

Organic Horticulture in Northeast India: Strategies and Prospects

Northeast India includes eight states viz., Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura, occupy 7.7% of India's total geographic area and nurture nearly 50% of the biodiversity in the country of which about 32% is endemic. Mostly indigenous farming practices are followed in Northeast which are predominantly organic in nature and depend on the indigenous technical knowledge systems prevalent in the region for centuries. Agro-climatic conditions of the region are rainfed and most conducive for organic farming. The region is bestowed with diversity of numerous fruits, vegetables, flowers, spices, medicinal plants and a vast array of indigenous crops. Diversity in horticultural crops embraces the potential to strengthen the economy and ecology of the region through the adoption of organic horticulture by NPOP Guidelines-based farm production and wild collection either as commodities or value-added products. Sikkim was declared as the first fully organic state of the country in 2016 and all the other Northeastern states aim to shift towards organic farming.

THE most effective ecological and sustainable agriculture intensification model, organic farming, is a judicious option for wholesome and quality farm produce with no negative ecological impacts, and ensures adequate health of both the environment and humans. India's horticulture production has grown leaps in the last two decades and estimated to rise one per cent record of 350.87 million tonnes in 2022-23 (347.18 MT in 2021-22), riding on the back of higher output of fruits and vegetables according to the advance estimate of horticulture production released recently by the Ministry of Agriculture & Farmers Welfare, Govt. of India. Production at a higher sustainable level offers incredible scope to diversify and increase production and productivity. This opens up a window for organic horticulture towards both, diversification and development of safe food production systems.

As on 31 March 2023, the total area under the organic certification process (registered under the National Programme for Organic Production) in India was 10.17 m ha (2022-23). This includes 53,91,792.97 ha cultivable area and another 47,80,130.56 ha for wild harvest collection. India produced around 2.9 million MT (2022-23) of certified organic products which include all varieties of food products namely oil seeds, fibre, sugar cane, cereals, millets, cotton, pulses, aromatic and medicinal plants, tea, coffee, fruits, spices, dry fruits, vegetables, processed foods, etc. The total volume of exports during 2022-23 was 3,12,800.51 MT. Organic food export realization was around INR 5,525.18 Crore (708.33 million USD). The existing scenario offers considerable opportunity to

enhance the proportion of horticultural products both as commodities and value-added products or processed foods. Presently, India does not have a significant presence in the international organic trade with less than one per cent footprint.

Northeast India

Primarily, indigenous farming practices are followed in the Northeast (NE) region which are chiefly organic in nature and depend on the indigenous technical knowledge systems ubiquitous in the region for centuries. The agro-climate of the region is generally rainfed, which is most conducive for organic farming. Low use of synthetic fertilizers (<12.0 kg/ha) and chemicals, abundant availability of biomass and animal manure are typical to the region, therefore, this region, offers sufficient prospects for organic farming. Thus, the Government of India identified NE as a potential hub for promoting organic farming. While Sikkim was declared as the first fully organic state of the country in 2016, all the other Northeastern states intend transition to organic farming even if it may not be 100 per cent. Presently, a total of 1,98,348 ha is utilized for organic farming in the NE that includes almost 1,38,328 ha under NPOP certified organic farming while another 60,020 ha is in the process of conversion. Interestingly, this area encompasses all eight states with the highest area of 75,475 ha in Sikkim. Other seven states, apart from Sikkim, reveal encouraging signs of progress on the road to adopting organic farming. The production is expected to improve with the transfer and adoption of complete organic production technologies.



Organic Large Cardamom



Organic Kiwi Vine

Realizing the potential of organic farming in the Northeastern Region of the country, Ministry of Agriculture and Farmer Welfare has launched a Central Sector Scheme entitled “Mission Organic Value Chain Development for North Eastern Region (MOVCD-NER)” for implementation in Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura. The scheme aims at the development of certified organic production in a value chain mode to link growers with consumers and to support the development of the entire value chain starting from inputs, seed, and certification, to the creation of facilities for collection, aggregation, processing marketing and brand building initiatives. According to the Ministry of Agriculture & Farmers Welfare the MOVCD-NER scheme launched during 2015-16 has facilitated 1.73 lakh ha area under organic farming benefiting 1.89 lakh farmers as on 15 July 2023. During this period, 379 FPOs/FPCs were established entailing the creation of 205 collection, aggregation and grading units, 190 custom hiring centers and 123 processing units and packaging houses. Seven brands have also been developed.

Crop diversity

Northeast India has been established as a global biodiversity hotspot, and it is acknowledged for its diverse soil types, climate, and phyto and faunal diversity. The region is bestowed with a diversity of numerous fruits, vegetables, flowers particularly orchids, spices and medicinal plants. Likewise, a vast array of indigenous crops also anticipates opportunities to be utilized. This diversity in horticultural crops holds the potential to greatly strengthen the economy and ecology of the region by opting for organic horticulture through the adoption of NPOP Guidelines-based farm production and wild collection either as commodity or value-added products.

Fruit crops

Northeast India is considered as the Centre of Origin of many citrus species. Khasi mandarin (*Citrus reticulata*) is cultivated extensively and sweet orange (*Citrus sinensis*) is cultivated commercially in the region. Moreover, the species cultivated generally viz., *Citrus indica* Tanaka (Indian wild orange), *C. latipes* (Swingle), *C. ichangensis*

Swingle (Ichang Papeda), *C. medica*, *Citrus assamensis*, *Citrus macroptera* and *C. hystrix* are recorded in the sub-tropical forests of Northeast India and the foothills of the Eastern Himalayas.

The highest genetic variability of *Musa acuminata* and *M. balbisiana* is documented in NE India. *M. flaviflora* is limited to Manipur and Meghalaya. ICAR-National Bureau of Plant Genetic Resources (NBPGR) in 1986 collected some important landraces of banana (seeded Ladiarit and Ladison, Rigitchi and other elite types, Hatigola, Eboke, Ginde, Egitchi and Essing) from Meghalaya. Huge variation in *Pyrus*, *Rubus*, *Ribes* and *Prunus* has been observed in the region. Besides, a significant number of other tropical and sub-tropical fruits of the genera *Garcinia*, *Artocarpus*, *Phyllanthus*, *Annona*, *Averrhoa*, *Persia*, *Aegle*, *Passiflora* and *Tamarindus*, etc., profusely grow in the wild. One such indigenous fruit is Jackfruit, which grows abundantly in Tripura, Assam, Nagaland and Meghalaya with many cultivars and landraces.

More than 300 wild edible plant species are reported from NE India and some are consumed by different ethnic groups of the region. Two *Elaeagnus* species, namely, *E. latifolia* and *E. pyrifolia* are reported frequently in the region. It is quite common in Sibsagar, Dikho valley, Naga Hills, Khasi and Jaintia hills. Soh-Shang (*Elaeagnus latifolia*) is among the significant potential fruit crops extensively spread in Northeast India. *Docynia indica* and *D. hookeriana* are regularly observed in the region. *Pyrus pashia*, a medium sized deciduous fruit tree and two types of tree tomato (*Cyphopandra betaceae*) (dark red and yellow fruit type cultivars) are also reported.

Vegetable and Spice crops

Vegetables embracing solanaceous, cucurbitaceous, leguminous, leafy, cole, root, rhizomatous and bulbous crops comprise one of the major groups of cultivated plants in Northeast India. Around 16,000 germplasm accessions of diverse vegetables, tuber, spices and condiments crops were collected through numerous crop specific and multi-crop expeditions undertaken by ICAR-NBPGR alone or in collaboration with other institutes during 1986 to 1994-95. Northeast India shelters innumerable solanaceous plants. Nearly 35 species belonging to the family Solanaceae are reported from the region.

Chilli (*Capsicum* spp.) is commonly cultivated in warm to hot and humid climates in Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura. The chilli species *viz.*, *C. annum* L. var. *avicular*, *C. annum* L. var. *grossum*, *C. annum* L. var. *longum*, *C. chinense*, *C. eximium*, *C. frutescens*, *C. minimum*, and *C. pubescens* occur in this region. Bhut jolokia/King chilli is the world's most pungent chilli (over one million SHU) originated in Northeast India, particularly in Nagaland and is cultivated throughout the region. Cucurbits, one of the biggest collections of vegetable crops is extensively grown in all the states of this region. 15 genera of this group of vegetables are found in this region and many of them are lesser known. Kakrol (*Momordica cochinchinesis*) and Kartoli (*M. dioica*) are widely spread in Assam, Garo hills of Meghalaya and the Sikkim Himalayas.

A wide range of indigenous leafy vegetables akin Amaranths namely, *Amaranthus viridis*, *A. lividus*, *A. retroflexus* and *A. spinosus*, puiroi sag (*Basella rubra* and *B. alba*), *Rumex rasicarius*, *Chenopodium album* and *Ipomea reptans* are cultivated in Northeast India. Tuber and rhizomatous crops *viz.*, *Ipomea batatas*, *Colocasia esculenta*, *Amorphophallous* spp., *Dioscorea* spp. Ginger and turmeric along with various other spice crops also reveal substantial diversity in all the Northeast states.

Flowers, Bamboo, Medicinal and Aromatic Crops

Orchids are synonymous with the Northeast region which is recognized for its tremendous diversity. Nearly 17,000 species of orchids have been recorded in the world, of which about 1,250 are found in India and about 700 species in the NER. Arunachal Pradesh hosts around 620 species, Sikkim 523 species and Meghalaya 324 species. The indigenous species of orchids with ornamental value and market potential generally belong to the genera *Aerides*, *Anachnantha*, *Arundina*, *Cymbidium*, *Dendrobium*, *Paphiopedillum*, *Phaius*, *Renanthera*, *Phycostylus* and *Vanda* etc. Among the many species *Calanthe masuca*, *Cymbidium* spp., *Dendrobium nobile*, *Phaius tankervilleae*, *Vanda* spp., *Phalenopsis* spp. etc. are promising as cut flowers.

Bamboo is an important crop of the Northeast and it plays a pivotal role in the livelihood of the ethnic people. Approximately 50% of bamboo species in India are documented from the Northeast region; nearly 12 species are rare and endangered. Arunachal Pradesh has 12 genera and 30 species, 8 genera and 30 species of bamboo are recorded in Sikkim, a total of 30 species under 14 genera are reported in Meghalaya, about 71 bamboo species in Nagaland, Mizoram has 35 species and so on.

The ethnic communities in Northeast India are knowledgeable of the wild plants possessing medicinal values. The tribal people use these plants to treat various ailments. It was reported that more than 500 species from Arunachal Pradesh, 256 from Assam, 526 from Nagaland, 194 from Tripura, 423 from Sikkim and 834 species from Meghalaya possess medicinal value and these plants have been used by the tribal community of this region for the time immemorial.

Organic production technologies

ICAR Research Complex for NEH Region, Umiam

and especially its Sikkim Regional Centre have developed research-based technological options for climate resilient mountain horticulture production systems encompassing organic production techniques of mandarin, kiwifruit, pear, guava, chayote, cherry pepper, okra, pea, ginger and turmeric, etc. Organic production technology of 14 high value vegetables *viz.*, broccoli, cauliflower, cabbage, coriander, lettuce, fenugreek, spinach, leafy mustard, pakchoi, garlic, pea, beetroot, carrot, and radish under low-cost plastic tunnels have been standardized for year-round production in various cropping sequences. Organic production technology for tomato, capsicum, cucumber, gourds, under low-cost plastic shelters during summer and rainy season and off-season vegetable production techniques in low-cost greenhouse for high priced vegetables *viz.*, broccoli, tomato, cucumber and capsicum have also been standardized. These technology packages have already been shared with all the Departments of Agriculture and Horticulture of all the states in the Northeast.

Soil acidity is common in the NE as a result of high rainfall and leaching of bases from the surface layer of soils. The management of acid soils can be solved either by addition of lime to counteract the abnormality of such soils or by manipulating agricultural practices to obtain the optimum crop production under the stress of soil acidity. Under organic farming, limited options are available to meet the nutrient requirement. The sources are recycling of organic matter, enrichment of compost, vermicomposting, animal manures, urine, farmyard manure, litter composting, use of botanicals, green manuring, etc. Use of biofertilizers like *Azolla*, *Azospirillum*, *Azotobacter*, *Rhizobium* culture, phosphorus and potash solubilizing bacteria, in combination may also enhance soil fertility. Different types of cakes *viz.*, neem cake, karanj cake, etc., may also enhance soil fertility in organic production.

Organic insect pest and disease management technologies include identification of tolerant varieties and adjusting sowing dates of major crops to minimize insect pests and diseases. Different locally available botanicals, bio-control agents (entomopathogenic fungi, *Bacillus thuringiensis* products, *Metarhizium* spp., *Beauveria* spp., NPV, etc.), oil-based formulations, and neem formulations, traps and lures, nematicides etc. are recommended against insect pests. Effective mechanical and cultural methods for management of major insect pests are also available. Technologies for organic disease management include organically permitted fungicides like elemental sulphur, copper-based fungicides, locally available botanicals, plant extracts, bio-control agents (*Pseudomonas fluorescens*, *Trichoderma viride*), cultural and mechanical management measures for diseases of major crops.

Strategies for sustainable organic horticulture development

- Evolve/refine location and niche crop specific organic production packages of practices.
- Establish efficient and cost-effective organic seed and planting material supply chain to augment productivity of horticultural crops.

- Strengthen the input supply chain for organic/bio pesticides, bio-fungicides and bio-weedicides.
 - Document and characterize local germplasm for effective use in genetic enhancement of crops to meet the challenges of biotic and abiotic stresses and improve yield and quality under organic management.
 - Identify and develop multiple resistance broad genetic base designer varieties, especially in vegetables and flowers for high productivity and quality under organic management.
 - Initiate studies on the impact of climate change on horticultural crops and develop mitigation strategies by early forecasting, varietal selection, agronomic management, cropping systems, soil conservation and water productivity.
 - Advocacy for a designated Organic Agri Export Zone in NE India to facilitate export and concurrent support to contract/cooperative farming.
 - Structure extensive human resource programs with greater emphasis on training farmers for organic cultivation of horticultural crops, livestock and poultry.
 - Design horticultural crops-based integrated organic farming systems for small holder farmers as climate change mitigation and income enhancement options.
 - Generate rural-based infrastructure for processing, storage, and smart packaging and value addition for fruits and vegetables products.
 - Vitalize the extension network for dissemination of knowledge/technologies and monitor the adoption of organic farming.
 - Bolster mechanization and automation in horticultural crops by development and use of appropriate tools/equipment.
2. *Generate value added and processed products:* Presently largely perishable high-volume exports made from the specialty crops Be processed in to low volume, high value products for export.
 3. *Introduce high value crops* like saffron, hing (*Ferula assafoetida*), spices (vanilla, clove, thyme, rosemary, oregano, etc.), walnut, almond, Blueberry, microgreens, etc.
 4. *Produce biomolecules* like vitamins, hormones, and secondary metabolites (e.g., terpenes, carotenoids, polyphenols, saponins, etc.), vanillin, curcumin, gingerol, allicin, antioxidants, flavonoids, anthocyanins, lycopenes, rutin, myrcenes, limonene, pinene, etc.
 5. *Extraction of high value oil* from moringa, tea, clove bud, rose, large cardamom, cinnamon, *Gaultheria fragrantissima*, *Ocimum* spp., Assam lemon, Kachai lemon, etc.
 6. *Cultivate high value medicinal plants* like *Nardostachys jatamansi*, *Swertia chirata*, *Picrorhiza kurroa*, *Withania somnifera*, *Rauwolfia serpentina*, *Panax*, giloy (*Tinospora cordifolia*), etc.

Prospects

Organic farming provides a plethora of opportunities to launch various businesses and start-ups from seed to seed/fruit, processed and value-addition in the input supply chain and also the consumer value chain. The total commercial output for sale from certified organic area, in-conversion and wild harvest production was 29,72,294.29MT while the total organic export was only 3,12,800.51 MT valued at ₹ 5,525.18 crore (\$ 708.33 million). We do not have even a toe-hold in the international organic market. This is largely because we export commodities and very less quantities of high value, low volume processed products. Given the population size of our nation, we are a large consuming nation wherein there are established players to the extent that organic groceries and perishables can be made available at the doorstep in urban areas and certain cities like Hyderabad boast of “Walk-in Urban Retail Farm” that offer clean, fresh products under Controlled Environment Agriculture. Competition for new entrants and small holders is stiff and unless the produce is aggregated, marketing will be a tough ask. Novelty will be the key to the success of organic horticulture which may set the cash bells ringing. It will also be important to focus on the inherent strength of Northeast India. Some novel products are suggested below.

1. *Specialty crops:* Each state has one to few special farm

produce, and to list some, Arunachal Pradesh – kiwifruit, apple, mandarin, Assam – tea, Bhut jolokia, ginger, citrus (Assam lemon, Kachai lemon), Manipur – Black rice (*Chak-Hao*), tree beans, Meghalaya – turmeric (Lakadong), Khasi mandarin, Mizoram – ginger, turmeric, Bird’s eye chilli, mandarin, Nagaland – King chilli, ginger, pineapple, Sikkim – large cardamom (now being cultivated in many NE states), ginger, turmeric, buckwheat, tea and Tripura – pineapple, cashew nut, Jack fruit, etc., which can be marketed as commodities.

CONCLUSION

Northeast India is an identified hub for the expansion of organic farming. Limitless possibilities and potential exist towards the development of organic horticulture with a focus on niche crops. Empowering interested farmers with the best available organic technological options and policy support from the respective state governments will be vital for all further progress in this direction. Research-based technologies will augment the crop yields and bridge the yield gaps normally witnessed in organic farms. Production of high value, low volume value added products with appropriate marketing infrastructure and linkages are necessary tools to ensure higher returns anticipated from conversion to organic farming or else the movement may not gather the desired momentum. Organic horticulture with all the good intentions will be self-sustainable only when it becomes farmer-driven.

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