

DIVERSITY OF CUCURBITACEOUS CROPS IN NORTH EASTERN REGION

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INTRODUCTION

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 six agro climatic zones. The North Eastern region is one of the richest reservoirs of genetic variability and diversity of different horticultural crops, i.e., various kinds of fruits, vegetables, spices, ornamental plants and also medicinal and aromatic plants. The diversity for cucurbitaceous crops of this region has mainly been managed by local farmers, often women. Considerable diversity exists among the regional cucurbitaceous crops including variation in plant type, morphological and physiological characteristics, reactions to diseases and pests, adaptability and distribution. Apart from the nutritional value, many regional cucurbitaceous 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 the 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 dispute, insurgency and others factors, which are responsible for horticultural diversity degradation. Adequate attention was given for systematic management of the rich diversity available in this region with the establishment of NBPGR Regional Station in Meghalaya and it gained remarkable momentum in recent years. Apart from this, the ICAR Research Complex for NEH Region (Meghalaya) with campuses through out the north-east, Central Potato Research Station (Meghalaya), Central Plantation Crops Research Institute - Regional Station (Assam), National Research Centre for Orchids (Sikkim), Botanical Survey of India (Shillong), GB Pant Institute of Himalayan Environment and Development - North-East Unit (Itanagar) and various universities in North East and their research stations have made tremendous efforts in collection, evaluation, conservation and utilization of regional germplasm for development of horticultural varieties in this region.

Keeping in view the regional demand for cucurbitaceous crops, more germplasm needs to be identified for collection particularly for high yield, quality, resistance to diseases and pests. The paper describes the diverse regional cucurbitaceous crops and their position in the traditional cropping systems of the region. It also highlights the collections, conservation, evaluation and utilization of regional horticultural species.

The North Eastern 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 criteria to measure the degree of diversity. The number of endemic species also reflects into account while assessing the richness of diversity.

In the NE region apart from cultivated cucurbits, enormous diversity occurs in semi domesticated and wild types in local pockets. Such types have been selected locally by tribal as part of their routine vegetable requirement. The most important crops genera included *Cucumis*, *Cucurbita*, *Momordica*, *Trichosanthes* and *Benincasa*. Many of these have not only contributed towards diversity but also are rich gene pool for important traits. These materials along with their close wild relative serve as genetic stocks by plant breeders for development of improves vegetable varieties. With increase in the population, there is immense need to explore newer sources of vegetables and to diversify vegetable farming/cultivation to meet

the present day's demand. The diversity present in cucurbitaceous crops will be very useful in screening newer sources of vegetables for present and future needs. The wild gene pool possess important traits and may be explored both by direct selection or improvement through breeding. They also constitute a priceless reservoir that contains genes conferring better adaptation to stress environment and also resistance to disease and pests.

Many of the cucurbitaceous vegetables being resilient and adaptive can be grown on the land, which is not suitable for other vegetables. They do not require a high input technology and can be raised with comparatively lower management costs. Several of them are very nutritious, remunerative and have come to rescue of people in times of crisis. Apart from the nutritional value, many regional cucurbitaceous crops are used for medicinal purposes, income generating and poverty alleviation programmes in the rural areas. The cucurbitaceous vegetables have longer storage life and some of them can be stored for years without decay.

EXPLORATION AND DISTRIBUTION

Cucurbitaceous vegetables: This large group of vegetable crops, consisting of more than 15 kinds, is grown and consumed within the region. In North East many species of cucurbits are found as vegetables and fruits. These include *Cucurbita*, *Momordica*, *Luffa*, *cucumis* and several lesser known cucurbitaceous crops. The cucurbits in northeastern region are grown as mixed crops with maize, ginger, French bean, amorphophallus, colocasia, cassava, chilli, etc., as well as pure crops. However, they are the main constituents in the kitchen garden of the farmers. Most of cucurbits are indigenous to northeast and few like chow-chow, *C. pepo*, etc., have been introduced, which have so acclimatized to this region that large variability is observed.

Table 1. Indigenous and exotic cucurbits in north eastern region

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.

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 Himalaya and NE region particularly Meghalaya. *C. sativus* var. *sativus* is cultivated all across the North Eastern region in tropical and subtropical conditions. However, *C. sativus* var. *sikkimensis* has adapted in temperate and humid climate. Among gourds, In North Eastern region maximum variability has been recorded for bottle gourd in fruit shape and size. The Indian gene centre has rich diversity in genetic resources of ridge gourd (*L. acutangula*) and sponge gourd (*L. cylindrica*) especially in North Eastern region. In bitter gourd small as well as large sized forms are available.

Chow-Chow (*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, is distributed in 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 and the Garo hills of Meghalaya (Ram *et al.*, 2002).

Table 2. 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>	Throughout 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, Tripura, West Bengal	Limited
<i>Momordica dioica</i>	Garo Hills	Rare
<i>Trichosanthes anguina</i>	Meghalaya, Tripura, Assam, West Bengal	Limited
<i>Trichosanthes dioica</i>	Tropical areas of Assam, Tripura	Limited
<i>Cyclanthera 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

Diversification of minor/underutilized cucurbitaceous vegetable in north eastern region

There are several minor/underutilized cucurbitaceous vegetables, which are grown and consumed by tribals of the region. These are mainly *Cucumis hystrix*, *cucumis trigonus*, *Luffa graveolens*, *Momordica macrophylla*, *Momordica subangulata*, *Trichosanthes cucumerina*, *Trichosanthes khasiana*, *Trichosanthes ovata*, and *Trichosanthes truncasa*.

GERMPLASM EVALUATION

In order to facilitate effective utilization of plant genetic resources, it is important that these are evaluated for productivity and its components, crop duration, resistance to biotic and abiotic stress and quality of produce. The germplasm material available at different centres has been evaluated and utilized for crop improvement.

Chow-Chow (*Sechium edule*) produces large starchy edible roots in addition to fruits. The tender leaves are also sold in the market and consumed by the tribal people. The National Bureau of Plant Genetic Resources, Regional Station, Shillong is the main organization involved in collection, characterization and conservation of several cucurbitaceous germplasm. Apart from this, ICAR Research Complex for NEH Region and Assam Agriculture University are also doing research work on the cucurbitaceous vegetables.

Table 3. Collection of cucurbitaceous vegetable germplasm

Cultivates species	Parts to be collected during exploration	Number	Source
<i>Cucurbita maxima</i>	Ripen fruit/mature seed		
<i>Cucurbita moschata</i>	Ripen fruit/mature seed	795	NBPGR
<i>Cucurbita ficifolia</i>	Ripen fruit/mature seed		
<i>Cucurbita pepo</i>	Ripen fruit/mature seed		
<i>Coccinia grandis</i>	Ripen fruit/mature seed		
<i>Cucumis sativus</i>	Ripen fruit/mature seed	294	NBPGR
<i>Cucumis callosus</i>	Ripen fruit/mature seed	156	NBPGR
<i>Cucumis melo var momordica</i>	Ripen fruit/mature seed	433	NBPGR

<i>Luffa acutangula</i>					
<i>Luffa cylindrica</i>					
<i>Momordica charantia</i>	Ripen fruit/mature seed		519	NBPGR	
<i>Momordica cochinchinensis</i>	Mature seed/tuberous root /stem cutting/apical shoots				
<i>Momordica dioica</i>	Mature seed/tuberous root /stem cutting/apical shoots				
<i>Trichosanthes anguina</i>	Mature seed/stem cutting/root cutting		144	NBPGR	
<i>Trichosanthes dioica</i>	Mature seed/stem cutting/root cutting				
<i>Cyclanthera pedata</i>					
<i>Benincasa hispida</i>	Mature fruit/mature seed		326	NBPGR	
<i>Lagenaria siceraria</i>					
<i>Sechium edule</i>					

Table 4. Cultivated species of cucurbitaceae of regional and local importance

Scientific name	Uses	Lowland (L) /highland(H)	Annual (A)/ perennial(P)	Chromosome No.	Comments
<i>B. hispida</i> (Wax or white gourd)	Young and mature fruits, young leaves and buds as vegetable, seeds	L	A	24	Fruit have long term storage capacity, seed from mature fruit can be taken during collection
<i>Cucumis anguria</i> (West Indian gherkins)	Young fruits as vegetable, pickles	L	A	24	Extraordinary numerous fruits
<i>Momordica dioica</i> (biter gourd)	Fruits, shoots and leaves as vegetable	L	A	28	Seeds from mature fruit are collected
<i>Trichosanthes dioica</i> (pointed gourd)	Fruits as vegetable	L	A	28	

Table 5. Cultivated crop genera and their wild relatives (interspecific, intraspecific and infraspecific categories)

Crop	Genus	Cultivars (species)	Wild relatives (species)	No. of taxa available in the region
Snake gourd	<i>Trichosanthes</i>	<i>T. palmata</i>	<i>T. palmata</i>	<i>T. palmata</i>
		<i>T. multiloba</i>	<i>T. multiloba</i>	<i>T. wallichiana</i>
		<i>T. cordata</i>	<i>T. cordata</i>	<i>T. multiloba</i>
		<i>T. truncata</i>	<i>T. truncata</i>	<i>T. cordata</i>
		<i>T. himalensis</i>	<i>T. himalensis</i>	<i>T. truncata</i>
		<i>T. dicaelosperma</i>	<i>T. dicaelosperma</i>	<i>T. dioica</i>
		<i>T. dioica</i>	<i>T. nervifolia</i>	<i>T. anguina</i>
		<i>T. nervifolia</i>	<i>T. cucumeriana</i>	
		<i>T. cucumeriana</i>	<i>T. lobata</i>	
		<i>T. anguina</i>	<i>T. integrifolia</i>	
		<i>T. lobata</i>		
	<i>T. integrifolia</i>			

Ash gourd	<i>Benincasa</i>	<i>B. hispida</i> <i>B. cerifera</i>	<i>B. cerifera</i>	<i>B. hispida</i> <i>B. cerifera</i>
Bittergourd	<i>Momordica</i>	<i>M. charantia</i> <i>M. balsamina</i> <i>M. dioica</i> <i>M. cochinchinensis</i> <i>M. denudate</i> <i>M. symbalaria</i>	<i>M. balsamina</i> <i>M. denudate</i> <i>M. symbalaria</i>	<i>M. charantia</i> <i>M. dioica</i> <i>M. cochinchinensis</i>
Melons	<i>Cucumis</i>	<i>C. trigonus</i> <i>C. prophetarum</i> <i>C. sativus</i> <i>C. sativus var. sikkimensis</i> <i>C. melo</i> <i>C. melo var. momordica</i> <i>C. melo var. utilissimus</i>	<i>C. hardwickii</i> <i>C. hirsutum</i> <i>C. metuliferus</i> <i>C. prophetarum</i> <i>C. zeyheri</i>	<i>C. sativus</i> <i>C. sativus var. sikkimensis</i> <i>C. hardwickii</i> <i>C. callosus</i> <i>C. anguina</i>

Trichosanthes

Trichosanthes palmata:

Leaves 3-7 inches across, usually palmately 3-7 lobed;

Flowers 1.5-2.5 inches across, male flowers in elongate racemes, female flowers on short peduncles;

Fruit 1.5-2 inches across, ellipsoid or globose, at first red with orange streaks.

T. multiloba:

Leaves 3-6 inches across, glabrous or scabrous with scattered bristly hairs on the nerves;

Flowers dioecious;

Fruit bright red with orange stripes.

T. cordata:

Leaves 6-8 inches across, entire, angled or obscurely lobed;

Flowers dioecious;

Fruit globose.

T. truncata:

Leaves 4-5.5 by 2.5-3 inches, ovate acuminate;

Flower male flowers white, female plant not seen.

T. himalensis:

Leaves 5 inches, irregular serrate;

Fruit 3-4 by 1-1¹/₄ inches, nearly circular in section.

T. dicaelosperma:

Leaves 4 by 3¹/₂ inches;

Fruits pubescent with 10 paler vertical bands.

T. nervifolia:

Leaves 3 by 1¹/₂-2 inches, membranous, not lobed;

Fruit 2-3 inches, circular in section, about twice as long as broad.

T. cucumerina:

Plant is annual and closely related to cultivated *T. anguina* (snake gourd) but differs in fruit length, shape and absence of stripes on fruit surface.

Leaves 2-4 inches diameter, usually 5-lobed about half-way down, lobes obtuse;

Flower monoecious, male peduncles in pairs, the earlier 1 flowered the later racemed.

T. lobata: Leaves pubescent beneath and with flaccid hairs;

Fruit 2-4 by 1-2 inches, acute at both ends.

T. integrifolia: Leaves 2¹/₂-6 inches; Fruit 2 inches diameter, red.

T. dioica: (parwal)

It is extensively cultivated in the warmer parts of the country/region. Plants are dioecious and normally grown in rainy season. Fruits are commonly used as vegetable. They are as pickled and are also used in confectionary. Several cultivated forms differing in size, shape and marking of the fruits are commonly grown.

Leaves about 3 by 2 inches, ovate-oblong, cordate;

Flower male peduncles paired but not racemed, male flowers wooly outside;

Seeds half ellipsoid, corrugate on the margins.

T. anguina: (snake gourd)

Leaves 5 lobed or angled leaves and long elongate cylindric; sometimes cultivated for the fruits, which are used as vegetable.

Fruits are characteristically long (up to 1.5 m) and often twisted with 7-8 white stripes along its length when green. The young fruits are largely used as a vegetable either boiled or in curries. Variation in the fruits, i.e., length, diameter, colour and number of stripes occurs within the species.

Momordica

In *Momordica* spp. total 60 species are reported world wide and out of them 7 are available in India but only four (*Momordica Balsamina*, *M. charantia*, *M. chochinensis*, *M. dioica*) are commonly available and cultivated in one or other part of north eastern region.

Uses: Fruits, leaves and roots of *Momordica* spp. are used as stomachic, carminative, antipurgative regulating diabetes; leaf extract is used as appetizer, astringent and in liver and spleen disorders. Roots are useful in piles and urinary disorders.

Momordica dioica: (kartoli or spine gourd)

It is also found in cultivated/semi wild form. It is dioecious, perennial in nature having tuberous roots. The green fruit is extensively used as vegetable by cooking or frying.

Leaves 1.5-4 inches long, cordate, acute more or less 3-5 lobed;

Flowers large, dioecious and yellow in colour;

Fruit 1-3 inches long, shortly beaked, densely covered with soft spines.

M. charantia: (better gourd)

It is totally domestic. Plant is monoecious, vine type and has variation in fruits shape and size.

Leaves 1-3 inches across, deeply 5-7 lobed;

Flowers monoecious and yellow in colour;

Fruit 1-5 inches long, tapering at both ends, is characterized by its tuberculate-muricate skin and sculptured seed surface; full mature unripe fruit at tender stage is used for vegetables, in pickles and curries and in salad. The fruit becomes yellow when ripens.

M. cochinchinensis: (kakrol or sweet gourd)

The plant is perennial with tuberous roots.

Leaves 4-5 inches across, usually 3 lobed;

Flowers dioecious, large, whitish;

Fruit 3-5 inches long, ovate or oblong, covered with conical points, bright red when ripens. Hard spines are found on fruit surface. The mature fruit is used as vegetable.

M. balsamina:

Leaves 1¹/₂-3 inches diameter, palmately 3-5 lobed to about the middle;

Fruit 1-3 inches, red, usually quite smooth. Immature tender fruits are used as vegetable or pickled

M. denudata:

Leaves 2-4 by 1-2 inches, deeply cordate, 3-5 lobed; Fruit $\frac{3}{4}$ inches long and broad.

M. cymbalaria:

Leaves 1-2 inches broad, 5-lobed; Fruit $\frac{3}{4}$ by scarcely $\frac{1}{4}$ inches, few, shortly obovoid, smooth, shining.

M. subangulata:

It is also dioecious and perennial in nature with short annual vines.

Benincasa

Benincasa hispida:

It is a tropical and subtropical fruit and has wide variability among its cultivars. The plant is monoecious vine type bearing large green fruits. The mature fruit becomes white and is used to prepare sweet (petha) from its mature fleshy parts.

Fruits are globose-cylindrical in shape and covered with thick epicuticular wax.

Benincasa cerifera: Leaves 4-6 inches diameter; Fruit 1-1 $\frac{1}{2}$ feet, cylindrical, without ribs, hairy, ultimately covered with a waxy bloom.

Cucumis

Cucumis trigonus:

Leaves 1-2 inches in diameter, entire; Fruits sometimes with a few scattered hairs, often with 10 stripes.

C. prophetarus:

Leaves 1-1 $\frac{1}{2}$ inches, reniform, subtriangular, much lobed; Fruit green, with paler vertical stripes.

C. melo: Leaves 3 inches diameter, petiole 2 inches; Female peduncle sometimes 2 inches; Fruit spherical ovoid elongate or contorted.

Cucumis melo var. *momordica* (snap melon or foot)

Cucumis melo var. *utilissimus* (kakari)

C. sativus: Leaves 3-5 inches diameter; Female peduncle sometimes 2 inches; Fruit commonly cylindrical, 12 by 1 $\frac{1}{2}$ inches.

Cucumis hardwickii:

It is closely related wild species and considered progenitor of cultivated cucumber. It is annual in nature and crossable with the cultivated types. It is resistant to green mottle virus and some nematodes.

Fruits small, oval, bitter with sparse and stiff spines on the surface

Flower monoecious

Leaves highly lobed.

PROBLEMS RELATING TO DIVERSITY CONSERVATION

- **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 the North-East as in the other parts of the country.

- **Over exploitation of genetic resources**
- **Deforestation and soil degradation**
- **The adverse impact of development and increase in the population**
- **Inter-departmental coordination:** There is a need for a close inter-departmental coordination for 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 in 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, does 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.

CONSERVATION OF DIVERSITY

Although there are not many agencies/organizations working exclusively for diversity conservation in the 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 and 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; GB Pant Institute of Himalayan Environment and Development, North-East Unit, Itanagar; 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 the north-east.
- **International Agencies:** International donor agencies in Meghalaya, Manipur, Assam and Nagaland have been playing crucial role in conserving the diversity through their respective projects.
- **International and National Policies and Conventions:** Many of the international treaties and national policies have significant impact on the conservation of diversity in the north-east.
- **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 IN DIVERSITY CONSERVATION

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

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 are the needs 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 cucurbitaceous 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.

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.
- Most of the problems are related to increase in population. The rate of population growth in the northeast 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.
- No policy as such is operational 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 serious 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

In the NE region considerable diversity exists among the regional cucurbitaceous 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 cucurbitaceous 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. 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.

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