Conservation and Sustainable Development of Plant Resources of North East India

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The Indian region having diverse geo-climatic conditions, boasts of a rich diversity of plants, animals and microorganisms. The diversity of ecosystems, species and genetic pool within the species is also abundant. Being the world's top 12 'mega-diversity' countries, India has the Eastern Himalayas and the Western Ghats as important 'hotspots' identified in the world (Myers *et al.* 2000). Over 49,000 species of plants that constitute 12 percent of the known plant species in the world are present in India. The flowering plants of our country comprise about 17,000 taxa of which 5725 are broadly considered endemic and represent 33.5 percent of the flora located in 26 endemic centres. North-East India (21.57°N - 29.30°N and 89.46°E - 97.30°E), comprising Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura and Sikkim has international boundaries with China, Bangladesh, Bhutan and Myanmar. The region is connected with the rest of India through a narrow corridor in North Bengal popularly known as the 'chicken neck'. Occupying an area of 2.55 lakh square kilometer, it accounts for 7.8 percent of the total land space of the country, is made up of mountains above the snowline and plains a little higher than the sea level. The total annual rainfall varies significantly. It reaches the maximum of about 1080 cm

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around Cherrapunjee and Mawsynram in Meghalaya (areas with the highest rainfall in the world). But it is significantly low in the rain shadow area of Assam's Nagaon district.

The total forest cover in North-East India is as follows :

Assam	39.10%
Arunachal Pradesh	61.67%
Manipur	49.01%
Meghalaya	31.80%
Nagaland	17.42%
Sikkim	36.30%
Tripura	60.01%
Mizoram	34.51%

(Source: http://www.northeastvigil.com)

The forests are very rich in timber-yielding trees. The *sal* and *teak* are the major tree species. Other important timber trees are *champa*, *semul*, *makai*, *hollong*, and *hollock*. Cane, agar-wood and oil, menthol, peppermint oil, lemon grass oil, turpentine, cinnamon (leaf, oil and bark), *Cassia* leaf and bark, and broom grass are important minor forest products of the region. Pine and bamboos are two main sources for the pulp and paper industry.

The North-East represents a distinct biogeographic zone, rich in bioresources, ethnic cultures and folk traditions. About 179 genera and 1152 species of legumes are present of which 263 taxa are endemic. As the region has a remarkably rich and diverse flora, being home to about 8000 species it is also known as the 'Cradle of Flowering Plants'. The region is both the primary and secondary centres of origin of about 50 crop plants with 190 wild relatives including citrus, banana, plantain, mango, rice, several species of legumes, cucurbits, orchids, bamboos, medicinal and aromatic plants. About 13 percent of the forested area of India is covered by bamboos, which play an important role in the economy of the country. India harbours around 18 genera and 130 species of bamboos of which 15 genera and 63 species are reported to be in North-East. There are 90

species of rhododendrons in India of which 80 are found in the Eastern Himalayas alone. The country's orchids are represented by 163 genera and 1100 species and of these about 780 species grows in the North-East and Eastern Himalayas. Some of the important medicinal and agri-horticultural plants of the North-East are listed in tables 1 and 2 respectively.

Plant genetic resources, which are the basis of the human survival and economic well-being-as they provide food, clothing, shelter, medicine, biomass energy and industrial raw material - offer a potential for providing many more yet unknown benefits to the future generations. From the commercial point of view, biodiversity has assumed enormous importance. There is an annual turnover of Rs. 23 billion (US $657 million) of Ayurvedic and herbal products from India (Natesh 1999). Between 70- 80 percent of the population relies on plants as the only source of medicine and over 7500 plants (out of 8900 species of ethno botanical interest) are used for medicinal purposes in the country. Biodiversity has been a source of revenue from extractable products obtained from individual species. The use of compounds, genes and species is essential for industrial purposes. Bio- prospecting links between biodiversity and industry have drawn greater attention in recent years. In the past, this activity generated revenue mostly for the industry and hardly any efforts were made for biodiversity conservation and the flow of profits to the source countries or individuals (Tamayo *et al.* 1997). Protection of plant genetic resources against bio-piracy, needs utmost priority and patenting laws governing this, need to be reviewed. Both direct and indirect economic benefits to humanity have been offered by biodiversity. Biodiversity is valued not only for its ecological, evolutionary, aesthetic and ethical importance but also as a potential source of new knowledge, innovations and ideas. These can generate industrially and commercially valuable Intellectual Property Rights (IPR) in all domains of biodiversity-based enterprises. The linkages and leads generated through sustainable use of bio resources (including the associated indigenous knowledge systems) and biotechnology are well

established. These lead to several areas of bio prospecting (Fig.1), more so in chemical and gene prospecting (Eisner 1997). Bio prospecting can be used to explore and evaluate the economic potentials of biodiversity through modern scientific and technological means. For nations like India, biodiversity represents the last remaining natural heritage, which can be used profitably for sustainable human development. The rich and unique wealth of medicinal plants and traditional medicine systems of India have the potentials to capture the world herbal and pharmaceutical markets, provided the country strives to bring in substantial value addition to the existing resource base and knowledge systems through modern bio prospecting methods (Pushpangadan 2002). Constitution of a State Medicinal Plant Board for North-East India is an urgent action required to oversee and co-ordinate the various activities pertaining to the medicinal plant sector of the region.

The plant genetic resources are getting depleted at an alarming rate. It is estimated that there are more than 2,70,000 plant species in existence and about 34,000, i.e., 1 in 8 of these are endangered (IUCN, 1998). One quarter of the plant species are estimated to be in danger of extinction within the next generation. The resources of the developing countries are more susceptible to threats due to the destruction of habitats because of the ever-increasing human population, unplanned developmental activities and ruthless exploitation of plants for commercial purposes. At times unmindful and excessive collection of plants by students of Botany may also endanger some rare plants. Human interference of the flora of North-East India could be due to the following reasons:

- Burning of forests during the pre-monsoon months for the growth of grass, which is the secondary forest product for cattle rearing and dairy farming.
- Burning of agricultural fields in the form of *Jhum* or shifting cultivation and *Bun* cultivation or burning of the undergrowth.

- Excessive and unmindful collection of forest by-products like medicinal herbs and minor non-wood forest products like ginger, ginseng, *Lycopodium* etc.
- Cutting of dense forests randomly for timber trade.

The above listed economic activities listed above have resulted in the huge depletion of rich forest resources or bio resources. The loss of a valuable germplasm can also be attributed to the excessive introduction of a particular species from one part of the world to another. The impact of the declining area under vegetation has resulted in a serious ecological imbalance leading to soil erosion, desertification, dwindling of forest wealth, wildlife and plant germplasm resources.

The end result has been the extinction of a great number of plant species including several unique and irreplaceable varieties, while many more await a similar fate. The reduction of diversity within the species means losing the variation required for the improvement of plants. Plant genetic resources have limits in their rates of growth, reproduction and adaptation. An additional loss of plant genetic resources on account of the destructive activities of man will jeopardize the welfare of future generations. The current rates of extinction demand immediate concerted remedial efforts because, in the face of accelerating losses, our greatest enemy is time. Further, biological resources are likely to be the basis of all future welfare and security of nations.

The conservation of plant genetic resources has been long realised as an integral part of plant genetic improvement programmes. During the last century the crop improvement worldwide was possible by utilising the genetic diversity of plants for breeding purposes. Conservation of plant genetic resources could be accomplished both by *in situ* and *ex situ* methods. According to Mao and Hynniewta (1999), the following points are worth considering for such conservation :

- ***Protected Area Network.*** Network of protected areas covering different bio-geographical and eco-climatic zones

may further be created and the existing areas be given proper protection.

- ***Fragile Ecosystem.*** Since the north-eastern mountain ecosystem is highly fragile and forests are depleting at a faster rate, it is of utmost necessity to identify the ecologically sensitive areas and to declare them for long-term scientific baseline studies.
- ***Sanctuaries.*** More gene sanctuaries of threatened plant species be established to avoid huge managerial problems.
- ***Alternate Cropping.*** Modern agricultural technology be encouraged amongst the rural people to grow cash crops like coffee, black pepper, pineapple, oranges, etc., in order to combat the pressure of shifting cultivation.
- ***Laws.*** More stringent laws be enforced banning the collection of wild plants for commercial exploitation. However, efforts may be made to encourage various communities to cultivate and multiply them to avoid collection from the wild.
- ***Botanical Gardens.*** A chain of Botanical Gardens be established at different altitudes to protect and multiply the germplasm of rare and endangered plant species.
- ***Sacred Groves.*** Sacred groves that are preserved on religious beliefs be protected at all costs being the germplasm banks of several threatened species.
- ***Threatened Plants.*** Special attention be paid towards protection of plants of economic importance that are threatened. They may be multiplied vegetatively or by tissue culture on a mass scale.
- ***Public Awareness.*** Popular write-ups, such as pamphlets, brochures, etc., especially of rare and endangered species in different local languages, besides English, be distributed to the general public to create for bringing awareness and a sense of responsibility towards their conservation.

In situ conservation involves protection of genetic resources in the natural environment through the protection of the environment

itself. It is an ideal and dynamic approach that allows plants to interact and co-evolve with other components of the ecosystem including insects, animals and microbes. However, this conservation method poses some problems. *In situ* conservation is costly to maintain and is highly susceptible to natural calamities like forest fires, extreme weather conditions, and damage by diseases and animals. On the other hand, Botanical Gardens have played an important role in *ex situ* conservation programmes particularly in acclimatization, rehabilitation, multiplication and judicious exploitation. The role of biotechnology is complementary to conventional conservation methods and can directly assist plant conservation programmes through molecular marker technology, molecular diagnostics, *in vitro* technologies and cryopreservation (Tandon 2000; Tandon and Kumaria 1998).

Computer-aided storage and retrieval systems of genetic resources will form an important tool to develop technology packages for conservation and ensuring exchange of information. The Bioinformatics Centre at North-Eastern Hill University has already made a beginning in this direction. An important aspect of this programme should be to prepare databases and provide information on patents. Adequate safeguards have to be made against bio-piracy. In this context, patenting cells must be created in different parts of the country. A comprehensive, mutually accessible database should be built up by accessing data from diverse sources. This should be extended to small and difficult to access publications. This database should be used for making benefit-sharing claims. Data on available germplasm for breeding and cultivation should be made available to researchers and farmers of the region. Steps must be thoroughly undertaken to prepare computerised and easily accessible inventories, which would consider the areas involving techniques in traditional conservation, use of local drugs and practices in agriculture. Technical information should be converted to easily comprehensible information in regional languages. This information should be made widely available for the participation of people in the important areas.

There have been informal arrangements for access to genetic resources for example collaboration between scientists at universities and research institutes, leading to germplasm collections and programmes aimed at benefit sharing and publication of research articles. In addition, appropriate steps must be taken to encourage social and political awareness amongst scientists, and scientific literacy amongst social scientists and politicians. The region should move quickly to enact legislation to protect its bio resources and indigenous knowledge base for conservation and sustainable use of plant resources of the region.

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Table 1: Some of the medicinally important plants of Northeast India

Botanical Name	Family	Medicinal Use	Local Name
Acorus calamus	Araceae	Mental diseases, pregnancy	Kynbat ksuid, Bat-Bhut
Aloe vera	Liliacea	High blood pressure, piles	Jatyngkhieh
Angiopteris evecta	Angiopteraceae	Leprosy, ribs pain, fracture	Arthladawnpui
Ardisia paniculata	Myrsinaceae	Haemorrhoea	Naunuar
Aristolochia tagala	Aristolochiaceae	Liver ailments, stomachache	Kurthlong kynthei, U Bat Kpoh
Begonia peltata	Begoniaceae	Fever, stomach problems	Jajew khapmaw
Centella asiatica	Apiaceae	Diarrhoea	Bat moina
Costus speciosus	Costaceae	Fever	Gokgarik
Cuscuta reflexa	Convolvulaceae	Gastric ulcer	Jawieh raid
Datura stramonium	Solanaceae	Paralysis	Sla tiew dieng lieh
Dendrobium densiflorum	Orchidaceae	Bone fracture	Tiew-lyngskaw
Dendrobium fimbriatum var. *oculatum*	Orchidacea	Bone fracture	Tiew-lyngksiar
Ficus semicordata var. *conglamerata*	Moraceae	Liver ailments, many others	Thei pui
Garcinia lancaeafolia	Clusiaceae	Stomachic	Pelhte
Gaultheria fragrantissima	Ericaceae	Rheumatism	Lathynrait
Hedyotis scandens	Rubiaceae	Cough and cold	Mo-Shoshu, Meid
Mimosa pudica	Mimosaceae	Diabetes	Kynbat iambait
Musa paradaisica	Musaceae	Ringworm, threadworm	Pashox kait
Nepenthes khasiana	Nepenthaceae	Asthma, indigestion, kidney problems	Ksetphare, Tiew rakot

Osbeckia rostrata	Melastomataceae	Swelling of muscles	Soh lakthut
Paedaria scandens	Rubiaceae	Fractures	Diengjyrmi pnah
Panax pesudoginseng	Araliaceae	Diabetes, stomachache, cancer, paralysis, tonic	Jynseng, Kynbat Sying Jinseng
Solanum khasiana	Solanaceae	Toothache	Sohpdok
Taxus baccata	Taxaceae	Brain tumour,	Diengkseh Blei
Vitex negundo	Verbenaceae	Muscular pain	Tyllai skip
Vitis bifurcata	Vitaceae	Sciatica, swellings	Hruiveikual
Zanthoxylum armatum	Rutaceae	Skin diseases	Jaiur Blei

Table 2: Some of the important agri-horticultural plants of Northeast India

Botanical Name	***Common name***	***Family***
Aegle marmelos	Wood apple	Rutaceae
Artocarpus heterophyllus.	Jackfruit	Moraceae
Baccaurea sapida	Lotka fruit	Euphorbiaceae
Bambusa arundinaceae	Bamboos	Poaceae
Cassia fistula	Cassia	Caesalpinaceae
Cyathea brunniana	Cyatheas	Cyatheaceae
Citrus spp.	Lime, lemon. oranges	Rutaceae
Coix lacryma jobi	Pseudo-cereals (job's tear)	Poaceae
Curcuma longa	Turmeric	Zingiberaceae
Digitaria cruciata	Pseudo-cereals (Raisham)	Poaceae
Dendrobium falanarii	Orchid	Orchidaceae
Dendrocalamus hamiltonii	Bamboos	Poaceae
D. longispathus	Bamboos	Poaceae
Gossypium arboreum	Cotton	Malvacee
Grewia asiatica	Phalsa fruit	Tiliaceae
Magnifera indica	Mango	Anacardiaceae
Oryza sativa	Rice	Poaceae
Paphiopedilum fairieanum	Orchid	Orchidaceae
Saccharum officinarum	Sugarcane	Poaceae
Saccharum sinense	Sugarcane	Poaceae
Triticum aestivum	Dwarf wheat	Poaceae
Zingiber officinale	Ginger	Zingiberaceae

Fig. 1. Biodiversity and Bioprospecting Links