



## REVIEW ARTICLE

### DEVELOPING ROAD MAP FOR NORTH-EASTERN AGRO-CLIMATIC ZONES

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#### ABSTRACT

There is immense potential for vertical and horizontal growth in horticulture sector in North East region. At present horticultural crops account for only 18.60% of cultivated area. This share is highest in Sikkim followed by Manipur, Arunachal Pradesh, Meghalaya, Tripura, Mizoram, Assam and Nagaland. Major challenges to be come across are Climate change due to rise in temperature, erratic precipitation and sea level rise, greenhouse gas emission, fragmented ecosystems, loss in biodiversity and trade and competitiveness. Developmental issues include ISO certification of organizations, MoU with nearby organizations, adoption of Swachh Bharat Abhiyan and MeraGaonMeraGaurav programs. Researchable strategies on utilization of natural health, enhancing farmers income, efficient utilization of water and other resources, organic farming, development of human resources, marketing, technology dissemination and quality services to be addressed for the region.

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## INTRODUCTION

The economy of the North Eastern states is mainly rural and agrarian. The region offers scope for cultivation of a wide variety of agricultural crops because of its diversities in topography, altitude and climatic conditions. Land is a critical resource in many of the NE states, and availability and management of land for agricultural activities are essential for raising the region's overall agricultural production and productivity. The region's agricultural system is predominantly traditional. The overall geographical land to man ratio for the NE region (0.67 hectare/person) is much higher than the national average (0.32 hectare/person). Population to land ratio is highest in Arunachal Pradesh followed by Mizoram, Sikkim and Manipur. The per cent utilization of cultivable area in the NE regions (62.04%) less than the national average (73.05%). About 80% of the farmers in the NE region belong to small (less than 1.44ha) and marginal (less than 0.40 ha) category. Moreover, with increase in population, the average size of land holding is gradually reducing over the years. This is primarily because hilly terrain constitutes nearly two third of the regions geographical area, and large sized holding are not feasible. The average size of land holding for the NE States (1.60 ha) is marginally higher than the all India (1.57 ha). Among the NE States the average size of land holding is highest in Nagaland

(6.92 ha) and lowest in Tripura (0.97ha). The average plot size is very small for mechanization of agriculture and adoption of modern farming practices. Hence, high value crops such as different types of flowers will provide high remuneration from limited resources. There is immense potential for vertical and horizontal growth in horticulture sector in the region. At present horticultural crops account for only 18.60% of cultivated area. This share is highest in Sikkim followed by Manipur, Arunachal Pradesh, Meghalaya, Tripura, Mizoram, Assam and Nagaland. There is need to expand area under horticultural crops particularly in Assam, Mizoram and Nagaland where at present it is less than 20% of the cultivated area.

The global population is expected to rise by about 9 billion in 2050. Food, shelter, energy, employment, health care etc. have to depend upon the bio-resources of the Planet Earth. This uncertainty is due to climate change, agriculture pattern, urbanization etc. which are closely linked with biodiversity, economy and the welfare of the humanity. In 2050, 1.6 billion people of our country should have adequate, nutritious, safe and healthy food and adequate fibre within the available natural resources as well as aesthetic items.

Major challenges that we have come across are

- Climate change due to rise in temperature, erratic precipitation and sea level rise

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- Greenhouse gas emission
- Fragmented ecosystems
- Loss in biodiversity
- Trade and competitiveness

### Developmental issues

- ISO certification of the institute for quality management systems
- Display of Client/Citizen's Charter Board (2015-16) for delivery of good and quality services
- Swachh Bharat Abhiyan program for clean, green, colourful and healthy atmosphere of the working areas of office
- Minimum government and maximum governance through innovative action plans
- MoU's with SAUs like CAE& PHT (CAU), Ranipool, Sikkim; UBKV, Cooch Behar, West Bengal and Sikkim University, Gangtok, Sikkim for collaborative research, training and education.
- Adoption of MeraGaonMeraGaurav program in nearby villages for lab to land programs.

### RESEARCHABLE ISSUES

#### Utilization of natural wealth

The North Eastern Hill Region is biodiversity hotspot of a number of horticultural crop species including citrus (17), banana (16), mango (2), peach (3), underutilized fruits (300), *Prunus* species, taro (300), yams (200), leafy vegetables, beans, cucurbits, lesser known vegetables and medicinal and aromatic plants and orchids (900) and other ornamentals like *Bauhinia*, *Cassia*, *Callistemon*, *Erythrina*, *Jacaranda*, *Rhododendron*, *Azalea*, *Bougainvillea*, *Camelia*, *Gardenia*, *Hibiscus*, *Jatropha*, *Nerium*, *Thunbergia*, palms, foliage, bulbous plants and wild flowers. Habitat loss, Deterioration and Fragmentation, introduction of exotic species, Overexploitation, Environmental Pollution, Global Warming, Commercialization of Agriculture and Forestry, Jhum cultivation, Tea plantations, Timber Felling, Forest Fires, Unscientific method of harvesting, Hunting, Soil Erosion, Encroachment Problem, Construction of reservoirs and dams, Charcoal making, Grazing are the causes for loss of diversity.

#### Strategies

- Conservation of biota in fragmented landscapes, protecting and increasing the habitat, improving habitat quality, increasing connectivity, managing disturbance processes in the wider landscape, planning for the long term, and learning from conservation actions undertaken.
- The value and importance of indigenous peoples' and local communities' customary sustainable use and traditional knowledge in conserving and upholding biodiversity, land- and seascapes, and protected areas should be acknowledged. Incentives may be needed to entice people to participate in conservation and recovery programs.
- Implementation of community-based projects on biodiversity conservation provides opportunities to actively engage and involve local and indigenous people.

- There is an urgent need to develop Biodiversity Profile of India so that we have adequate knowledge on existing species, ecosystem and genetic resources and threats to them in order to monitor and report on biodiversity (e.g., extinction rates, biodiversity loss). The main causes for a lack of knowledge on biodiversity loss include limited number of scientific experts, national indicators, research, finance and available technology and lack of biodiversity specific educational program.
- More biosphere reserves, sanctuaries and germplasm banks need to be established.
- Promoting education and awareness about plant diversity conservation and sustainable utilization and biodiversity conservation at the local level to be encouraged.
- An integrated conservation approach including conservation genetics, mycorrhizal associations, pollinators interactions, *in-situ* conservations (Biosphere Reserves, National Parks, Sacred Grooves, Gene Sanctuary and Individual Trees) and *ex situ* conservations (Field Gene Banks, Botanical Garden, Herbal Garden, *In-vitro*-conservation, Cryo-preservation and DNA Bank) will be taken up.
- Genetic enhancement through clonal selection and pre-breeding, breeding for commercially important traits, functional genomics and molecular breeding tools like marker-aided selection and gene stacking and customized genetic engineering.

#### Enhancing Farmers income

The diverse Agro-climatic situations in the Region offer excellent scope for growing different horticultural crops like fruits, vegetables, spices, plantation crops, medicinal and aromatic plants. A wide range of tropical, sub-tropical and temperate fruits such as banana, mandarin orange, pineapple, apple, peach, pears, jackfruit, papaya, hatkora (*Citrus microphylla*) and vegetables, both indigenous and exotic, are grown in the region. In terms of its contribution to the national production, the Region accounts for about 5.1%(fruits) and 4.5% for vegetables. Organized cultivation of crops like kiwi, passion fruit, off season vegetables, anthurium, cut flowers (Rose), patchouli, geranium etc. has started in recent years. Bamboo, cane, medicinal & aromatic plants and herbs are mostly being handled by forest departments or land resources departments. While food grains are grown in the valleys (plain and gentle slopes), horticulture crops are cultivated on higher hill slopes. A large chunk of cultivable area is still un-explored due to multiple reasons, lack of market avenues being the most significant. The percentage utilization of cultivable area in the NE regions (62.04%) is less than the national average (73.05%). Mono cropping is the predominant method of cultivation. In the absence of multi-cropping, little or no surplus is generated in the agricultural sector.

#### Strategies

- Building up a strong crop improvement programme based on sound breeding methodologies that will yield into development of hybrids/varieties of internationally acceptable quality traits. It is essential to develop own hybrids suitable for varied agroclimate for our country fulfilling the basic requirements of market demands.

- Development of protocols and production of quality planting materials through micro-propagation techniques.
- Round the year production technology of commercial horticultural crops
- Effective water and nutrient management systems through hydroponics and aeroponics
- To increase productivity through selection of area specific horticultural crops and improved package of practices in fallow lands and the land other than current fallows.
- Intensive crop production system through selection of suitable genotypes, cropping system INM, IPM and organic farming approaches.
- Crop diversification from low value to high value crops, water loving crop to water saving crop, single crop to multiple crop / mixed crop, crop alone to crop with crop livestock – fish – apiculture and agriculture production to production with processing and value addition for sustainable production.
- Development of pre-harvest, harvest and post-harvest technologies including smart packaging for specific target groups like domestic and export market and hybrid/variety specific technologies.
- Use of wild edibles and waste for production of phytochemicals such as colour, food, feed, herbal medicines and essential oils.

#### Efficient utilization of water and other resources

- Development of rainfed, disease and pest resistant and high yielding varieties. hybrids of fruits and vegetable crops suitable for various land situations.
- Popularization of micro-irrigation through adoption of drip irrigation and drip herbigation, contract farming to risk sharing between firms and farmers, precision farming of high value horticultural crops for reduction of cost of production and maximization of profit
- Quantification of water use efficiency and water requirements in target horticultural crops based on growth habit for per drop more crop.
- Effective water and nutrient management systems through hydroponics and aeroponics of high value horticultural crops.
- Follow up of economically viable and sustainable horticulture based farming systems such as Agri-horticulture, Agri-horti-silvi-pastoral system, multi-tier horticultural systems, mixed horticultural land use and pure horticultural land use for conservation of water and soil and intensive crop production.

#### Organic Farming

The north eastern states were identified for promoting organic farming. These states are selected because the land is almost virgin and the crops are virtually organic. The use of inorganic fertilizers and chemicals is meagre in the region. All the households are maintaining livestock producing sufficient quantities of on-farm manures. The region is receiving very high rainfall leads to production of biomass including weeds, shrubs, and herb which could be efficiently used in organic production. The region has the potential of about 47 mt of organic manure including 37mt from animal excreta and 9 million tons from crop residues. The region is home to some

niche crops like Assam lemon, Joha rice, medicinal plants and passion fruits. NE accounts for 45% of total pineapple production in India. Sikkim is the largest producer of large cardamom in the world. NE is the fourth largest producer of oranges in India. Extent of chemical consumption in farming is less than the national average. Eighteen lakh ha of land in NE can be classified as 'Organic by Default'.

Potential horticultural crops for organic farming in NE Region

**Fruits:** Pineapple, Passion fruit, Kiwi fruit, Orange, Banana, Strawberry

**Vegetables:** Radish, Capsicum, Tomato, Carrot, Cabbage, Sprouting Broccoli, Leafy Vegetables

**Spices:** Turmeric, Ginger, Large Cardamom

**Tuber crops:** Potato, Sweet Potato, Colocasia

**Flowers:** Orchids, Anthurium, Gladiolus, Gerbera, Lillium

#### Development of human resources

There are a number of institutions, departments, colleges, universities, NGOs, local community Groups in the region engaged in agricultural activities. Those are State Government Agencies, many Research Organizations such as Botanical Survey of India, Shillong, G.B. Pant Institute of Himalayan Environment and Development, (North-East Unit, Itanagar and Sikkim Unit, Panthang), Indian Council of Agricultural Research for North-Eastern Hill Region, Barapani, Shillong with campuses throughout the north-east, State Forest Research Institute, Itanagar, NBPGR, Shillong, North-Eastern Hill University, Shillong, Nagaland University, Kohima, Mizoram University, Aizawl, Arunachal University, Itanagar, Tripura University, Agartala, Assam University, Silchar, Tezpur University, Tezpur, Gauhati University, Guwahati, Assam Agricultural University, Jorhat, Regional Research Laboratory, Jorhat, Dibrugarh University, Dibrugarh, Central Agricultural University, Imphal, Manipur, National Research Centre for Orchids, pakyong, Sikkim and Central Potato Research Station, Upper Shillong; Non-Governmental Organizations; International Donor Agencies in International donor agencies in Meghalaya, Manipur and Assam and Nagaland; Academic Institutions including Schools and Colleges and the shifting cultivators and other traditional farming communities of northeast have played a key role in conserving the rich horticultural crops germplasm of the region. In spite of the availability of many hybrid and high yielding varieties these farmers have been cultivating the traditional varieties for generations.

#### Strategies

- Regeneration and cultural practices for many species need to be researched and standardized for their cultivation. Rare, Endangered and Threatened species need immediate action for ensuring their continued existence.
- Identification and classification of rare, Endangered and Threatened
- Richness of diversity of horticultural crop species through fully inventorization and Documentation.

- There is a conspicuous gap between research and field needs. The established formal institutions like university departments, departmental research stations and others rarely consult the farmers and local communities about their problems while pursuing research. Need-based research solutions needs to be sorted out.

### Marketing

Market arrivals of horticultural produce have shown significant increase and are expected to accelerate further in coming years. Besides, per unit prices of the produce have also found to increase. State Marketing Regulation Acts have been passed by all the States in the region except Manipur. However, APMCs are not active. Many of them have not yet formulated by-laws for regulating markets practices as per the Act. As such, marketing of horticulture produce continues to take place in dis-organised manner in Haats and shanties patronized by tribal clans. Except for Meghalaya and Tripura no State in the region has drawn up long term market development plans. The APMCs yards set up by the State AMBs are of recent origin and are not yet fully stabilized and functional in any of the States. Major part of horticulture produce in the Region, therefore, is traded in traditional retail and wholesale markets run by the communities/clients. This infra-structure is not "regulated". In case there is a cluster of 10-20 producers in a village/habitation, the agent of alocal retailer/wholesaler might buy their produce at the farm gate and transport it to anorganized/un-organised retail market yard at the road side. Most of the horticulture produce for local consumption is thus marketed on the road net-work. In case no agent reaches the farm gate, producers will individually or collectively transport the produce by any available means (light motorized vehicles or head loads) to the nearest market site. The longer the distance, the higher would be the cost of transportation, reducing thereby the producers' profit margin. There are number of land custom stations located in different states with neighbouring countries. Different Agri-export zones of commodities declared in the region are Tripura (Pineapple), Sikkim (Orchids) and Assam (Ginger). Lack of proper transport facilities in one of the major reasons for a poor level of commercial floriculture activity in the region. There are a number of National Highways in the region connecting the state capitals. The rail network in the region is mainly concentrated in the state of Assam. AAI and NEC have together been funding upgradation of these airports. Guwahati airport is the only airport in the region with night landing facilities. The market infrastructure in the region is very poor. There are no integrated post-harvest management facilities, collection centres or auction centres. In many states, there are no retail markets for flowers, even the major market related activities are confined primarily to the respective state capitals. The only active flower markets in the region are SukreshwarGhat (Guwahati) and Ima Market (Imphal). There are no cold storages for flowers in the region.

### Technology dissemination

- Large scale field demonstration of production technologies using advanced tools.
- Grower's seminars, KisanMela, exhibition, Brainstorming session, and Awareness campaign to address challenges among target groups for successful dissemination of technologies.
- Use of IT and ICT tools like use of Agri-Clinics t for IPM, water management, INM, animal health care, breeding and nutrition, agroforestry, organic farming, vermicomposting and production of bio-pesticides; Agri-Business Centre for higher yields, better nutrition and sustainability especially in value addition to primary products and agro-processing; Kissan Call Centres shared to provide information on demand by utilizing telecommunication infrastructure available in the country; FM transmitters for rural areas, Kissan Channels for audio-visual broadcasting among rural masses; video conferencing and web based agricultural information dissemination system..
- Documentation and utilisation of ITK's and scientific revalidation.
- Women empowerment in crop cultivation, high value vegetable cultivation, animal husbandry, marketing, post-harvest management and value addition, floriculture and homestead medicinal plants cultivation.

### Services

1. Weather agro-advisory services
2. Providing technical support to private sector laboratories for multiplication and expansion of orchid cultivation
3. Human resource development through MTC, Short Course Training, On/Off Campus Training and job training
4. Evaluation of floriculture related research projects
5. Preparation of course curriculum and question papers on floriculture in graduate and post-graduate levels.
6. Evaluation of Thesis on floriculture in post-graduate levels

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