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Conservation of medicinal and aromatic plants of northeast India

In primary health care, traditional medicines are frequently used by the low-income groups both in the urban and the rural areas. This also holds for the northeast region of India. The value of traditional healers is being recognized by health authorities, who see the traditional medicine as an important element of primary health care. The cost of providing the modern medicine to the entire low-income group is inhibitive to the government and the treatment proves expensive to the users as well. Efforts of the pharmaceutical companies for access to large quantities of plant material are on the increase. The trade of medicinal plants and plant products through local processing can present valuable economic opportunities in the northeast India. The current and future welfare of the population is, and will be, dependent on a sustainable supply of useful indigenous plants. The useful role of the trade in MAPs is being threatened by unsustainable harvesting; cultivation of MAPs can be a solution. A modest beginning has been made. MAP-based local micro-enterprises can also bridge the gap between the rural poor and the relatively well-off urban rich, and promote social harmonization besides a sound environmental conservation.

1. INTRODUCTION

The Northeast region of India comprises eight states, viz., Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura. It has a geographical area of 2,62,382 sq km that accounts for about 8% of the total area of India territory. The region lies between 22° N and 29° 5' N latitudes and 88° 00' E and 97° 30' E longitudes, and shares international border with four countries, viz., Bhutan, China, Myanmar and Bangladesh. The region is predominantly mountainous interspersed with valleys and plains. The altitudinal variation ranges from flood plains of Brahmaputra River to Himalayan peaks about 8585 msl. The altitudinal variation and rainfall patterns of southwest and northeast monsoon play a significant role in the development of ecological niches in this region, which is characterized by heavy precipitation, rich forest cover and biodiversity, fragile mountain ecosystems, high seismicity, a drainage pattern marked by valleys dissected by three major rivers (Brahmaputra, Teesta and Barak) and their tributaries, and low population density. Being home to more than 225 tribal communities, it is a treasure house of biological and cultural diversity, with high ethnic plurality, and contains rich indigenous knowledge systems. The region still has more than 64% of the total geographical area under forest cover. According to 1991 census, the total population of the region is about 31,954,000.

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Being a megacentre of endemism and possessing 1808 plant species (Nayar, 1997), the north-eastern region of India is identified as one of the 'hot-spots' along with the Eastern Himalayas. With about 50% of the Indian flora (over 49,000 species), it possesses a great variation in vegetation (Nayar, 1997; Rao, 1997). The region is the richest reservoir of genetic variability, especially in medicinal plants, orchids, rhododendrons, bamboos, balsams and primulas. More than 7500 plants (out of 8900 species of ethnobotanical interest) have been known to be used for medicinal purposes, most of them growing wild in the region. Some of the important medicinal plants of the region are *Acorus calamus*, *Aconitum* spp, *Coptis teeta*, *Costus speciosus*, *Digitalis purpurea*, *Dioscorea* spp, *Ephedra gerardiana*, *Gentiana kurroa*, *Gloriosa superba*, *Hydnocarpus kurzii*, *Rauvolfia serpentina*, *Rheum emodi*, *Nardostachys jatamansi*, *Picnorhiza kurroa*, *Podophyllum hexandrum* and *Taxus baccata*, among others.

There has also been a global resurgence of interest in plant-based drugs or herbal drugs. A recent survey in India has revealed that more than 1200 medicinal plants are in use in the manufacturing and processing sectors and 162 plants are predominantly traded (CERPA, 2002). Conservative estimates put the monetary value of medicinal and aromatic plants (MAP)-related global trade at more than 60 billion USD (Govt. of India, 2000). India's export earnings from the trade in 2000-2001 was estimated at Rs. 3.2 billion (about 80 million US \$) per annum. With increasing popular demand for medicinal and aromatic plants (MAPs) all over the world, the trade is expected to grow at an estimated rate of 10-15% per annum. Besides, MAPs also provide crucial livelihood options for millions of rural people in South Asia, particularly for women and tribal people. In India, the collection and processing of medicinal plants contribute to at least 35 million workdays of employment a year (Govt. of India, 2000). Given the above, it looks germane to go in for analysis of the biodiversity wealth of the region along with the ethno-biology of different tribes, and for the inventorisation and documentation of the MAPs. This paper focuses on some species, representing the popular plant forms that are traded in the market.

2. DEPLETION OF MAPS AND MANAGEMENT PROBLEMS

Plant genetic resources are getting depleted due to indiscriminate felling of forest trees for timber, shifting cultivation, shrinking habitats as a result of population explosion, and the ruthless exploitation of plants for trade and unplanned developmental activities. Around 20% of plants in the region are considered to have been threatened. Plant genetic resources have limits in their rates of growth, reproduction and adaptation. Therefore, any additional loss of plant genetic resources due to the man-made destructive activities will jeopardize the welfare of future generations. The current rates of extinction demand immediate and concerted positive efforts.

In some areas of the northeast India, public sector agencies exercise monopoly over the purchase and processing of MAPs and other forest products, thus fostering inefficiencies, thwarting commercial development, and

preventing fair pricing for collectors; if timely measures are not taken, these resources may be lost without getting real benefits to the stake-holders and the communities concerned. The attempts made at the policy and project levels to revamp this sector, remain poorly coordinated, inadequately funded, without any clear direction and full of scepticism and information gaps.

Major problems related to MAPs management are the absence of proper survey and identification. A serious hindrance in the development of these resources is caused by the lack of storage facilities, inadequate communication, inaccessibility in remote obscure areas, collection being labour intensive, time consuming and without guarantee of early returns, lack of adequate data on the availability of drug material, lack of quality control in collection and grading non-availability of systematic marketing channels and lack of R & D institutions and modern research facilities in the region.

Though the collection of Mishmi Teeta is banned, the trade still goes on. Other species like *Acorus calamus*, *Rubia cordifolia*, *Andrographis paniculata*, *Taxus wallichiana* have been taken up at suitable locations all over the state of Arunachal Pradesh. A germplasm bank of MAPs has been established at Chessa, a field research station of the State Forest Research Institute. Research laboratory unit at Naharlagun has also undertaken a project to develop agro-techniques of certain species like *Citronella*, *Abroma augusta* and *Rheum emodi*. Though at a very limited scale, some cottage units of processing Citronella and some other plants have come up in Arunachal Pradesh.

Certain medicinal plants require immediate conservation and trade restrictions. *Nepenthes khasiana* (pitcher plant) is an insectivorous plant which is endemic to Meghalaya (War Jaintia of Jaintia Hill, Mawsynram of West Khasi Hill and Garo Hills Districts), and is listed in the Cites Index and IUCN as the most endangered species. It is used as medicine by the villagers. This species is a victim of unregulated and rampant trade in the West Khasi hills; trade restrictions or a complete ban may save this species from extinction.

All orchids including those with medicinal importance have found flourishing market in India and abroad. Their trade in Meghalaya is unchecked despite being carried out right in front of the authorities responsible for conservation of these species. Some important orchids have already vanished, few others are on the verge of extinction. The endangered and rare orchids of the northeast region include *Paphiopedilum venestrum*, *P. villosum*, *Cymbidium cochleare*, *Hebenaria khasiana*, *Bulbophyllum rothschildianum*, *Calanthe herbaceae*, *Diplomeris pulchella*, *Taeniophyllum khasianum*, *Renanthera imshootiana*, *Dendrobium* spp. and *Vanda* species. The well known Lady's slipper orchids (*Paphiopedilum insigne* and *P. hirsutissimum*), which were abundant in the forest of Cherrapunji, have become rare due to their continuous uprooting. In Garo Hills, the Tura peak area contains a number of orchid species of which *Dendrobium densiflorum* and *D. chrysanthum* are quite common. Gradual deforestation has destroyed many ground orchids of the Baghmara-Balphakram area in Garo Hills, rich in the lowland orchids.

In the private sector, there appears to be little understanding of the MAPs cultivation in agricultural systems, particularly concerning the economics of

production and marketing processes. As a result, neither the state nor the private companies and individuals are able to recognize the value of commercializing the production of indigenous plants. Small-scale farmers have no tradition knowledge in cultivating MAPs and rely on the natural environment for their production.

3. CONSERVATION AND MANAGEMENT STRATEGIES

The alarming depletion rate of the plant genetic resources has shown that out of more than 2,70,000 plant species in existence, about 34,000 (i.e., one in eight) are endangered (IUCN, 1998). Since the biological resources are likely to be the basis of the future welfare and security of nations, conservation of plant genetic resources is being considered as an integral part of plant improvement programmes. Conservation of plant genetic resources could be accomplished both by *in situ* and *ex situ* methods. Protected Area Network covering different bio-geographical and eco-climatic zones may be created and the existing areas be given due protection. More gene sanctuaries of threatened plant species could be established to avoid managerial problems and modern agricultural technology be encouraged amongst the rural people to grow cash crops like coffee, black pepper, pineapple and oranges, in order to combat the pressure of shifting cultivation. Laws banning the collection of wild plants for commercial exploitation need to be enforced more strictly. *In situ* conservation involving the protection of genetic resources in the natural environment 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, but this conservation method poses few problems too. It is costly to maintain and is highly susceptible to natural calamities like forest fires, extreme weather conditions and plant damage by diseases and animals. Botanical gardens have played important role in *ex situ* conservation programmes particularly in acclimatization, rehabilitation, multiplication and judicious exploitation. Biotechnology can have a complementary role and plant conservation programmes can find strength from molecular marker technology, molecular diagnostics, *in vitro* technologies and cryopreservation (Tandon and Kumaria 1998; Tandon 2000).

Cultivation of MAPs could provide farmers with an attractive opportunity to increase their income. Production of MAPs through cultivation will also reduce pressure on wild resources, thus contributing to the conservation of biodiversity. Nevertheless, attempts are now underway to cultivate some species and protect their important natural habitats in the northeast region. Indeed, cultivation offers the best hope for conserving many MAPs growing in the wild. It also permits better species identification, improved quality control, and increased prospects for genetic improvements. Some of the MAPs that have been selected for propagation and trade by the locals of the region through unethical trading practices are described in this chapter:

3.1 *Curcuma longa* Linn. syn. *Curcuma domestica* (Family: Zingiberaceae)

During the last two decades, turmeric's ancient use in treatment of digestive and liver problems has been confirmed by scientific research. The herb has also been shown to inhibit blood-clotting, relieve inflammatory conditions and help lower cholesterol level. Turmeric is native to India and southern Asia and is cultivated throughout the southern and eastern Asia. It is propagated by cuttings from the root, and needs well-drained soil and a humid climate. The rhizome is unearthed in winter.

Despite its long-standing use in India and China, therapeutic action of turmeric was not researched until recently when there was an upsurge of interest in foods and medicines that lower cholesterol levels or have antioxidant properties. Turmeric proves to be strongly antibacterial when applied to the skin and exposed to sunlight. Curcumin, a strong antioxidant, is the constituent responsible for this action. Turmeric may perhaps be a valuable preventive remedy for those at the verge of developing cancer. It has been shown to have an anticoagulant property and keeping the blood thin (Kuttan et al., 1985). It also increases bile production and flow, and has a protective action on stomach and liver. Turmeric improves the action of liver and is a traditional remedy of jaundice in the Indian and Chinese herbal medicine. It is also an ancient remedy for digestive problems such as gastritis and acidity and helps increase mucus production. It also alleviates nausea. Even though turmeric does not relieve pain, its anti-inflammatory action makes it useful for arthritis and other inflammatory conditions such as asthma and eczema. Due to its anti-inflammatory, blood-thinning and cholesterol lowering properties, turmeric is now used to reduce the risk of strokes and heart attack. Applied to the skin, turmeric is useful in treating a number of conditions including psoriasis, and fungal infections such as athlete's foot. In the International market the price of pure curcumin is Rs. 5000 g⁻¹. In the local market, crude powder is sold at the rate of Rs. 500 kg⁻¹ and the fresh rhizomes at the rate of Rs. 200 kg⁻¹.

3.2 *Flemingia vestita* (Family: *Fabaceae*)

A much-branched trailing herb with tuberous roots, found practically throughout the Himalayas and Khasi Hills up to an elevation of 8,000 ft. Stems are 1-3 ft. long, hirsute, wiry; leaves trifoliolate with obovate-cuneate leaflets; flowers bright red; pods sub-cylindrical, hairy, one-seeded. A disease, probably related to the scab of potatoes, affects the crop. The affected tubers are disagreeable to taste and their skin assumes a dirty colour.

The plant is cultivated in Khasi hills, often following the harvest of potato crop, for its tuberous roots. It is sown in February-May and harvested in November. About 20 kg of 'seed' in the form of tubers are sown per acre and an yield of 20 kg/acre is obtained. The tubers are nearly elliptical, 15-20 cm long and possess an agreeable nutty flavour. The skin, which is somewhat pungent, is removed by rubbing under water or by peeling, and the tubers are eaten raw. The peel is used as an anthelmintic agent. The local price of the fresh tubers with peel is Rs. 200-250/kg; after processing and peeling it is Rs. 500-550 kg⁻¹.

3.3 *Gaultheria fragrantissima* Wall. (Family: Ericaceae)

Indian Wintergreen is a much-branched, evergreen, aromatic shrub, 1-3 m in height, with orange-brown bark, commonly found in the Central and Eastern Himalayas, Khasi hills and the hills of Western Ghats at altitudes of 1500-2500 msl. It is also grown as an ornamental plant in hilly areas. The leaves are known to contain oil, which is used mainly as an anti-rheumatic, anti-sciatica, painkiller, stimulant, carminative, antiseptic, vermicide and as an ingredient of perfumery, insecticidal repellents, soft drinks and dentifrices (Chopra et al., 1986). The species is still abundant but its large-scale exploitation by herbalists may call for the uncalled for. The principal constituent of the oil is methyl salicylate. Indian wintergreen oil is distilled in small scale in the Nilgiris and Assam. Methyl salicylate obtained from natural sources is in high demand in the market as the starting material for aspirin and other medicinal compounds. A 100g of leaves yields approximately 0.6% oil of wintergreen. The current market rate of pure methyl salicylate is Rs. 8000 kg⁻¹.

3.4 *Litsea citrata* Pers. (Family: Lauraceae)

It is a common deciduous shrub or a small tree found in the eastern Himalayas, up to an altitude of 850-1000 msl. Flowers and fruits are aromatic and, on distillation, yield volatile oil that is used as insect repellent and as a basic ingredient in perfumes and toiletries. The mature fruits and flowers, on distillation, yield about 95% and 37% citral, respectively, whereas seeds give about 20% pale yellow fat (Nath et al., 1994; Choudhury et al., 1998). The leaves and bark of the tree yield volatile oils and two alkaloids, namely, laurotetanine and methyl laurotetanine. Citral obtained from natural sources still commands a better market than one obtained synthetically. The current market price of 95% citral is approximately Rs. 6000 L⁻¹. In a good fruiting season, a mature tree can yield up to 30 kg of fruits. This will work out to approximately 500 gms of 95% citral yield per tree. The oil obtained with such a high percentage of citral easily finds a good market in most pharmaceutical and phytochemical industries in addition to the perfumery industry.

3.5 *Piper longum* Linn. (Family: Piperaceae)

A slender aromatic climber with perennial woody roots occurs from Central Himalayas to Assam, Khasi and Mikir hills, lower hills of Bengal and evergreen forests of the western ghats (from Konkan to Travancrore).

The fruits are used as spice and also in pickles as preservative. They have a pungent pepper-like taste and produce salivation and numbness of mouth. They contain alkaloids piperine (4-5%) and pipartine (m. p. 124-250), and two new liquid alkaloids, one of which is designated as alkaloid A (Shankaracharya and Rao, 1997). This is closely related to pellitorine producing marked salivation, numbness and tingling sensation of mucous membranes of mouth. A sample of dried fruit of *P. longum* on steam distillation gave 0.7 per cent of an essential oil with spicy odour resembling that of pepper and ginger oils (Rahiman and

Nair, 1987). Besides, dry roots and thick parts of stem are used as an important drug (*Piplamul*) in the Ayurvedic and Unani systems of medicine.

The fruits and roots are used in respiratory tract disorders like cough, bronchitis and asthma, as counter-irritant and analgesic when applied locally for muscular pains and inflammation; as snuff in coma and drowsiness and internally as carminative, general tonic and haematinic; as sedative in insomnia and epilepsy; as cholagogue in obstruction of bile duct and gall bladder; as anemmenagogue, abortifacient and anthelmintic; and in dysentery and leprosy. Sun-dried black pepper is sold at Rs. 85 kg⁻¹ in the local markets.

3.6 *Pogostemon cablin* Benth. (Family: *Lamiaceae*)

Commonly called Patchouli, it is an erect, branched and pubescent herb, 0.5 to 1.0 m high and aromatic when crushed. The leaves are ovate to oblong-ovate, coarse, simple or doubly crenate-serrate, on both surfaces more or less densely tomentose; the glands are dotted beneath, up to 12 cm by 10 cm.

The oil is found mainly in the leaf and a small quantity is present in the tender parts of the stem. The yield of oil varies from 2.5 to 3.5% on shade-dried bags of leaves and an average yield of 2.5% may be considered satisfactory in commercial distillation (Maurer, 1976; Akhila and Tewari, 1984). Patchouli oil is viscous liquid, yellowish-green to brownish, possessing a warm, powerful, sweet herbaceous, aromatic, spicy fragrance which improves with ageing. Sesquiterpene constitutes 40-50% of the oil out of which patchouli camphor or patchouli alcohol, called patchoulol, represents 35-40% of the oil (Lawrence, 1990). About 90% of the oil consists of compounds which have very little influence on its odour; one or more satellite components may be responsible for the characteristic odour.

Patchouli oil is extensively used as a flavouring ingredient in major food products including alcoholic and non-alcoholic beverages, frozen dairy desserts, candy, baked goods, gelatine, meat and meat products. It is an important essential oil of the perfumery industry as it blends well with other essential oils like vetiver, sandalwood, geranium, lavender, cedar wood derivatives and clove oil (Hasegawa et al., 1992). It is regarded as the best fixative for heavy perfumes which impart strength, character, alluring notes and lasting qualities. There is no synthetic chemical to replace this oil; this enhances its value in the perfumery market. It is in great demand for soaps, scents and body lotions, pre-shave and after shave lotions and detergents. The oil also gives one of the finest attars when blended with sandalwood oil. It is used as an ingredient in insect-repellent preparations and is said to have anti-bacterial properties as well.

Fresh leaves of patchouli are used as a decoction with other drugs to treat nausea, diarrhoea, cold and headache in the Chinese system of medicine. Dried leaves are used for scenting wardrobes, and have antirheumatic action. Tenacity of odour is one of the virtues of patchouli oil. Adulteration of patchouli oil is quite common; the main adulterant is gurjon balsam oil. Other adulterants include copaiba balsam oil, 8-camphene, methanol, cedarwood oil, castor oil and isobornyl acetate (Sugimura and Ichikawa, 1990). The shade-dried

patchouli leaves are subjected to steam-distillation for obtaining the oil, which is sold at the rate of Rs. 2000-2500 L⁻¹.

3.7 *Solanum khasianum* Clarke (Family: Solanaceae)

A stout, much-branched undershrub up to 1.5 m tall with almost straight prickles, it is found in Meghalaya, Nagaland, Manipur and Arunachal Pradesh up to an altitude of 1850 msl. *Solanum khasianum* has recently come into prominence as a rich source of solasodine. The fruits of this plant are richer in steroidal alkaloids than the leaves of *S. aviculare*, used in some countries for the production of solasodine. A survey conducted by the Botanical Survey of India has shown varied production of alkaloids in the mature fruits of *S. khasianum* var *chatterjeeanum*, collected from different areas; the fruits collected from Cherrapunji contained 3.2% while those from Khasi hills and Jaintia hills, 2.1% and 2.02% respectively. Fruits from Bombay are reported to yield 2.6 per cent solasodine (Yaniv et al., 1983). The concentration of solasonine is the maximum in mature fruits when their colour changes from green to yellow (50-60 days after fruit set). Immature fruits and over-ripe fruits contain very small quantities of alkaloid. The fleshy cover and washed seeds, which form about 60 per cent of the whole fruit, contain no alkaloids. The alkaloids concentrate in the mucilage surrounding the seeds. Used as crude drug, fruits contain diosgenin and are sold in the market at the rate of Rs. 100 kg⁻¹.

3.8 *Smilax glabra* Roxb. (Family: Liliaceae)

The rhizomes of several species of this genus furnish the drug Sarsaparilla. Since the botanical descriptions generally deal with the aerial parts of plants, details regarding the rhizomes are lacking for most species. *Smilax glabra*, *S. lanceolata* and *S. perfoliata* are some of the Indian species having tuberous rhizomes. *Smilax china* Linn., a native of China, has tuberous roots (known as China Roots), which are used in India as a drug called *Chob-chini*. The tubers are fleshy when immature but become woody later on; the tubers and young asparagus-like shoots of a number of species are eaten raw or cooked as vegetable. Alcoholic extract of the plant is reported to contain a glucoside and a colouring matter (Ting et al., 2000). Decoction of the fresh root is used for the treatment of sores and venereal complaints (Yeung, 1985). The plant is collected from Moreh and other parts of Manipur and Meghalaya. The roots are dried and the peel is taken out and sent to drug manufacturing companies at a price of about Rs. 200 kg⁻¹.

3.9 *Swertia chirayita* (Roxb. Ex Fleming) H. Karst (Family: Gentianaceae)

It is known as Brown or White Chiretta or Chirata in trade, it is an erect annual plant, 60-125 cm in height, found in the temperate Himalayas at altitudes of 1200-3000 m from Kashmir to Bhutan, and in the Khasi hills of Meghalaya at

1200-1500 msl. The plant spreads quickly; it forms seeds which are shed during October-November. It can also be cultivated in suitable localities in the temperate Himalayas. The seeds, which are very small, may be sown in a nursery and the seedlings transplanted later in the field. The whole plant is medicinally important, but the root is said to be the most useful part. The chiretta is much prized in India as a tonic and is bitter without aroma or astringency. In western India it is used as a remedy for bronchial asthma and liver disorders. If taken with sandal wood paste, it is said to stop internal haemorrhage of the stomach. It is anthelmintic, and has anti-diarrhoea properties (Joshi and Dhawan, 2005). It is common in all the northeast states of India and, therefore, has ample scope for cultivation. The current market price of the crude drug in northeast India is Rs.150 kg⁻¹.

3.10 *Taxus baccata* Linn. (Family: *Taxaceae*)

It is found in the high altitudes of Sub-Himalayan forest, particularly in Arunachal Pradesh and Meghalaya. It has a restricted distribution in the Himalayas, occurring sporadically under mixed coniferous forests at altitude 2,500-2,700 msl. The plant is in great demand in India as well as abroad, for its leaf and bark as the pharmaceutical raw material. The price of *Taxus* leaves varies from Rs. 5 to Rs. 35 kg⁻¹. *Taxus* yields the drug taxol from its leaves and barks. Taxol is used for the treatment of ovarian and breast cancer. The market price of taxol is far more fantastic, because of its rareness and effectiveness. In 1994, the cost of one kg of taxol was Rs.180 crores. However, to produce one kilogram of taxol, about 2000 to 3000 fully grown *Taxus* trees will be necessary. Therefore, it is apparent that the value of about 25,000 trees will far exceed the value of entire forest wealth of states like Arunachal Pradesh or Meghalaya. Areas which were abundant in its population are now devoid of this tree and the natural stands can be found only on the Northern ridges of the Himalayas. In Meghalaya, this species is restricted to the "Law Lyngdoh" sacred grove of Mawphlang. Destruction of its natural habitat and illegal trade has to be checked to conserve it both *in situ* as far as possible and *ex situ* in protected areas (Kayang, 2005). Conservation in botanical and experimental gardens should be considered and propagation through seeds and other techniques be attempted.

4. CONCLUSION

Cultivation of locally available medicinal plants, particularly of endemic species, has a great promise for farmers in the northeast India.

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