

## DIVERSITY OF HORTICULTURAL CROPS IN NORTH EASTERN REGION

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### INTRODUCTION

The North East region has its own unique combination of living species, habitats and ecosystems, which together make up its diversity rich resource. While speaking strictly about plant diversity, two regions of the country are termed as hot spots. These are – Western Ghats and the North Eastern hill regions. In all living organisms the species is the single most useful unit to use in diversity assessment. Species richness and the relative abundance of different species is another criterion to measure the degree of diversity. The number of endemic species also reflects into account while assessing the richness of diversity.

The North Eastern region of India comprising eight states namely Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura and Sikkim has vast physiographical variations, which have been represented in 6 agro climatic zones. North East region is one of the richest reservoir of genetic variability and diversity of different crops i.e various kinds of fruits (Table 1 & 2), different vegetables (Table 3), spices, ornamental plants and also medicinal & aromatic plants. The diversity for horticultural crops of this region has mainly been managed by local farmers, often women. Considerable diversity exists among the regional horticultural species including variation in plant type, morphological and physiological characteristics, reactions to diseases and pests, adaptability and distribution. Apart from the nutritional value, many regional horticultural crops are used for medicinal purposes, income generating and poverty alleviation programmes in the rural areas.

### EXPLORATION AND DISTRIBUTION

#### **Fruits**

**Citrus:** Being the home of several citrus species, rich genetic diversity occurs in the region. Bhattacharya and Dutta (1956) described 17 citrus species, their 52 cultivars and a few probable natural hybrids from this region. In lemon alone, as many as 32 strains are available. The species *C. limon*, *C. medica*, *C. jambhiri*, *C. ichangensis*, *C. latipes*, *C. macroptera*, *C. assamensis*, *C. indica* and *C. aurantium* are considered indigenous to this region. The Indian wild orange *C. indiaca* is found in the Naga hills and Meghalaya.

**Banana and mango:** Maximum genetic variability of *Musa acuminata* and *M. balbisiana* occurs in NE India. *M. flaviflora* is localized to Manipur and Meghalaya. There are other species found in Sikkim and Khasi Hills, which need systematic collection and conservation. Some native *Mangifera spp.* are found in Tripura, Manipur, Mizoram and South Assam. Wild form of *M. indica* and its allied species *M. sylvetica* occur in Arunachal Pradesh, *M. khasiana* and *M. pentandra* in Assam.

**Temperate fruits:** Rich diversity occurs in *Pyrus*, *Rubus*, *Ribes* and *Prunus*. The Shillong plateau of Khasi hills in Meghalaya has many *Prunus* species such as *P. napalensis*, *P. undulata* and *P. cerasoides*. *Pyrus pyrifolia* var. cubha makai (*P. serotina* Red) is grown semi commercially in Meghalaya, Manipur and other places. Wild kiwi (*Actinidia callosa* and *A. stragosa*) is found growing in the natural forests of Arunachal Pradesh and Sikkim.

**Tropical and sub tropical fruits:** A large number of other tropical and subtropical fruits belonging to the genera *Garcinia*, *Artocarpus*, *Phyllanthus*, *Annona*, *Averrhoa*, *Persia*, *Aegle*, *Passiflora*, etc., are found growing wild in the region. One of the indigenous fruits that requires attention is jackfruit, which grows abundantly in Tripura, Assam and Meghalaya with a large number of cultivars.

**Under utilized fruits:** Of the 300 edible plant species found in the NE region, some of them are really worth consuming by various ethnic groups of tribals. Two species of *Elaeagnus*, viz *E. latifolia* and *E. pyriformis* are known to be grown in NE region (Pandey, 2002). It is quite common in Sibsagar (Dikho valley), Naga hills, Khasi and Jaintia hills. *Docynia indica* and *D. hookeriana* are commonly found in the region. *Pyrus pashia* is a medium sized deciduous fruit tree also found in NE region.

**Table 1.** Diversity of major crops in North-East India.

Crops	Estimated diversities	Diversities collected till 2000
Taros	300	272
Yams	230	200
Citrus	17 spp.+52 vars.	80
Banana	16 species	120
Orchids	700 species	15

Source: Hore (2001)

**Table 2.** List of major fruit diversities in North East India.

Common name	Species	No of cultivars in the region	No. of wild relatives (approx)	Distribution
<b>Tropical</b>				
Mango	<i>Mangifera indica</i> L.	25	2	Tropical areas of Assam, Meghalaya, Mizoram, Tripura
Ber	<i>Zizyphus mauritiana</i> Lamk	8	3	Plains and Hills upto 500m
Pineapple	<i>Ananas comosus</i> L.	7	-	Introduced and naturalized in the region. Jaldhup and Lakhat type pineapple found in Assam
Aonla	<i>Embllica officinalis</i> Gaertn	5	2	Star aonla found in Mizoram and round aonla found in all states of north east
Guava	<i>Psidium guajava</i> L.	7	1	Tropical and subtropical (upto 1000m) zone of India
Banana	<i>Musa acuminata</i> Colla. <i>Musa balbisiana</i> Colla.	50 1	14 3	Throughout the tropical and subtropical zones of the country
<b>Subtropical</b>				
Lime, lemon & oranges	<i>Citrus spp.</i>	17 plus their 52 vars.	-	Lime and lemon in both tropical & subtropical while oranges in subtropical zone.
Peach	<i>Prunus persica</i> Benth & Hook.f.	7	3	Meghalaya, Nagland and Arunachal Pradesh
Plum	<i>Prunus domestica</i> L. spp. institia (L)	11		Meghalaya, Mizoram
Strawberry	<i>Fragaria vesca</i> l.	3		Hills of NE region
Apple	<i>Malas sylvestris</i> (L)	4	1	Arunachal Pradesh and introduced in Nagaland

**Table 3.** Large diversities in vegetable crops- NE region.

Indigenous	Eggplant, lablab bean, cucumber, smooth gourd, ridge gourd, snake gourd, sweet gourd
Introduced	
Ancient	Garden pea, onion, bottle gourd, cowpea, okra etc.
Recent	Tomato, chilli, cauliflower, cabbage, French bean etc.

### Vegetables

**Solanum group:** There is wide range of *Solanum spp.* found in the various parts of the region (Table 4). The local tribals grow a vegetable having red tomato like fruits slightly bitter in taste but related to brinjal and belonging to the genus *Solanum*. In Manipur another kind of brinjal having roundish fruit and intermediate in appearance between tomato and brinjal is grown.

**Table 4.** *Solanum* species in North East India.

Cultivates species	Remarks
<i>Solanum macrocarpon</i> L.	Introduced in NE region
<i>Solanum xanthocarpum</i> Schard & Wendl	Used as vegetable and medicinal purpose
<i>Solanum indicum</i> L.	Domesticated, used as vegetable and medicine
<i>Solanum mammosum</i> L.	Possibly introduced, ornamental with high solasodine percentage
<i>Solanum khasianum</i> Clarke	Wild and cultivated for solasodine alkaloid
<i>Solanum torvum</i> Swartz.	Wild, sold in the market in Mizoram
<i>Solanum berbisetum</i> Nees	Ripe fruits are eaten
<i>Solanum ferox</i> L.	Wild, leaves are used medicinally
<i>Solanum spirale</i> Roxb.	Wild but domesticated for medicinal use in Arunahcal Pradesh
<i>Solanum sisymbriifolium</i> Lam.	Native of Africa, wildy grown in Meghalaya
<i>Solanum kurzii</i> Br.	Endemic in Garo hills, Meghalaya
<i>Solanum gilo</i> Raddi.	Introduced in NE region as vegetable

**Table 5.** Important species of chili and their characteristics.

Scientific Name	Common Name	Comments
<i>C. annum</i> L.	Sweet pepper, chillies, Hot pepper	Principal source of commercial dry chillies.
<i>C. annum</i> L. var. <i>avicular</i>	Bird pepper	Wild type, said to be progenitor of bell pepper.
<i>C. annum</i> var. <i>grossum</i> Sendt.	Sweet pepper	Fruit contains less capsaicin,
<i>C. annum</i> var. <i>longum</i> Sendt.	Pepper	Used to produce condiment.
<i>C. chinense</i> Jacq	Pepper	Closely related to <i>C. frutescens</i> .
<i>C. eximium</i> Hunziker	Pepper	Wild type, pseudo self incompatible, related to <i>C. pubescens</i> .
<i>C. frutescens</i> L.	Tobacco pepper, Bird chilli	Widely cultivated in dry regions of India, highly pungent fruits used for sauce preparation.
<i>C. minimum</i> Roxb. Syn. <i>C. fastigiatum</i> Bhumme	Bird-eye-chili	Cultivated all across NE region but at very limited scale, closely resembles <i>C. annum</i> .
<i>C. pubescens</i> Ruiz. and Paron	Pepper	Introduced in India for breeding purposes

**Tomato and chili:** Tomato is an introduced crop roughly in 18<sup>th</sup> century and most of the introductions are bred varieties, which have adapted to this region (Seshadri and Srivastava, 2002). Germplasm of wild species of tomato *L. pimpinellifolium*, has been found in NE region. Chillies are usually grown in warm to hot and humid climate in Manipur, Mizoram, Meghalaya, Nagaland, Tripura, and Arunachal Pradesh (Table 5) in that order with respect to area under the crop. Due to the long history of cultivation, outcrossing nature and popularity of the crop, large genetic diversity including local landraces have evolved. In hot chili great range of variability for several attributes (fruit shape, size, colour and bearing habit and semi-perennial, perennial and pungency) occur throughout the North Eastern region.

**Cucurbitaceous vegetables:** Consisting of more than 15 kinds, these vegetables are grown and consumed within the region (Table 6). In North East many species of cucurbits are found as

vegetables and fruits; these include *Cucurbita*, *Momordica*, *Luffa* and several lesser known cucurbitaceous crops.

Exotic	Indigenous
Bottle gourd, pumpkin, snake gourd, ash gourd, chow-chow etc.	Cucumber, <i>Luffa</i> gourds, <i>Momordica</i> gourds, <i>Trichosanthes</i> gourd, and tinda etc.

**Table 6.** Diversities of cucurbits in North East India.

Cultivates species	Area of concentration for diversities	Range of diversities
<i>Cucurbita maxima</i>	Throughout the country	Extensive
<i>Cucurbita moschata</i>	Hilly areas	Moderate
<i>Cucurbita ficifolia</i>	Meghalaya	Introduced, neutralized
<i>Cucurbita pepo</i>	Meghalaya, Mizoram	Limited
<i>Coccinia grandis</i>	Assam, West Bengal	Limited
<i>Cucumis sativus</i>	Through out the country	Wide
<i>Cucumis callosus</i>	Foothill areas of Assam	Confined to limited pockets
<i>Luffa acutangula.</i>	Tropical areas of Assam	Wide
<i>Luffa cylindrica</i>	Tropical and subtropical areas of Assam, Meghalaya, Manipur, West Bengal	Moderate
<i>Momordica charantia.</i>	Throughout the country	Moderate
<i>Momordica cochinchinensis</i>	Assam, Meghalaya, Manipur, West Bengal	Limited
<i>Momordica dioca</i>	Garo Hills	Rare
<i>Trichosanthes anguina</i>	Meghalaya, Tripura, Assam, West Bengal	Limited
<i>Trichosanthes dioca.</i>	Tropical areas of Assam, Tripura	Limited
<i>Cylanthera pedata</i>	Hills of Meghalaya, Manipur, Nagaland and Arunachal Pradesh	Moderate
<i>Benincasa hispida</i>	Assam, Nagaland, Meghalaya	Wide
<i>Lagenaria siceraria</i>	Throughout the country	Wide
<i>Sechium edule</i>	High hills of Meghalaya, Manipur, Mizoram, Nagaland, Sikkim and Darjeeling of West Bengal	Moderate

Pumpkin varieties abound in number with variation in fruit size, fruit skin, flesh colour thickness, sweetness, etc. The wild species *Cucumis hardwickii*, the likely progenitor of cultivated cucumber, is found growing in natural habitats in the foothill of Himalayas and NE region particularly in Meghalaya. *C. sativus* var. *sativus* is cultivated all North Eastern region in tropical and subtropical conditions. Among gourds, in North Eastern region maximum variability has been recorded for bottle gourd in fruit shape and size. The NE region has rich diversity in genetic resources of ridge gourd (*L. acutangula*) and sponge gourd (*L. cylindrica*). Small as well as large sized forms of bitter gourd are also available.

**Crucifers:** These are essentially cruciferous vegetables namely cauliflower, cabbage, knolkhol, etc., introduced from the days of East India Company in 14<sup>th</sup>-15<sup>th</sup> century when European traders visited this region (Seshadri and Srivastava, 2002). Variability in Indian cauliflower widely exists in Assam and Meghalaya.

**Leguminous vegetables:** A wide variability of French bean, cowpea and Indian bean is found in the various parts of the region (Table 7). In French bean, climbing or pole type is popular among the tribals since it is used for mix cropping with maize, the stem of which act as the support for the bean. One of the interesting species of *Vigna* namely *V. vexillata* is grown by the tribals of Tripura. It is a legume cum tuber crop with much variation in edible tubers (Arora and Pandey, 1996). Sword bean (*Canavalia ensiformis* (L) DC) of papilionaceae family is also cultivated on limited scale in the North

Eastern region (CSIR, 1950). Winged bean is confined in humid sub tropical parts of NE region (Sarma, 2001).

**Table 7.** Diversities of vegetable legumes in North East India.

Cultivates species	Diversities in cultivars	Wild related species
Sem- <i>Dolichos lablab</i>	12	<i>Dolichos falcatus</i> , <i>D. biflorus</i>
French bean- <i>Phaseolus vulgaris</i>	14	-
Sword bean- <i>Canavalia ensiformis</i>	02	<i>Canavalia gladiata</i>

**Leafy vegetables:** The important leafy vegetables include lai (*Brassica juncea*), lafa (*Malva verticillata*), palak (*Spinacea oleracea*). In addition to these a wide variety of indigenous leafy vegetables are also available. These are amaranth (*Amaranthus spp*), puroi sag (*Vasella rubra* and *B. alba*), sorrel (*Rumex rasicarius*), etc. Other indigenous leafy vegetables used occasionally are jilmilsag (*Chenopodium album*) and Kalmou sag (*Ipomea reptans*). *Amaranthus viridis*, *A. lividus*, *A. retroflexus* and *A. spinosus* are important leafy types grown in North East India (Sarma, 2001).

**Tuber and rhizomatus crops:** Based on the colour and the skin to broad types of sweet potato are grown in the region. These are the white skinned and the red skinned variety. A number of dioscorea species *alata*, *bulbifera*, *brevipetiolata*, *esculenta*, *hamiltonii*, *hispida*, *kamaonensis*, *nummularia*, *pentaphylla*, *puber* and *quinata* were recorded in the Region. *D. hamiltonii* occurs in humid forests of NE hills(Sarma, 2001). Varieties of tapioca or cassava like M-4 and hybrids H-97, H-165, H-226 have also been cultivated to some extent. In colocasia also there is a wide variability even with in one species such as *Colocasia esculenta* (Sarma, 2001).

**Lesser-known vegetables:** In addition to the above there are a large number of indigenous vegetable crops that are used particularly by the tribal population. Maximum such varieties are available in Arunachal Pradesh. Tree bean (*Parkia roxburghii* G. Don.) is one of the most common of multipurpose tree species in Manipur and Mizoram (Kumar *et al.*, 2002). In the hilly areas tree tomato (*Cyphomandra betacca*), a perennial shrub producing red tomato like vegetables, is also grown and used as such. It is grown as backyard venture crop in Meghalaya (Thakur *et al.*, 1988). Another vegetable tree, growing in the lower altitude zones and popular among the people, is drum stick or horse reddish locally called Sajina (*Moringa oleifera*).

Cho-Cho (*Sechium edule*), a native of tropical America, is a very popular vegetable in the region commonly called squash and grows abundantly without much care and attention. *Flemingia vestita* known as Sohphlong, is consumed raw. It is a weak climbing/trailing type, under ground tubers, distributed the humid to sub tropical regions of NE India upto 1500m (Sarma, 2001). Kakrol (*Momordica cochinchinesis*) and kartoli (*M. dioica*) are widely spread in Assam, the Garo hills of Meghalaya (Ram *et al.*, 2002).

**Spices:** A wide range of variability has been found in ginger and turmeric. Lakadong the local variety of turmeric is grown in Jowai area of Meghalaya. Poona and Thinglaidon performed better in most of the states except Tripura and Sikkim indicating suitability for large scale cultivation for green ginger production. Nadia variety of ginger is well adopted in North East region. A type of ginger having rhizomes with bluish black tinge inside called Black ginger is grown by the inhabitants of Mizoram. Wild relatives of large cardamom (*Amomum subulatum*) and cinnamon are available in the forests of this region.

## ORNAMENTAL PLANTS

The ornamental plants, which are found in NEH region, include species of *Mannolia*, *Rhododendron*, *Cassia*, *Erythrina*, *Calustemom*, *Dacasenda*, *Myrica*, *Bauhinia*, etc. About 600 species of orchids are naturalized in great proportion in this region. Wide range of variability has been found in Sikkim, Arunachal Pradesh, Meghalaya and Manipur.

## MEDICINAL AND AROMATIC PLANTS

Medicinal plants of known use like *Rauvolfia serpentina*, *Solanum khasianum*, *Dioscorea proceri*, *Coptis teeta* are widely available in the region. Orchids as medicinal agent have been used by the tribals of NE states like Arunachal Pradesh, Nagaland, Meghalaya and Mizoram.

## GERMPLASM EVALUATION

In order to facilitate effective utilization of plant genetic resources, it is important that the plant genetic resources are evaluated for productivity including components, crop duration, resistance to biotic and abiotic stress and quality of produce.

A dwarf and late maturing polyembryonic mango cultivar Moresh bears sweet fruit with high pulp content within 2 years from planting and is free from stone weevil. The locally available species like *Malus baccata* is widely used as rootstock of apple while *Pyrus pashia* is a common rootstock of pear. The ripe fruits of *Elaeagnus*, viz *E. latifolia* and *E. pyriformis* are edible and used for making refreshing drink (Pandey, 2002). The fruits of *Docynia indica* and *D. hookeriana* acidic, greenish with red tinged are eaten fresh and in pickles as well as in jelly preparation.

Some of the brinjal varieties have excellent quality in having large size, soft flesh and less seeds. An important species of medicinal importance (solasodine content) is *S. khasianum*. Another species *S. torvum* is extensively used in Ayurvedic medicine system. Three tomato varieties namely Manileima, Manikhamnu and Manithoibi were released by State Variety Release Committee, Manipur and found suitable for rice-based cropping system. *L. pimpinellifolium* is also good source of resistance to late blight and tomato leaf curl virus (Seshadri and Srivastava, 2002). In chilli, a collection from Tezpur (Assam) has been found to have the highest capsaicin content recorded so far anywhere in the world.

Cho-Cho (*Sechium edule*) produce large starchy edible roots in addition to fruits. The National Bureau of Plant Genetic Resources, Regional Station, Shillong is maintaining more than 10 germplasms of Indian bean. Winged bean has excellent nutritional qualities particularly being very rich in protein (Rao and Dora, 2002). In the trials conducted by ICAR Research Complex for NEH Region, Umiam varieties of sweet potato such as S-162, S-69 and S-30 have been found to be promising. Recent studies indicate the dioscorea hybrid H-312 and H-1687 are more adapted to wide range of conditions ensuring higher tuber yield. Tree tomato is consumed as delicious chutney when raw or after roasting and peeling off the skin. The tubers of *Vigna vexillata* are rich in carbohydrates and minerals. The tubers of *Flemingia vestita* are rich in iron (2.64 mg), phosphorous (64.06mg) and contain fair amount of protein (2.99 g), calcium (19.77) and carbohydrates (27.02g) (Sarma, 2001). Turmeric variety Megha turmeric-1 (earlier known as RCT-1) and ginger variety Nadia were found suitable for the region. Lakadong is a turmeric variety found in this region, which has high percentage of curcumin content (7.4%).

The native species of orchids having ornamental value and market potential usually belong to Aerides, Anachnantha, Arundina, Cymbidium, Dendrobium, Paphiopedillum, Phaius, Renanthera, Phycostyllus and Vanda etc. (Borthakur, 1992). The juice from cut leaves of *Cymbidium giganteum* is used by Khasis for clotting of blood while the juice of Vanda flower is used as eye drop for cure of glaucoma. There is immense scope of medicinal and aromatic plants for possible use of local germplasm in the improvement of vegetable crops for the use in horticultural industry (Borthakur, 1992).

## CONSERVATION OF DIVERSITY

### Constraints

- **Land tenure issues:** Land tenure systems vary widely among different North-Eastern states, which are quite different from the rest of India. The complexity in land ownership and tenurial rights makes it difficult for survey, demarcation and consolidation of land. Therefore, cadastral survey and land demarcation are completely absent in the hill areas of northeast.
- **Gender and equity issues in natural resources and diversity management:** Unequal distribution of land resources is responsible for increasing dependence on forests by certain sections of the society leading to diversity degradation. Resolving the gender and equity issues

concerning natural resource management is equally important in North-East as in the other parts of the country.

- **Inter-departmental coordination:** Inter-departmental coordination is essential to the sustainable management of horticultural resources in the region.
- **Smuggling of timber across the international border:** The illicit felling of trees and timber smuggling across the international borders has been the most important cause of horticulture areas/forest degradation in border.
- **Shifting cultivation:** Unregulated shifting cultivation by the local tribal populations has been a major threat to sustainable diversity management particularly in unclassed and community forests of the region.
- **Inter-state border dispute:** There exist a lot of inter-state border disputes among the north-eastern states. Most of these border areas are forest lands and because of boundary disputes, such lands are often declared as 'no man's land' and hence, do not come under any form of management. This leads to the degradation of diversity in such areas.
- **Insurgency:** The long insurgency problem in some states such as Assam and Tripura has considerable impact on diversity conservation.

### **Prospects**

Although there are not many agencies/organizations working exclusively for diversity conservation in north-east *per se*, the activities taken up by many organizations including non-governmental and traditional institutions, government departments and scientific institutions have direct or indirect implications for diversity conservation.

- **State Government Agencies:** Many state agencies are now involved in such diversity conservation activities as establishment of germplasm banks for horticultural crops.
- **Research Organizations:** Many state and central government research organizations including universities of the region are engaged in research, inventory and conservation of diversity in the region. Such organizations are 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 through out 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.
- **Non-Governmental Organizations:** Many non-governmental organizations are now working for the conservation of diversity in north-east, although most of them are local and grassroots level.
- **International Donor Agencies:** International donor agencies in Meghalaya, Manipur and Assam, and Nagaland have been playing crucial role in conserving the diversity through their respective projects.
- **International and National Policies and Conventions:** All the international treaties and national policies have significant impact on the conservation of diversity in the north-east.
- **Academic Institutions Including Schools and Colleges:** The educational curriculum in the universities, colleges and schools has an important role to play in diversity conservation.
- **Shifting Cultivators:** The shifting cultivators and other traditional farming communities of north-east 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.

### **Gaps**

The depletion of diversity and inadequacy in actions to conserve the diversity of the region may be attributed to several factors, which range from inadequate knowledge about diversity and its components to adoption of wrong and inappropriate policies by the concerned stakeholders.

### 1. Gaps in knowledge and information

- Information on urban diversity is scanty
- Species inventory in inaccessible areas of Arunachal Pradesh, Nagaland, Karbi Anglong and North Cachar hills of Assam, and parts of Mizoram and Manipur is yet to be made.
- Information on genetic diversity is extremely poor
- Information on wild ornamentals and aromatic plants is scanty.

**2. Gaps in vision:** Most of the programmes and activities being undertaken by the state governments are shortsighted. Long-term planning based on sustainable development strategies and integration of diversity conservation issues with development planning is the need of the hour.

- **Monoculture plantations:** In order to increase the revenue generation, the State Horticulture Departments pursue the policy of raising plantations of commercially important species by clearing and burning the natural diversity areas.
- **Introduction of high yielding varieties/hybrids of crops:** The horticulture departments are introducing various high yielding varieties/hybrids of horticultural crops. This is associated with increasing use of inorganic fertilizers and chemicals for plant protection. Such policies not only ignore the indigenous species and varieties but also have adverse effects on existing flora and fauna.
- **Conversion of natural vegetation areas into cash crops:** Cash crops such as tea, coffee, cardamom, ginger and turmeric are being encouraged by several agencies throughout the north-east. Many shifting cultivation rehabilitation programmes introduce these cash crops as alternatives to shifting cultivation. These plantations are obviously taken up on lands with natural vegetation (in past or present) at the cost of diversity.

### 3. Gaps in policies and legal structure

- The wrong conservation policies with focus on economically important species have been harmful to diversity. Such policies as adopted in Tripura, Mizoram, Nagaland and Meghalaya have not only decreased the species diversity in natural/ rehabilitated forests but have also resulted in accelerated soil erosion and loss of soil moisture.
- The policy of rehabilitation of *jhumias* through rubber plantation as has been done in Tripura may prove to be a disaster for other floral species in such areas.
- The policy of promoting high yielding varieties and assessment of progress and success on the basis of consumption of fertilizer and plant protection chemicals has led to ignoring the indigenous varieties. The government subsidy and credit policy is instrumental in adopting these schemes.
- Through the Public Distribution System only HYV are distributed. There is a need to include distribution of indigenous varieties too.
- The planners have not considered the role and value of diversity in preparing developmental plans. Such ignorance has been responsible for taking no efforts to conserve and enhance diversity.
- Most of the problems are related to increase in population. The rate of population growth in the north-east is unusually high. This causes tremendous strain on the natural resources and adoption of certain policies that are not very friendly to conserve diversity. No population policy has been adopted for future planning.
- Education policy does not include teaching on diversity conservation. The school curriculum should be able to mould the young minds in favour of diversity conservation.



- There is no policy as such to create awareness among masses for diversity.

#### **4. Gaps in institutional and human capacity**

- The number of trained taxonomists in the region is grossly inadequate. This is one of the most important bottlenecks for completing the inventorization of diversity.
- Not all persons concerned with management of genetic resources understand the concept of diversity in proper perspective. Many of them suffer from biased attitudes. So it is imperative that those who plan, decide and implement the developmental programmes are adequately trained and educated in favour of diversity conservation.
- There are a number of institutions, departments, colleges, universities, NGOs, local community groups that follow certain programmes having bearing on genetic resources. While framing their programmes, these agencies are motivated to pursue their own goals in watertight compartments without considering their impact on other programmes or existing resources. There is no institution, which can make them sit together and discuss the programmes in a holistic manner.

#### **5. Gaps in diversity related research and development**

- Regeneration and cultural practices for many species need to be researched and standardized for their cultivation. Threatened species need immediate action for ensuring their continued existence.
- Identification and classification of threatened species need to be done.
- Richness of diversity of horticultural crop species is yet to be fully inventorized and documented.
- 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 needs to be encouraged.

### **CONCLUSION**

Considerable diversity exists among the regional horticultural species including variation in plant type, morphological and physiological characteristics, reactions to diseases and pests, adaptability and distribution in the NE region. Apart from the nutritional value, many regional horticultural crops are used for medicinal purposes, income generating and poverty alleviation programmes in the rural areas.

Problems relating to diversity conservation and development of horticulture in north eastern region are land tenure issues, gender and equity issues, inter-departmental coordination, smuggling of timber across the international border, shifting cultivation, inter-state border, insurgency, etc., which are responsible for horticulture diversity degradation. The establishment of NBPGR, ICAR, BSI, and various universities in north east has made tremendous impacts in collection, evaluation, conservation and utilization of regional germplasm for development of horticultural varieties in this region. Keeping in view the regional demand for horticultural crops more germplasm needs to be identified for collection particularly for high yield, quality, resistance to diseases and pests, tolerance to frost and acidity.

### **REFERENCE**

- Arora, R.K. and Pandey Anjula, 1996. Wild edible plants of India-diversity, conservation and use. ICAR, NBPGR, New Delhi, pp 294.
- Bhattacharya, S.C. and Dutta S., 1956. Classification of citrus fruits of Assam. ICAR Monograph No.20.
- Borthakur, Dharendra Nath, 1992. Agriculture of the North Eastern region with special reference to hill Agriculture. Beecee Prakashan, Guwahati, pp 47-58.

- CSIR, 1950. The wealth of India, CSIR, New Delhi. Vol. II, pp 56.
- Gosh, S.P., 1984. Horticulture in North East Region. Associated Publishing Company, New Delhi,
- Hore, D.K., 2001. North East India-A hot-spot for agrobiodiversity. *Summer school on agriculture for hills and mountain ecosystem*, pp 361-362.
- Kumar, Sunil K., Suresh, V.R., Nagachen, S.V. and Singh, Th. Raghmani, 2002. Tree bean: a potential multipurpose tree. *Indian Horticulture*, Oct-Dec, pp10-11.
- Pandey, G., 2002. Popularizing under exploited fruits for consumptions, *Indian Horticulture*, Oct-Dec, pp 18-21.  
pp 38.
- Ram, D., Kalloo, G. and Banerjee, M.K., 2002. Popularizing kakrol and kartoli: the indigenous nutritious vegetables. *Indian Horticulture*, pp 6-9.
- Rana, R.S., Gupta, P.N., Rai, Mathura and Kocchar, S., 1995. Genetic resources of vegetable crops, management, conservation and utilization. NBPGR, New Delhi, pp 1-19.
- Rao, Srinivasa M., and Dora, Dillip K., 2002. Less known vegetables for nutritious, health and economic security- Indian context. International Conference on Vegetables, Bangalore, pp 610-617.
- Sarma, B.K., 2001. Under utilized crops for hills and mountain ecosystems. *Summer school on agriculture for hills and mountain ecosystem*, pp 308-314.
- Seshadri and Srivastava, Umesh, 2002. Evaluation of vegetable genetic resources with special reference to value addition. International Conference on Vegetables, Bangalore, Bangalore. pp 41-62.
- Thakur, N.S. Azad, Sharma, Y.P. and Barwal, R.N., 1988. Tree tomato cultivation in Meghalaya, *Indian Farming*, Feb., pp 3.
- Tripathi, R.S. and Barik, S.K., 2003. North East eco region diversity strategy and action plan. Ministry of Environment and Forest report, pp 15.