.
- Good investment opportunities exist in many areas of processing industries through Mission mode projects.
- High Environmental Sustainability Index.

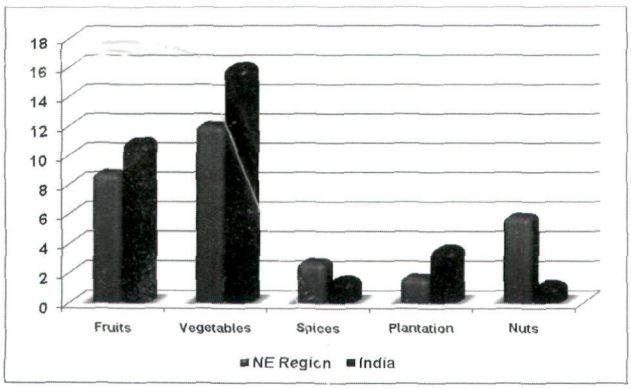
**Present Status of Horticulture in NEH Region (2007-08)**

| State | Fruits | | Vegetables | | Spices | |
|---|---|---|---|---|---|---|
| | A | P | A | P | A | P |
| Assam | 122.70 | 1410.80 | 328.90 | 4474.20 | 27.20 | 18.50 |
| Arunachal Pradesh | 57.50 | 107.90 | 23.73 | 110.00 | 8.20 | 47.50 |
| Manipur | 39.10 | 273.70 | 12.09 | 113.70 | 8.70 | 7.70 |
| Meghalaya | 28.60 | 235.20 | 42.45 | 352.50 | 18.40 | 80.90 |
| Mizoram | 22.30 | 219.60 | 1.20 | 37.30 | 9.00 | 38.30 |
| Nagaland | 11.80 | 53.00 | 10.38 | 63.50 | 4.50 | 26.20 |
| Sikkim | 9.30 | 13.90 | 20.06 | 95.90 | 34.0 | 42.40 |
| Tripura | 34.10 | 525.60 | 33.55 | 423.50 | 4.50 | 9.40 |
| NE Total | 325.4 | 2839.7 | 472.36 | 5670.6 | 114.5 | 270.9 |
| India Total | 5775 | 663503 | 7803 | 125887 | 2603 | 4103 |
| NE share (%) | 5.63 | 0.43 | 6.05 | 4.50 | 4.40 | 6.60 |

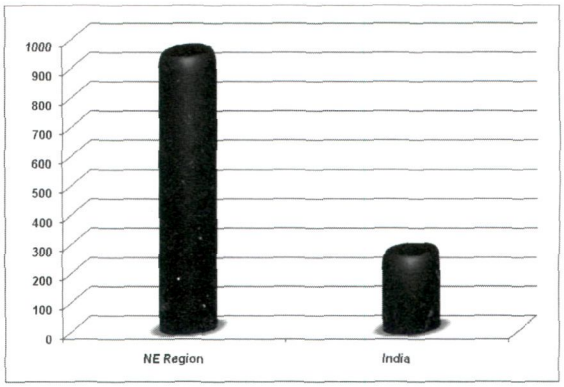
| State | Plantation Crops | | Nuts | | Cut Flowers | |
|---|---|---|---|---|---|---|
| | A | P | A | P | A | P (lakh no.) |
| Assam | 105.00 | 181.30 | NA | NA | NA | NA |
| Arunachal Pradesh | NA | NA | 8.20 | 47.50 | NA | NA |
| Manipur | NA | NA | NA | NA | NA | NA |
| Meghalaya | 12.10 | 16.50 | NA | NA | NA | NA |
| Mizoram | 2.00 | 5.30 | NA | NA | 0.05 | 36.59 |
| Nagaland | 1.10 | 1.40 | NA | NA | 0.02 | 16.50 |
| Sikkim | NA | NA | NA | NA | 0.01 | 22.82 |
| Tripura | 6.70 | 11.70 | NA | NA | NA | NA |
| NE Total | 126.9 | 216.2 | 8.2 | 47.5 | 0.08 | 75.91 |
| India Total | 3226 | 12045 | 132 | 177 | 161 | 43417 |
| NE share (%) | 3.93 | 1.79 | 6.21 | 26.84 | 0.05 | 0.17 |

Source : NHB Database 2008 A = Area ('000 ha); P = Production ('000 MT); NA = Not available

With the intervention of improved production technology and faster dissemination of technical know-how, there has been a manifold increase in the magnitude of production of fruits and vegetables in last couple of years. The productivity scenario is also quite hopeful as compared to national level. In spices, nuts and floriculture, the productivity of NE region is higher than the national average. But, it has been observed




*Horticultural Productivity of NE Region and India*




*Productivity of Cut Flowers in NE Region and India*

that the production venture of many horticultural crops in the region is taken up without having an organized marketing plan. Many a times, the production ventures are designed targeting the local markets only. Post harvest losses of almost all the farm produce in the region is very high due to near zero facility for their handling, processing, value addition, packaging and even organized marketing. It is an irony though the region produces best quality of turmeric, ginger, king chilli, pineapple, orange, and passion fruit; there are no organized processing and marketing units for any of these crops.

In order to cater the future demand of the protective value added foods in the region, the government and other development agencies are also putting untiring efforts as a result of which the quantum of production and productivity in horticultural crops is envisaged to reach higher scale. But in the arena of the value addition and processing, the North Eastern States are still in infant stage. Over the last few years, there has been a positive growth in ready to serve beverages, fruit juices and pulps, dehydrated and frozen fruits and vegetable products, tomato products, pickles, convenience veg-spice pastes, processed mushrooms, and curried vegetables. Besides processing of major fruits for various value added products, North Eastern processing industries are also looking for value added products from minor or underutilized fruits. But due to outdated technology and non-existence marketing chain for procurement of raw materials, the processing sector is facing lot of problems. It

is noteworthy that mere emphasizing quantitative increase will not carry meaning unless appropriate post harvest management practices are devised and practiced. Despite the favourable factors and the scope for cultivation of horticultural crops, the development of processing sector has not picked up momentum as expected.

**Why Such Situation?**

Inaccessibility and transportation bottlenecks restricts timely linkage between production site and market, lack of quality testing and certification laboratories, long chain of intermediaries contributing to high costs and inefficiencies, high costs of carrying inventories, working capital, and taxation, and overshadowing of consumption patterns by cultural practices; post harvest losses particularly for fruit and vegetable crops become very high ranging between 30-60%. The major reasons for poor growth of processing sectors in NEH Region are –

- Poor socio-economic condition of majority of farming community limits them to take up commercial horticultural farming.
- Small size of land holdings is unable to support the industry with suitable raw material.
- Severe water scarcity during winter months
- Limited credit facility due to absence of land tenure system in hill region.
- Preferential demand for fresh fruits and vegetables than the processed products by a majority of population.
- Lack of awareness about maturity indices, primary and minimal processing.
- Low market surplus due to sustenance farming rather than market-driven farming.
- Absence of retail chain and regulated market.
- Lack of packing stations.
- Poor transport system.
- Tendency of the industry to procure from local markets where there is no control over the grades and quality, which reduces the processing efficiency.
- Near-zero availability of storage infrastructures like cold storages, refrigerated vans, cargoes etc.

**Scope for Processing and Value Addition of Horticultural Crops in NEH Region**

Value addition of horticultural crops can play a unique role in economic upliftment of NE region by improving the income of the rural people. Cultivation as well as processing of these crops is labour intensive and as such they generate lot of employment opportunities for the rural population. The processing sector has the potentiality to be the largest growth sector in this region in terms of production, consumption, export and growth prospects. The government has accorded it a high priority, with a number of fiscal reliefs and incentives, to encourage commercialization and value addition to agricultural produce, for minimizing pre/post harvest wastage, generating employment and export growth.

### Fruits Sector

The NE region is the natural home for many fruit crops – commercial or underutilized. There is a vast scope for area expansion under horticulture based farming system by judicial management of natural resources. Pineapple produced in this region is considered as one of the best in its quality. The quality and storability of Khasi mandarin is much better than other mandarins. The productivity of passion fruit is also higher than the national productivity. Recently, the cultivation of strawberry and kiwifruit is gaining popularity among the farmers. In addition, so many underutilized fruits like *Prunus nepalensis*, *Citrus macroptera* are grown in this region which has the tremendous potentiality for processing and value addition. Banana is grown abundantly in the region. Only, there is a need to introduce suitable varieties for processing purpose. Other fruits like Assam lemon, grape, guava, papaya, litchi, mango and temperate fruits like peach, plum, pear, cherries, walnut etc. are grown in different NE states. This abundant availability of such a number of fruits offers a large scale of choices for the entrepreneurs. Moreover, most of the fruit crops here are cultivated by organic means without any chemical input which is pre-requisite for export market. Not only the food products but some other non-food product like fibre from banana or pectin from jackfruit or citrus can produced by establishing community based processing units by unemployed rural youths. Tree tomato is another crop which is rich in tannin. All these facts reflect a bright ray of hope for growth of processing industries in North East.

### Vegetables Sector

In addition to commercial vegetable crops, some underutilized vegetables (like tree bean) are abundantly available. One of the unique features of this region is its varying soil and climatic character that can be easily explored for off-season vegetable cultivation. The locally processed fermented bamboo shoot is very popular in South Asian countries like Thailand. This market can be grabbed easily by establishing market chain and promotional campaign for canned bamboo shoots. The availability of wide range of vegetables round the year as well as high scale spoilage indicates the scope for vegetable processing in the form dried, dehydrated and frozen products or soup powder. The NE region is rich in different types of tuber crops, that can be used for extracting starch and dextrose which are in high demand in the global market. The Kolkata unit of 'Lays' (PEPSICO) has started contract farming in Meghalaya to procure potato during off season for chips making. Similar kind of venture can be started in this region for making of chips and french fries. Even in rural sector, low cost processing sector can be popularized for making products like pickle, murabba and candy etc. involving the farm women for better income generation.

### Spices Sector

Spices sector is the most potential area for value addition in North East. High quality ginger, turmeric and chillies are grown in this region. The North Eastern Region is famous for King Chilli, the hottest chilli in the world. Recently, Nagaland has got the GI right for king chilli. The Meghalaya region is also known for Lakadong turmeric with high

curcumin content. In Manipur, wide range of turmeric germplasm of different colours is available which is rich in many medicinal properties. The soil and climatic condition of hilly areas is ideal for cultivation of fibreless ginger. The some varieties of ginger in Nagaland are rich in oleoresin and low in fibre content. Sikkim area is famous for cardamom cultivation. Most of the spices are grown organically by the farmers. These crops can be a boon to the North East economy if the fresh or value added products is marketed properly with a regional branding. High value products like curcumin, capsaicin, gingerol, oleoresin, spice oil can be prepared in commercial scale. On the other hand, low scale spice based processing units can be established for making ginger candy, ginger cubes, turmeric capsule, curry powder and spice mix.

**Plantation Sector**

The plantation sector in NE region has not yet been exploited properly except arecanut, tea and rubber. But other crops like coconut and oilpalm can be grown successfully in the tropical belt. In many NE states, plantation of cashewnut has been started but without any processing unit, which is a big question mark for its success. Cashew is such a crop that can be processed on commercial scale as well in farm level. In Goa, local entrepreneurs are earning good revenue by selling 'Fenny' (a drink prepared from cashew apple) to the tourists. Apart from its potentiality for value addition, cashew is considered best crop for checking soil erosion, the major problem in hilly terrains. The only drawback in the plantation sector is the unavailability of suitable varieties that need to be introduced to the growers. The NE region is also ideal for rubber plantation. Rubber Board is trying to extend the area mostly in Meghalaya and Tripura. But, there is no rubber based processing industry in this region. So, this scope can be utilized by the industry to start some venture on plantation based processing industry.

**Floriculture Sector**

Profits in selling flowers are often more than 100 per cent and may in fact go up to 200 to 300 per cent. The export market offers a good potential for florists. The United States can be the primary destination for flowers followed by Germany, Netherlands and the UK, particularly during winter. In case of domestic market, the region has the scope to fulfil the demand of cut and loose flower from Kolkata market. Dry flowers have a vast potential for exports. Among the North Eastern States, Mizoram and Sikkim has made a good progress in Anthurium and Orchids. Initiatives have already been taken in Nagaland and Arunachal Pradesh. Manipur and Meghalaya also have good potential in floriculture sector. Shirui Lily, the state flower of Manipur, was awarded the prestigious merit prize in Royal Horticultural Society Flower Show held in London during 1948.

Almost all North Eastern states are rich in orchid germplasm. At present so many technologies have been developed for value addition of orchids. It is a crop of diversified utility. It can not only be marketed as cut flowers, but can also be used for preparation of food, cosmetics, perfume etc.

**Potential flower crops of NEH Region**

| | |
|---|---|
| Arunachal Pradesh | Chrysanthemum, Carnation, Gladiolus, Lilium, Anthurium, Foliage, and Succulent Plants, Begonia, Orchids |
| Manipur | Roses, Gladiolus, Anthurium, Orchids |
| Meghalaya | Rose, Carnation, Lilies |
| Mizoram | Anthurium, Roses, Chrysanthemum, Bird of Paradise |
| Nagaland | Amaryllis, Anthurium, Gerbera, Lilium, Chrysanthemum, Dahlia, Gardenia, Begonia, Gladiolus, Marigold, Foliage Plants |
| Tripura | Orchids, Anthurium, Tuberose, Marigold, Gladiolus |
| Sikkim | Orchids, Rhododendron, Ferns, Gladiolus, Anthurium, Lilies, Alstroemeria, Carnation |

**Potential sector of value addition of flower crops in NEH Region**

| Product | Plant Type |
|---|---|
| Fresh cut flowers | Orchids, Gladiolus, Carnation, Chrysanthemum, Tuberose, Gerbera, Anthurium, Bird of Paradise, Heloiconia, Camellia |
| Potted plants | Foliage plants, shade loving plants, plam, cycads, cactus, succulents, ornamental bamboo |
| Dry flowers | Most of the flowers |
| Underground parts | Bulbs, corms, rhizomes, tubers of rainy and winter season flowering ornamentals |
| Essential oil | Rose, Jasmine, Gardenia, Orchids, Hachipat, Katki |
| | The supply of planting materials of improved varieties of flowers to the growers needs to be ensured. Introduction of high tech-production system of year-round cultivation of flower crops, provision of subsidy for establishment of protected structure, technology backup on scientific package of practices and value addition and organized marketing strategy could be solution to develop the region as floral belt of India. |

**Medicinal and Aromatic Plants**

The North Eastern Hill Region is one of the largest reservoirs of different indigenous medicinal and aromatic plants. So many ITKs are also available in rural sector on the use of these crops for different purposes. The adaptogen like Gin seng are available in hilly regions. The region is also suitable for aromatic plants like scented geranium, citronella, lemon grass etc. But due to lack of processing industries for extraction of active ingredients like alkaloids, flavanoids, glycosides, carbohydrates, phytochemicals

and essential oils; such an enormous scope for pharmaceutical and cosmetic industry has not yet been explored. Recently, some initiatives have been taken under National Mission on Medicinal Plants for large scale multiplication of medicinal and aromatic plants. But, without processing industries, this venture will not be successful in future. There is an urgent need to explore the hidden opportunity by introducing contract farming, establishment of processing unit, development of market chain and storage facility for medicinal and aromatic plant sector.

**Integrated Farming System Approach for Community Level Value Addition**

Creation of non-farm job opportunities in production catchments through post harvest activities is being considered as one of the most powerful mechanisms of transferring the benefits of economic growth to rural sector. Horticultural produces from production catchments (rural areas) is taken to wholesale market located in urban areas for further distribution to consumers and some of the produces are processed in urban areas, as the required skill and infrastructure are available. Had 60-70 % of the produce been processed in production catchments, the consumers in rural areas would have the access to processed products at lower prices, post harvest losses would have been reduced and the by-products would have been utilized effectively. Considering the above realities in mind, the integrated farming system will be the best approach to ensure sustainable development of hill agriculture.

It is based on the concept that "there is no waste", and 'waste is only a misplaced resource which can become a valuable material for another product'. All the components of agriculture like crop-livestock-fishery-forestry-horticulture are integrated in a complimentary way. Horticulture based farming systems need to be promoted to ensure that the different raw materials for the processing industries are available round the year and such farming system will also check soil erosion which is a common feature in the region. Since, the majority of the farmers are marginal farmers and therefore, setting up of community based processing units will be a viable option for utilizing the fruits and vegetables for making value added products. It will ensure livelihood, nutritional and food security in the region.

Under Horticulture based Integrated farming system, not only fruits, vegetables, spices and plantation crops; but floriculture and medicinal and aromatic plants can also be taken as profitable venture. Identified bamboo species (for processing of tender bamboo shoot) or tree bean can be an ideal agro-forestry component in areas like Nagaland and Manipur. Side by side, off season cultivation of vegetables and spices should be promoted for year round availability to the processing units.

**Future Strategies**

The challenge of promoting processing and value addition of horticultural produce would, therefore, require increasing investments in R & D to increase productivity and quality to best averages in exporting countries, and extension services to communicate technology to the farmers. It also requires directing efforts towards cultivation of fruits and vegetables on a large scale, quality preservation and food safety, promotion of food processing and

infrastructure development. The task would require us to follow a disciplined approach to examine the problem of the processing sector and plan coordinated efforts to solve them in a time frame. The process would start right at the farm gate, followed by monitoring every stage of processing up to the final stage of marketing.

- Transfer backstopping through transfer of scientific production package, promotion of organic farming, community level value addition and low cost storage.
- Database generation on equipment, processes manufactures, codes and standards and project files and impact assessment studies.
- Value addition in human capital through knowledge enhancement of farm producers, scientists and entrepreneurs and extension field officials.
- Development of processing and marketing development authority for NEH region.
- Managing demand supply imbalances in a better manner and potential elimination of inefficiency along the supply chain by reducing the number of intermediaries.
- Development of Mobile Processing Unit and Food Park for major fruits and vegetables.
- Developments of infrastructural facility like transport, storage and pack house etc.
- Linking of modern Cold stores to the farms and the market through logistics network based on the use of refrigerated trucks and containers supported by an IT Network with latest software applications for managing an efficient supply chain.
- Development customized end-to-end Cold Supply Chain services capable of handling the produce from the farm gate to the end customer to eliminate wastage by intergrating all activities from pre and post harvest management to storage and logistics for the fresh produce.
- Govt. Subsidy for establishment of community based processing unit, low cost storage structure etc. through financial institution or mission mode projects.
- Attractive offers to processing industries for establishment of processing plants in NEH region
- Development of local mandi and regulated market.
- Propagation of Public-Private-People Partnership in relation to horticulture based processing ventures
- Development of ICT Centre or Information kiosk at remote area
- Providing consultancy services for establishing food processing industries.
- Strategic advertising by using print, electronic and web media for marketing and export promotion of processed products.

**Capacity Building**

Separate programme should be launched in order to develop trained manpower for promotion of value addition and marketing of horticultural produce. To achieve this objectives training and demonstration should be conducted on –

- Pre and post harvest management, low cost preservation and community based processing of horticultural produce
- Packaging and low cost preservation technique
- Entrepreneurship development and marketing of horticulture produce

**Research Priorities**

Post harvest technology of horticultural crops is one of the most important areas of research and very little work has been done in this area in our country in general and Northeast India in particular. The following are some of the issues, which need immediate attention from researchers.

- Development and evaluation of cultivars with higher shelf life
- Environmental friendly pest and disease control
- GAP and SPS measures for better quality of fruits
- Fundamental research on senescence, ripening, respiration, ethylene effect, chilling, fermentation, superficial browning
- Ethylene management during ripening and storage of horticultural crops
- Standardization of maturity indices for determination of suitable harvesting date
- Method of harvesting, grading and sorting techniques
- Objective non destructive measuring of quality and maturity
- Impact of pre-harvest and postharvest factors on shelf life and postharvest quality
- Low cost technology for community based value addition
- Standardization of spray drying technology for underutilized fruit crops
- Postharvest Physiology of horticultural produce
- Regulation of fruit color and aroma
- Consumer and traders quality preferences in each country
- Cost and return of the investment of post harvest technologies
- Development of recipes for novel value added products
- Humid forced air pre-cooling
- Post harvest treatments (heat, UV and gamma irradiation, $CO_2$, chemicals) for storage ability.
- Possibilities of modified atmosphere packaging (MAP), absorption layers, inserts sensors, PP films with micropores
- Environmental friendly packaging using nanotechnology
- Minimum impact and vibration norms, for bruising during sorting and packaging.
- Adaptive control of storage conditions with biological sensors
- Storage, during transport and as quarantine measures
- Monitoring refrigerating systems
- Optimum storage conditions for storage of tropical fruits, ornamentals, planting material, fresh pack and lightly processed produce
- Controlled atmosphere (CA) storage of fruits
- Prevention of possible pathogenic organisms in plant products during storage

- ❖ Effective waste utilization technology for both on-farm and industrial sector

**Epilogue**

Despite the various schemes and programmes of the government for promotion of processing of horticultural crops, a lot needs to be done. The scientific production technology and post harvest management of different crops has to be taken to farmers to maintain the quality and grade. For this purpose, the extension machinery has to be geared up. Awareness among the growers and rural youths needs to be grown regarding preservation and processing of horticultural crops for earning more profit. Moreover, wide publicity through print and electronic media needs to be given to the government schemes for promotion of processing and marketing of horticultural crops. Separate promotional campaign needs to be launched to attract the processing industries and external buyers.

It is very necessary to develop the "North East Consortium for Promotion of Processing and Export of Horticultural Crops" (NECPEHC) for proper coordination with ICAR, other research institutes, NEC, APEDA, NHB, FPIs, Spices Board, Tea Board, Rubber Board, Financial Institutions (like NABARD), Govt. Departments, National and International Agencies for launching promotional schemes, sharing of knowledge, developing infrastructure, conducting research and transfer of technology, providing financial assistance and facilitating marketing etc. Thus a concerted effort of all the agencies will help the North Eastern Region in finding an important place in the processing sector of India.