

Ethnobotanical observations on bioresource management in Northeast India

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Abstract

During the past over 3 decades the authors have been engaged in the botanical studies in northeast India specially Arunachal Pradesh and Meghalaya. During the course of floristic exploration, several ethnobotanical observations were also made. Out of these, there are significant ones which have a bearing on conservation and sustainable use. Few of these have been supporting livelihoods and economic development for the rural community. These traditional practices are worth considering for replication and therefore this deserves a detailed study. The paper discusses the features of biodiversity and ethnobotanical studies from the region, highlighting the salient observations on certain important botanical resources and associated practices. The paper suggests further detailed investigation that can bring in a positive impact in resource management.

Keywords: *Northeast India, Biodiversity, Ethnobotany, Traditional practices, Conservation*

Introduction

North east India is rightfully recognised as one of the richest areas for biodiversity as well as cultural diversity (Rao, 1994). Encompassing the eight states *viz.* Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura, the region has a geographical coverage of over 262185 sq. km which is roughly over 7.9% of Indian geographical area. However, in terms of floral diversity it accounts for over 50% of Indian flora. Over 220 ethnic groups having a population of 38,857,769 (census 2011) inhabiting the region take advantage of the rich flora and fauna for their sustenance and cultural needs. Perhaps, there is no region in the country which has a greater dependence on natural resource and environment as the northeast. Obvious reasons for this include the physiographical isolation, inaccessibility of many areas, diverse tribal culture, and inhospitable terrain and so on (Haridasan, 2001).

This interdependence of community over their plants

and long tradition of living with plants have resulted in an unparalleled development in the field of ethnobotany (Deorani & Sarmah 2007, Hegde & Ingalthalli 1988, Jain 1981, Kanjilal *et al.* 1934-40, Lalramginglowa 2003a, 2003b, Rai & Lalramginglowa 2010, Rawat & Choudhury 1998, Saklani & Jain 1994, Sapu Changkija *et al.* 2010, Sharma & Sharma 2010, Sinha 2001, Tsarong 1994). Many researchers have explored the region both floristically and ethnobotanically (Gian Singh *et al.* 2003). Their works have brought out a fund of information that suggests the uniqueness and richness of the region. Few of the pioneers include, S K Jain, R R Rao, P K Hajra, S K Borthakur, Saklani, Jamir, Kharkonger, Changkija, Lalramginglowa, P.K. Singh, Sundriyal, Y Kumar, L R Bhuyan, Padmaraj Gajurel, S K Barik, M S Rawat, and of late Madhumita Nath and several others (Gian Singh *et al.* 2003). Despite all these there still remains much more to do. Many areas still lie unexplored that include documentation which is far from complete, follow up research on

ethnobotanical leads, and much more. Despite these grim facts the region still is one of the best havens of ethnobotanical information. A peep into biodiversity and ethnobotany is rewarding and has great scope. In the following paragraphs let us familiarise with those aspects.

Materials and methods

As part of floristic exploration to build herbarium at State Forest Research Institute (SFRI) several remote areas in the region have been visited. This gave simultaneous opportunity to record ethnobotanical information on the plants in the study area. The methodology followed largely based on Jain and Rao (1977) for herbarium studies, Jain (1987) for Ethnobotany. We have modified the methodology to suit to local needs specially considering the long distances traversed in each trip. There has been semi structured interviews and discussion with local leaders, wise and old people representing particular community inhabiting the area visited. Local traders, shopkeepers and plant produce gatherers were also contacted wherever available. So also the forest department front line staff who are posted in these villages. The information gathered are recorded in tour notes and tour reports which are regularly prepared and submitted in SFRI. Most of these lie as grey literature which are regularly consulted and pooled relevant information. We had also consulted several research papers for more information on these plants which are also incorporated in this article.

Observation

Biodiversity

Rao (1994) in his treatise on floristic diversity of India highlighted the importance of northeast and brought out the glaring gaps in our understanding. The salient features mentioned include that the region boasts of over 50% of the Indian flora. Excepting a few, most forest types found in India can also be seen here. There are several endemic and curious plants that are seen

only in this region. Many areas still lie unexplored or under-explored. Some areas are increasingly exposed to several developmental pressures and results in threat to biodiversity warranting immediate conservation strategy and action (Jain & Rao 1983, Mudgal & Hajra, 1999, Ved *et al.* 2003, Pandey & Barik 2006, Haridasan 2006). Inadequacy in our understanding of the biodiversity of the region becomes more clear when we see the bio resources and the information what we have (Mudgal & Hajra 1999). Medicinal plant is a unique component of the flora of the region. In the most authentic publication on Indian medicinal plants Ved & Goraya (2008) there is exhaustive information on medicinal plants from all regions of the country, but for the north east. The regions rich tribal culture could have contributed enormously in our health care. Probably the only consolation comes from the several ethnobotanical publications that emerge from reputed institutes in the region. Prof. Borthakur has pioneered such studies and triggered several other efforts (Borthakur 2003). A perusal of the ethnobotanical publications from the region reveals the potential lying hidden in the biodiversity of northeast India. Assam, Meghalaya, Mizoram and Nagaland saw not only publications in the form of research papers but also in several books relating to ethnobotany, especially medicinal plants (Saklani & Jain 1994, Rawat & Choudhury 1998, Sinha 2001, Sapu Changkija *et al.* 2010). Few of our medicinal plants, so popular these days, which include *Taxus*, *Ginseng*, *Acorus*, *Homolomena*, *Paris*, *Cordiceps*, *Rubia*, *aquilaria*, etc., came to forefront largely through the pioneering ethnobotanical studies (Haridasan *et al.* 2003). Similarly, the region is also known for the rich handicrafts, bamboo and cane resources, dyes, aromatics and so on. Yet another spectacular find from here is the paper plants like *Daphne* and *Edgeworthia*. Interestingly the region also boasts of some of the effective traditional methods of fishing, which uses certain plants like *Derris*, *Aesculus* etc. Though they

poison fishes temporarily, they are not lethal and often have a temporary impact. The advantage is in fact in their being eco-friendly and sustainable. We should also recall the tea expedition by Griffith and the regions contribution to the world. In fact, people from the region also use few other species in place of tealeaves, especially among high altitude dwellers.

Ethnobotanical studies give clue to the resource details like bioculture, traditional practices, culture and heritage of several communities. The article looks at few glaring examples of resource utilisation and management, linking it to ethnobotanical knowledge.

Ethnobotany: The region offers great scope for ethnobotanical studies and research. This is mainly because of the rich biodiversity and diversity among the many tribes inhabiting the region. Realising the potential, several researchers have pursued their research and their studies have resulted in recognising a very large number of plants useful for human welfare and resource management practices. These are perhaps the only available documentation of people and their plants, which are of immense utility in Biodiversity management. It is pertinent to note that their studies could bring out several unique plants from this region. Their utilisation practices are also in many ways novel to the outside world. Due to wide ranging altitude and resulting diversity in forest type (the region boasts of over 52 forest types (Champion & Seth 1968) the flora inhabiting too are divergent and offer habitat specific solutions for the community for their resource need. Thus from the region we have in tropical zone *Agar*, *Homalomena*, *Mesua*, *Canarium*, broom grass, bamboo and rattan, Wood carving trees etc. Along the subtropical zone the resources that we find include *Zanthoxylum*, Pinshing, Sangmer, Mishmi teeta, Orchids, Pine, and dye yielding species like *Rubia*, etc and plants that are used for fumigation and medicine like *Artemisia*, used by the community extensively. Along the temperate zones the plants representing the resource include unique paper making plants like

Daphne, oil yielding plants like *Gaultheria*, aromatics like *Juniperus*, *Rhododendron*, *Anthopogon* etc. Food plants in high altitude are unique in these zones which is also rich in crops and crop relatives.

A very striking feature is the bamboo and cane resources and their utilisation (Singh 2002). On the management aspect are the crop management in high altitudes, the customary regulations of harvesting like the Pinshing, the bamboo field protection and harvesting by Apathanis, the ritual related practices, epidemic containment practices and several others. The studies have also been pointing to the potential of these in economy of the region and livelihood. Few of the remarkable species that holds promise are listed below. So also some selected practices unique in the region. It is worth recollecting the practices so helpful in conservation like the ones related to Hornbil brooding, fishing, tiger poaching etc are very unique from this region.

1. *Acer capadocicum* Gleditsch (Aceraceae): This large temperate tree is often sought by community for their leaves, which are used as tea leaves in very high altitudes. We have seen this tree leaves collected and stored for making tea in Thungri, Baisakhi etc in West Kameng district, Arunachal Pradesh. The leaves are harvested during autumn. They are cleaned, dried in sun and stored for future use. The leaves are dried spreading them over the roof tops in bamboo mats. This tea substitute is beneficial in many ways, especially in remote areas. Though the tree occurs in other states, it is only in the states of Sikkim and Arunachal Pradesh we could observe the usage in this way.

2. *Aconitum ferox* Wall. ex Ser.(Ranunculaceae): This herb is seen in alpine zones. The tubers are in fact a highly traded commodity and harvested from wild. Traditionally the tubers are also used by tribes for their traditional hunting practice, using arrows. They have special harvesting procedures and processing for use in arrows as poison. The arrows are smeared with the

aconite tuber paste which is applied on arrow heads already smeared with *Rhaphidophora* latex as binding agent. Among the Adi tribe in Arunachal Pradesh, the rituals associated with the collection, is a pointer to the conservation ethos of the community. The collection trips are made as a ritual, following certain taboos and obeisance. The place and hall where they keep the aconite is well cleaned and made out-of-bound for people and polluting the area in any form is forbidden. The produce is in high demand and highly priced for its medicinal use by industry. The species is already listed in endangered plant list as Critically Endangered (Ved *et al.* 2003). Sikkim Forest Department is doing well in multiplying and planting them. Their nursery in north Sikkim is a model for replication elsewhere. The Community living there has special skill in successfully maintaining the nursery. The species is naturally seen in high altitudes of Arunachal Pradesh specially along Tawang, Hotspring, etc and Sikkim. Our observation is from Gorging Upper Siang district.

3. *Aquilaria malaccensis* Roxb.: (Thymelaeaceae) This is the most talked about tree for its unique transformed heartwood which is known as eagle wood or 'Agar'. The transformation of wood is believed to be perhaps, the result of fungal infection and physiological changes (Beniwal 1987 a, b). Over exploitation has happened and decimated the trees from wild for its high cost produce. The community has ethnobotanical knowledge related to recognising the trees with Agar which is difficult to know from external observation, collection and of late, artificial induction of agar formation. The Deori tribe has certain secret formula wherein they use a sort of jaggery solution into the wood by piercing with long nails. If properly documented and assessed this could bring in more returns from Agar plantation (Beniwal.1987b). The tree is distributed in most of the northeast region. However, they are totally decimated from wild, though the species is largely cultivated with community participation, especially in Lohit and

Changlang districts in Arunachal Pradesh, Dimapur in Nagaland, Garo hills in Meghalaya, Agartala in Tripura, Upper Assam in Assam etc. Our observation is from Mahadevpur in Arunachal Pradesh.

4. *Calamus flagellum* Griff. (Arecaceae) An interesting cane with profuse thorns. The leaves are used for thatching house roofs which are comparatively much durable. The use is almost like *Livistona* palm leaves. The leaves are harvested and spun to mats and used in half split leaves. The fruits are edible and the cane is also used for furniture. The Adi tribe in Siang district has small groves near their village for *Calamus flagellum*. Our observation is from Yingkiong, Karko and other locations. The species is also seen in wild in Meghalaya, Nagaland, Mizoram.

5. *Canarium strictum* Roxb. (Burseraceae) This lofty tree is seen along the tropical zones in north east India. The tree is easily recognised with the lofty trunk and white bark. The young leaves are deep reddish. The community induces resin flow by wounding the bark with Knife (Dav). The resin oozes out and solidifies. The dried solid resin is scraped and collected for trade and domestic use. The resin is widely used for fumigation and as incense in poojas and rituals both in household and community level. In recent past it is observed that the tree is getting depleted and are exposed to different threats, especially due to deforestation and habitat destruction. There is good scope for improvement in harvesting technology for sustainable collection and utilisation. Our observations are from Bhalukpong and Chessa in Arunachal Pradesh. The species is found occurring upto subtropical elevations in all states. The resin is sold as NTFP to other regions as well.

6. *Coptis teeta* Wall. (Ranunculaceae) A very rare herb found only in pockets as small patches. They are harvested for the valuable roots which are known as 'golden thread' (Mudgal & Jain 1980). They are used by local community as a panacea for several health problems. In few locations in Arunachal

Pradesh cultivation of this valuable plant is taken up by few local farmers. They have the knowledge of growing them. The cultivation is a very tedious and laborious process. The field is kept meticulously clean by removing all fallen objects over the plants. The locations are also difficult to access. From Melinja, Hotspring area travellers used to gather the rhizome and bring it to the homes, dry and store for personal use for trade. This endangered species is under threat due to over exploitation and habitat destruction and it needs to be conserved (Ved *et al.* 2003). Our observations are from Chinipani near Anini, Melinja, Simbi in Lohit district and Mayodia in Lower Dibang valley district. Arunachal Pradesh Forest department has taken up cultivation with limited success. They have also created an MPCA for the species in Myodia which could ensure seed supply naturally and *in situ* conservation.

7. *Cordyceps sinensis* (Berk) Sacc. is now considered a synonym of ***Ophiocordyceps sinensis*** (Berk.) G.H Sung, J.M. Sung, Hywel-Jones & Spatafora (Cordycipitaceae). This is a new resource found from the region occurring in alpine zones. *Cordyceps* is popularly known as summer grass winter worm locally Yarsa Gombu. The whole system includes a grass, a worm and fungal fruiting body. The worms with fungal fruiting body is meticulously collected after making observations in the dawn. The community often make temporary camps in the sites where *Cordyceps* is growing. This produce fetches extremely high price and is like a gold mine for the area. Our observations are from Tawang, Thungri region of Arunachal Pradesh. Needless to mention indiscriminate and uncontrolled over exploitation has a telling impact on the population. Experience from Uttarakhand could be very useful in managing the resource. There are several publications on this resource from Uttarakhand. Conservation efforts and sustainable collection methods are needed to perpetuate this resource.

8. *Dendrocalamus hamiltonii* Nees et Arn.ex Munro (Poaceae): The most common bamboo seen gregariously in wild in the region at tropical and sub tropical zones. They are early colonisers in jhum fallows. The communities collect new shoots from wild sources. They are gathered and cleaned at the collection site. The sheaths are removed and young tender part is sold as such for fresh use or processed as bamboo tenga. The shoots are chopped and dried for making pickles. The shoots are also pressed with heavy stone over a stack of shoots which are made flat and water expelled. These shoots are allowed to ferment and preserved for use for future. They are also pickled like other common pickles. The shoots thus produced is little sour and has a sulphurous smell. They are liked by all communities inhabiting the region. Our observation is from Nongpoh in Meghalaya and Itanagar in Arunachal Pradesh. All states in north east India have good population of this species.

9. *Daphne papyracea* Wall. ex Steud. (Thymalectaceae) An interesting shrub of north east India at comparatively higher elevations along subtropical and temperate forest. The plant grows gregariously as undergrowth in coniferous and mixed forests. They are characterised with usually clustered shining green leaves on branch tips and white fragrant clusters of flowers. The bark exfoliates in long strips on pulling the branches. The community has indigenous process to make paper out of this plant. The paper is made at household level using local vessels, equipment and easy techniques which we saw near Mukto village in Tawang district. The skill with which they are evenly spreading the fibre pulp in mesh based frame and then drying it in sun is amazing expression of craftsmanship. This handmade paper is used for prayer flags and decorating gompas. The paper is very much in demand for letter pads, visiting cards etc. There is immense scope for rural youth to get trained in modern paper making and paper industry for optimising and value addition. The species is widely seen in Arunachal

Pradesh high altitudes, Sikkim, Meghalaya.

10. *Diploknema butyracea* (Roxb.) HJ Lam. (Pinshing) (Sapotaceae) This handsome tree is maintained by the local community around Kalaktang and vicinity of West Kameng district. The tree is valued for its seeds yielding edible oil for which the community has special process. They gather ripe fruits, crush the kernels, boil them in water and scoop the floating fat and store for personal use. The community believes that the use of this fat give them extra nourishment, strength and vigour to combat the difficulties of living in adverse conditions prevailing in the hills. Since the tree is extremely threatened due to unsustainable collection, the community realised the danger of losing the resource and initiated action by themselves. Indiscriminate cutting and destruction of tree is forbidden and the community has customary laws to this effect. Our observation is from Kalaktang, in Arunachal Pradesh. There is potential for this plant to be grown in large areas under forestry programmes and supporting production of oil at cottage industry level. The species is mostly confined to west Kameng district, especially Kalaktang area. The tree is also found in Dibang valley near Tewari Gaon above Roing.

11. *Elaeagnus conferta* Roxb. (Elaeagnaceae) This scandent bushy shrub or straggler with thorns is found growing in subtropical and temperate zones in all states in the region where such elevation range is available. They can easily be identified with the silvery shining leaves and pink spotted fleshy fruits. The fruits are harvested and sold as fresh fruit in markets as seen in Shillong, Cherrapunjee, Bomdila etc. In Shillong the fruit is known as Soh shang, Soh Khlur etc. There is good probability of it being harnessed as a commercial commodity with value addition prospects. The plant is seen in Meghalaya, Nagaland, Manipur, Arunachal Pradesh and Sikkim. The sacred groves in Mawphalng, Mawsmal etc harbours the species as under canopy plants.

12. *Fagopyrum esculentum* Moench. (Polygonaceae): Buck weed, the plant is cultivated at higher elevations, especially by the Buddhist community. The nutlets are harvested and used as food, after pounding it as flour. The community has cultivation technology specially, manuring and irrigation which are quite interesting and use local materials as aqua duct. The process of harvest and its utilisation too are worthy of documenting and researching for community development. The fields are prepared in slopes with terrace. A spread of litter of Oaks is made during the dry season and kept in fire. The ash certainly adds to nutrition but it also help in pest and disease management. The irrigation is through small channels and bamboo splits as ducts. This practice we could see between Namti Plain and Kibithoo in Lohit district and in Lhao village near Tawang and similar areas. The harvested produce is dried and punded using water propelled mills erected on swift flowing streams and falls. The species is cultivated as field crop in Arunachal Pradesh, Sikkim, etc.

13. *Homalomena aromatica* (Roxb.) Scott. (Araceae) Sugandh manthi. This gregarious aroid plant grows as forest undergrowth along moist shady localities. The plant is exploited for its aromatic rhizomes which fetch reasonably good price. There is a spurt in exploitation from wild, pushing it to extreme peril. The community has been sustainably using it for long, till the commercial exploitation started. Our observation is from Chessa and Bhalukpong, in Arunachal Pradesh. The species is naturally seen in foot hills of Arunachal Pradesh and adjoining Assam, especially in Sonitpur, Lakhimpur, Papum pare, West Kameng, east Kameng districts etc.

14. *Lindera pulcherima* (Nees.) Benth. (Lauraceae). A medium sized tree seen in subtropical and temperate regions. The tree is valued for its fruits that yield vegetable oil. In Tawang area in Arunachal Pradesh it is known as Sangmer. The community has special

methods for extracting oil and using it almost like Pinshing from Kalaktang (Please refer Madhuca below in this paper). The fruits have good local demand. The community has traditional technology for oil extraction from the seeds. As the seeds are harvested for oil, regeneration could naturally get hampered. Probably the SFDs can initiate project to start afforestation using this sort of trees which will also ensure community support. The species is known to grow in Arunachal Pradesh, Sikkim, Meghalaya and Nagaland.

15. *Litsea cubeba* (Lour.) Pers. (Lauraceae) An aromatic tree with green drooping slender branches. Grows well in tropical and subtropical zones. The fruits are harvested and sold in the market as vegetable and flavouring agent. This is a delicacy for the local people, especially in Arunachal Pradesh. The green near ripe fruit bunches are harvested and sold in bundles. We have seen this being sold in Naharlagun and Pasighat markets; so also in Imphal in Manipur. The local community also make chutney out of this fruits by grinding along with other fruits and leaves. This tree can be easily grown in jhum fallows. There is good local demand and also as an NTFP for distillation of oil. Occurs in all states of northeast India.

16. *Livistona jenkinsiana* Griff. (Arecaceae) an endemic palm of the region that is valued for its leaves. The leaves are used for roofing. Every leaf is split into two and dried and stacked. This is then traded locally and in major markets. Most of the rural traditional houses are roofed with this palm leaf which is very durable and weather resistant. Communities themselves has palm groves for this important plant. The fruits of the palm is also used by certain communities. Our observation is from Itanagar, Pasighat and Chowkham in Arunachal Pradesh and Changki in Nagaland. The plant grows well in tropical and subtropical zone. The slopes in village are ideal sites for its plantation. SFRI Itanagar has brought out a propagation and cultivation manual (Haridasan *et al.* 2001). This endemic species

deserves conservation efforts. There are local practices and also traditional knowledge for harvesting, that ensure sustainable harvesting and use.

17. *Millettia pachycarpa* Benth. (Fabaceae) A very large climber or trailing species in tropical zone with brownish tinged young leaves. The fruits and roots of this plant is used for immobilising fish as traditional fishing practice. The fruits and roots are crushed and the juice is used for traditional fishing. Needless to mention this sort of fishing is ecofriendly and sustainable compared to the use of dynamite and blasting, large scale trapping using net, etc. The species is seen in all states of the region in tropical forests. *Aesculus assamicus* a tree from this region is also used in this way for fishing.

18. *Myrica esculenta* Buch. – Ham. Ex D. Don. (Myricaceae) This tree, occurring in high altitudes all along the Himalayan hills, is valued by the community for its fruits, which are commercially sold in the market, especially in Shillong. The fruits are sour and sweet when ripe with warty skin. The community is aware of the right time for collection and processing for sale. There is information on its value addition like making squash, juice, etc from Uttarakhand, where it is known as Kaiphall. The fruits are also used for dry pickling using salt to preserve. We could see the fruits being sold in Shillong markets by the name of Soh phi. The tree is also seen in other states like Nagaland, Sikkim, North Bengal (Darjeeling and Kurseong) and Arunachal Pradesh.

19. *Nepenthes khasiana* Hk.f. (Nepenthaceae) The pitcher plant of India is located in southern part of Meghalaya along a narrow belt. The plant has ethnobotanical significance apart from academic curiosity as being the largest insectivorous plant in the country (Joseph & Joseph 1986). The plant is over exploited out of curiosity and for academic demonstration purpose. The juice accumulated at the base of the pitcher is collected and used for eye

diseases. The plant is difficult to grow elsewhere other than its natural zone of distribution. The Government of Meghalaya has established even a wild life sanctuary exclusively dedicated to this endangered species (Ved et al 2003). The north eastern hill university has taken up propagation and restoration efforts which are paying. Our observations are from Jarain, Maheshkola and Domiasiat in Meghalaya

20. *Parkia roxburghii* G. Don (Mimosaceae) The most valuable and reputed tree for its edible bean – the Manipuri bean. The tree is localised in Manipur, Mizoram, Meghalaya etc. The people in the region harvest the green fruits and sell them in bunches. They also use the seeds of ripe fruits. The beans are high priced and sold in all markets in Manipur, Mizoram and other states. The green fruits and seeds are a delicacy among the people, especially for those hailing from Manipur and Mizoram. There is high demand which is only increasing year after year. Hence this species is a valuable resource which not only promotes local economy and ecology. Our observations are from Imphal, Senapathi, Moreh, etc in Manipur and Aiswal, Kolasib and other towns and villages of Mizoram. Based on the local importance the tree needs to be grown specially under social forestry programmes and propagated in large numbers to meet the communities requirement. The community has indigenous knowledge in processing and utilising the produce.

21. *Prasiola crispa* (Lightfoot)Kutzing (Prasiolaceae), Chlorophyta. This is a unique algal resource in high altitude of Arunachal Pradesh, which is not known to many. The algae grows in swift flowing river attached to rocks and boulders. They are gathered in winter months in tins. After draining water the algae is spread like round cakes and dried in sunlight. The well dried cakes are stored and used for domestic consumption. They are also traded in local markets which fetch good price. However, collection is extremely difficult and need special skill in locating and harvesting. The

algae is used as vegetable. Our observation is from Newmeling Thungri route in the river. So far we know it to be occurring in this part of Arunachal Pradesh only. Possibly there can be food processing interventions to make it more acceptable and last long.

22. *Phrynium pubinerve* Bl. (Marantaceae) Koupath A gregarious growing herb in tropical wet areas specially as forest undergrowth. The leaves are comparatively resistant to tear unlike banana leaves. Most of the communities in north east uses this leaf as plates and packing materials. Even temporary sheds are thatched with this leaves. Most picnics and parties will have this leaf usage for distributing feasts and meals. We have recorded this from North Lakhimpur in Assam and Chessa in Arunachal Pradesh. Thankfully they are biodegradable and non polluting. They are also used for packing articles like salt, meat, vegetables etc. Probably there exists scope for value addition and improving the usage. The use of this can reduce pollution due to plastics which is a major problem in the region. The species is widely distributed in all states at lower elevation.

23. *Phyllostachys bambusoides* Seib. & Zucc. (Poaceae) Bamboo crop management. A very unique way of bamboo plantation is seen among Apathani tribe in Arunachal Pradesh. The community maintains small plots of bamboo which are fenced with bamboo with a gate that is fitted with lock as seen in Hapoli, Ziro area of Lower Subansiri district in Arunachal Pradesh. The farmer has special knowledge about its maturity. They do not keep any culm which is over 5years old. Certain external feature like the algal spread and lichen presence on culms help them know the culms with right age. They also do not allow people to enter the plot while the new shoots are emerging to avoid trampling damage. Similarly there is restriction regarding harvesting in line with lunar phase. This unique way of cultivation is now acclaimed world over. The bamboo is used for all perceivable purposes

in our life including house roof, wall, floor, posts and much more.

Gates and arches with bamboo. An interesting observation on ethnobotany and cultural linkage is the decorative gates, arches and other signs made of bamboo placed in vulnerable locations, especially at entry points to villages, homes and fields. Each has a special significance be it a ritual after death, an epidemic, a property demarcation, the bamboo species used may vary from place to place and ritual to ritual. In any case such practices lead to conservation action.

24. *Quercus griffithii* Hk.f. & Th. Ex DC (Fagaceae) This gracious tree is important in the subtropical landscape. The leaves are clustered at branch tips. The young ones have been in use for rearing Tassar silk . At Dirang there is an oak Tassar silk breeding centre. The galls in the branches are gathered for medicine industry. The wood is extensively used for making charcoal. The trees shed their leaves profusely during autumn. Local farmers gather the dry leaves from forest floor and transport it to their cultivation fields. The leaves are then spread as mulch in their fields. No other place we can see such a practice. Our observations are from Dirang valley and Shergaon-Jigaon area in Arunachal Pradesh. This practice adds nutrition, retains moisture and enhances productivity in the fields. The species is also seen in Meghalaya, Sikkim, Nagaland, Manipur etc.

25. *Rhus chinensis* Mill. (Anacardiaceae) A medium sized tree in tropical to subtropical zones usually in degraded and jhum fallows. The fruits are harvested when ripe which is perceived by change of colour from green to reddish. The ripe fruits which are sour are dried and pounded to powder and stocked. The community uses the powder for digestion as a folk medicine. In fact they consider it as local Digene which is consumed after taking food, especially by the some tribe of Nagas. Our observation is from Changki village in Nagaland. The people have indigenous

knowledge for using it. The plants can be protected for preserving them. There appears to be not much problem in regeneration. The species is seen growing in all most all states in subtropical zone, mostly in open areas.

26. *Rubia cordifolia* Linn. (Rubiaceae) Laneru. This climber is usually seen in subtropical and temperate zones in NE India especially along exposed slopes. The plant is used for making indigenous organic dye and is also traded as medicinal plant from the region. Easily identified with its scabrid young stems and four long petioled spreading leaves at each node. The roots and basal portion of the stem of this plant are harvested, cut into pieces and dried for trade and local use. They are dried in sun spread on large bamboo mats and over tin roofs of the houses as we saw in Munna camp and Dirang valley. The community is involved in collection and preparation of colourful dye. In Nagaland they make dye and use in their adorable shawls and handle ornaments of weapons like Dao, Spear etc. This is already a NTFP in trade bringing economic returns to the community. The species is seen between 1000mtr to 2000mtr elevation zone in states like Meghalaya, Nagaland, Mizoram, Arunachal Pradesh, Manipur and Sikkim. The collection method followed currently is unsustainable.

27. *Taxus wallcchiana* Zucc. (Taxaceae) This is a very popular tree for its valued NTFP - the Taxol yielding leaves. The species grows in the temperate zones in northeast India, especially in Arunachal Pradesh, Sikkim, Meghalaya and Nagaland. They are seen with other conifers like *Tuja*, *Pinus*, *Abies*, *Picea* etc and also with Oaks and Rhododendrons. They have been over exploited for its high demand and priced leaves (Haridasan 1996). This has almost decimated the population of this plant. At certain localities of its distribution like in Tawang, the community got aware of the imminent peril to the plant population and rose to the occasion to save the plant by adopting prohibition

of collection from wild, especially in Tawang area. The customary law which they have is simulable. In fact the collection practice is unsustainable where instead of lopping, the collectors cut whole tree and strip the leaves which affect the population and regeneration. The SFRI Itanagar, has developed propagation technique and raised demonstration plot near Bomdila with promising results. These efforts by community and the department can help in conserving and augmenting the resource. There are good populations in and around Newmelling towards Thungri which could be preserved as a conservation plot or seed stand.

28. *Wallichia oblongifolia* Griff. (Arecaceae) This palm is commonly seen in foothills along tropical semievergreen belt and subtropical lower zones (Anupam Sarmah *et al.* 2006). They are used by community for production of a sort of starch through indigenous methods. This is also a food for pigs. The stem is cleaned by scraping the outer parts and chopped into pieces and smashed to pulp under water. The starch solution is sieved and the collected starch is dried and made into cakes which are used subsequently for domestic and trade. Our record is from Seppa in Arunachal Pradesh. The starch is considered a famine food. Their methodology of production are documented by research establishments specially concerned with sociology. There is enough scope to improve upon the techniques used by the community and enhance product recovery. They can also be incorporated in plantation programmes. There are few community owned plots as seen in Upper Siang (Karko – Ramsing) in Arunachal Pradesh.

29. *Wrightia coccinea* Simson / *W. arborea* (Dennst) Mabberley (Apocynaceae) A tree of sporadic occurrence in tropical forest zones. The wood of the tree is used for making masks for dancing and festivals, especially by the Buddhist community. The wood is harvested from wild, shade dried, cured and chiselled by expert craftsmen. The practice is more seen in

Changlang, Tirap and Lohit districts. The wood is light and do not warp while it is easy to grind and polish. This species is also getting depleted in their natural zone of distribution and need to be conserved. The tree is regenerated naturally with their wind dispersed seeds which have a coma for floating in air. There is nursery technology available with SFRI Itanagar and thus the population could be enhanced. The species is also seen in Sikkim, Nagaland, Manipur and Mizoram.

30. *Zanthoxylum armatum* DC. (Rutaceae) This is an aromatic tree with thorns. Leaves and fruits are used by indigenous people. The ripe fruits are collected, dried and packed for future use and sale. The commodity is sold after drying in small packets. The fruits are very aromatic, pungent and four lobed with shining black seeds. Large quantity is sold in markets in West Kameng and Tawang districts of Arunachal Pradesh. Our observations are from these localities. The seeds can be used for raising nursery seedlings. The fruits are also used for manufacturing essential oil called Timur oil. The community also uses tender leaves as condiment and vegetable as can be seen in markets of Itanagar, Pasighat etc. Over exploitation will lead to impaired regeneration. However, the community understands the value of the species and avoids cutting of the species and tries to cultivate them. The species is seen in all states in the region along the tropical and subtropical forests.

31. *Zalacca secunda* Griff. (Arecaceae) Leaves of this nearly stemless palm is used much like *Calamus flagellum* and *Livistona jenkinsiana* for roofing. One can see many clumps in tropical wet evergreen zones, especially in Lohit, Changlang and Tirap districts (Thomas & Haridasan 1997). For the community this is a priced possession specially for roofing their indigenous type houses. Our observation is recorded from Mahadevpur, Namsai, Lathao in Lohit district Arunachal Pradesh. There are good populations in Namdapha too. The community has traditional

knowledge with respect to their utilisation. Habitat destruction is a reason for worry. The species is also reported in adjoining areas of Assam.

Few other interesting aspects from the region:

Worshipping trees: An interesting observation from the region is the practice of worshipping trees. In fact most of them worship the sun, moon (Donyi – Polo), nature etc. In some places, one can see trees wrapped with red cloth strips. Such plants are revered and not damaged or cut. This is an effective way to conserve the plant. Similarly Buddhist community too tie handmade paper strips on trees and bushes as part of their poojas and rituals. Mostly the trees are large and lofty in the first case. These trees are known to harbour arboreal fauna and epiphytes in profusion, which makes it more relevant.

Insect repellents fumigation: In the hills there is practice of fumigation with aromatic plants to ward off insect pests. *Artemisia nilagirica*, *Rhododendron anthopogon*, *Juniperus recurva* and other species are few such plants used to burn as fumigating agent. Such burning is also culturally linked and is a common practice. Species like *Rhododendron* and *Juniperus* are getting reduced in their natural areas of occurrence. This is despite their collecting the leafy branches and not uprooting. Perhaps afforestation programmes could incorporate these species in their list of plants to be planted as a measure of conservation and augmenting resource. Our observations are from Drinang, Tawang, etc.

Commercially exploited medicinal species of recent interest: *Acorus calamus*, *Paris polyphylla* and *Dendrobium nobile*, *D.chrysanthum*, *D. fimbriatum*, etc are commercially exploited in the recent past form wild without concern for sustainability. However, these are also used by the community in different ways.

Discussion

Northeast India has rich biodiversity and ethnobotanical information. Several species known

to be ethnobotanically important are also utilised for economic progress. Many of them are traded as raw material or as value added products. With a perusal of such plants from the region, one can find a huge number of possible candidates. We have considered many such species with a perspective of uniqueness from the region, traditional use, possibility of value addition, scope for technological intervention and so on. Thus, we have shortlisted 31 species for this paper though conscious realisation that a lot more are still remaining. This, in fact, is just a sample survey result. Such an ephemeral study itself has indicated the large scope that exists in the region. Further, we can see that there is unique traditional knowledge and practices associated with the utilisation which are often not documented. Needless to mention they are suited to local ecosystems. Several of these are also replicable elsewhere and will have huge economic potential. In few cases the exploitation is such that often it is destructive and doing much harm to the existing population. There is need for reversing this trend by adopting suitable traditional practices and techniques which are available in the region among the community if required with suitable modification, for augmenting resource, conservation and sustainable use. Species like *Taxus* which was more abundantly available in states like Arunachal Pradesh has come to a level which is much below the viable population and has become so scarce in most areas due to over exploitation. With the advances in nursery technology, there is technology available for mass propagation and plantation which can be adopted for raising seedlings. Proper incentivisation of plantation can get more community participation. Similarly, recently found resources like *Cordyceps* being a composite system of fungal association with grass and larvae is difficult to propagate and raise plantation. The species has already impacting the socio-economic condition of the local community. Sustainable harvesting methods and appropriate conservation action can sustain the

Selected plant resources of Northeast India



Aquilaria malaccensis



Coptis teeta



Daphne papyracea



Dendrobium fimbriatum



Homalomena aromatica



Juniperus fumigation



Madhuca butyraceoides



Nepenthes khasiana



Paris polyphylla



Parkia roxburghii



Prasiola crispa (algal food)



Rubia cordifolia



Zalaca secunda (thatch)



Zanthoxylum fruits



Bamboo shoots for sale

population. Plants like *Aquilaria* have great resource potential with its Agar wood formation, which is unique in this region. Though the plant population from wild is decimated or nearly extinct, there are flourishing plantations and cultivation at homesteads. This would be more lucrative if induction of agarwood formation is ensured through inoculation techniques which are otherwise practiced by the local community. The community's traditional way of inoculation could be further researched and standard protocol developed. The indigenous knowledge on this resource hold greater promise in equitable exploitation of the plant. *Homolomena aromatica* is a plant that is easy to grow but no attempt on its cultivation is known from anywhere. Rapid exploitation has severely depleted the population. Probably an agro technology model could be developed through field oriented research and development for the sake of farmers. Plants like *Rubia cordifolia* are in demand, both by industry and the community alike. This plant incidentally is seemingly abundant though a downward trend in population is visible. Necessary conservation actions are to be taken up before it is too late. Similar is the case of *Aconitum* and *Coptis*. The community's understanding of the species and its propagation and utilisation can offer guidelines in conservation and sustainable use. A number of species like *Elaeagnus*, *Parkia*, etc are used by the community and valued by them. There is technology available for value addition of these species. Such technologies can be profitably adopted for the benefit of the region. So also leaves of *Livistona*, *Zalaca* and *Calamus* that have found favour from the community have already been engaged in cultivation at few sites. Such species could be promoted in large numbers so that the need of community is met with. There is also possibility of value addition in each case. Efforts in this direction could be rewarding. The cultivation practice using *Quercus* mulch as seen in Dirang or maintaining of bamboo plots by Apatanis are models for the entire world. Adoption of these

indigenous methods in cultivation practice can boost productivity. The use of leaf of *Maranta* for packing and plate purpose is a good option for reducing the dependence on plastics which will help reduce the environmental degradation on the earth. The starch making or paper making by different community offers scope to harness local resources which are time tested and ecofriendly. Integrative efforts for promoting these in rural areas will not only help meet local aspirations but also their employment and income generation. Further, most of the indigenous practices are not documented and may be lost over the years. This warrants for proper documentation and promotion of cultivation practices.

Conclusion

A perusal of information on biodiversity ethnobotany and community involvement in resource management will reveal that several species from the region have national demand and potential to boost the economy. A number of them have deep rooted cultural linkage. In this paper 31 species are mentioned individually and few others as group which are significant for the region on both counts. Each of these have great potential for community development and has scope for in-depth research. Obviously, there is much more to this list that need to be explored and brought out for the benefit of the community for their benefit as a resource to be harnessed in a sustainable way. Based on the above it is suggested that the local universities and researchers take up further research in these species relating to contemporary relevance. The R&D institutes dealing with the bio-resources may find them to be very interesting and carry on probes to enhance value addition and economic upliftment while ensuring ecological sensitivity. Traditional knowledge and practices could form the foundation for such work.

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Literature cited

1. Sarmah A, Haridasan K, Hegde SN and Borthakur SK 2006. Diversity and distribution of Palms in northeast India and their role in the Tribal Life. In (Edts) H N Pandey and S K Barik Ecology, Diversity and conservation of Plants and ecosystems in India. Regency Publications, New Delhi.
2. Beniwal B S 1987a. Silvicultural characteristics of *Aquilaria agallocha* Roxb. Arunachal forest news 5(1)31-33.
3. Beniwal B S 1987b. Silvicultural characteristics of *Aquilaria agallocha* Roxb. Arunachal forest news 5(2)72-75.
4. Borthakur SK 2003. Setting priorities to interfuse between Medicinal plants and Indigenous Knowledge to boost rural economy in Assam. In: Gyan Singh, H B Singh and T K Mukherjee (eds) Ethnomedicine of north east India NISCAIR, New Delhi pp 64-78
5. Champion H G and Seth S K, 1968. A revised survey of the Forest types of India. New Delhi.
6. Deorani S C and G D Sharma 2007. Medicinal Plants of Nagaland. BSMPS, Dehradun.
7. Singh G, Singh H B and Mukherjee T K (eds) 2003. Ethnobotany of Northeast India. NISCAIR, New Delhi.
8. Haridasan K 1996. *Taxus baccata*: a promising pharmaceutical raw material in north east India. Journal of the North Eastern Council, Shillong 16(2):20-24.
9. Haridasan K 2006. Diversity, Conservation and sustainable use of Medicinal Plants in India with special reference to northeast. In (eds) Pandey and Barik 2006. Ecology, Diversity and Conservation of plants and Ecosystems in India. Regency Publications, New Delhi., 377- 388.
10. Haridasan K, Anupam Sarmah, Bhuyan LR, Hegde S N and Ahlawat S P 2003, SFRI Information Bulletin No.16 - Field Manual for Propagation and Plantation of Medicinal Plants, State Forest Research Institute, Itanagar.
11. Haridasan K 2001. Conservation of forest genetic resources of Arunachal Pradesh and Eastern Himalayas. Forest Genetic Resources: Status, threats and conservation strategies (eds) Uma Shankar, R., Ganeshiah, K.N. and Kamaljit S. Bawa. 237-251
12. Haridasan K, Bhuyan L R, Basar J and Bisht N S 2001. Toko. (a multipurpose palm), SFRI, Itanagar.
13. Hegde S N and Ingalhali R S 1988. A note on the medicinal usage of some Orchids. Arunachal Forest News 6 (1): 11-18
14. Jain S K (ed.) 1981. Glimpses of Indian Ethnobotany. Oxford and IBH Publ.Co., New Delhi
15. Jain S K (ed) 1987. A Manual of Ethnobotany. Sci Publishers, Jodhpur
16. Jain S K and Rao RR 1977. A Handbook of Field and Herbarium Methods. Today and Tomorrow's Publ. New Delhi.
17. Jain S K and Rao R R 1983. An assessment of threatened plants of India. Botanical Survey of India, Howrah.
18. Joseph J and K M Joseph 1986. Insectivorous plants of Khasi and Jaintia hills Meghalaya, India, BSI, Howrah.
19. Kanjilal U N, Kanjilal P C, Das A and Purkayastha C 1934 – 1940. Flora of Assam, 4 vols. Govt. of Assam, Shillong.

20. Lalramnghinglova H 2003a. Ethno-Medicinal Plants of Mizoram. Bishen Singh Mahendra Pal Singh, Dehra Dun.
21. Lalramnghinglova H 2003b. State-of-the-Art Report on Ethnomedicines and their Plant Resources in Mizoram. In Gian Singh, Singh H.B. and Mukerjee T.K. (eds). Ethnomedicine of North-East India, 13-15 March 2001, NISCAIR, New Delhi.
22. Mudgal V and Jain S K 1980. *Coptis teeta* Wall. Local uses, distribution and cultivation. Bull. Bot. Surv. India, 22: 179-180
23. Mudgal V and Hajra P K 1999. Floristic diversity and Conservation strategies in India. Vols. I – III. Botanical Survey of India, Calcutta.
24. Pandey H N and Barik S K 2006. Ecology, Diversity and Conservation of plants and Ecosystems in India. Regency Publications, New Delhi
25. Rai P K and Lalramnghinglova H 2010. Lesser known ethnomedicinal plants of Mizoram, North East India: An Indo-Burma hotspot region. Journal of Medicinal Plants Research 4(13): 1301-1307.
26. Rao R R 1994. Biodiversity in India (Floristic aspects). BSMPS, Dehradun
27. Rawat M S and S Choudhury 1998. Ethnomedicobotany of Arunachal Pradesh (Nishi and Apatani Tribes), BSMPS, Dehradun.
28. Saklani Arvind and Jain S K 1994. Cross-cultural ethnobotany of Northeast India. Deep Publications, New Delhi.
29. Sapu Changkija, Ajungla L, Rongsenshashi and Renchumi Mozhui 2010. Medicinal and Aromatic Flora of Nagaland. Medicinal Plant development Agency Nagaland.
30. Sharma T P and Sharma S 2010. Medicinal Plants of Sikkim. Beracah Printing and Stationary. Gangtok, East Sikkim
31. Singh K A 2002. Boon of Bamboo resources in northeast India. In K A Singh (ed) Resource Management Perspective of Arunachal Agriculture. ICAR, Basar, Arunachal Pradesh.
32. Sinha S C 2001. Medicinal plants of Manipur. Manipur Association for Science and Society, Imphal.
33. Thomas S and Haridasan K 1997. On the occurrence of *Calamus inermis* T. Anders in Arunachal Pradesh. J. Econ. Tax. Bot. 21 (3): 715 – 716.
34. Tsarong T J 1994. Tibetan Medicinal plants, Kalimpong,
35. Ved D K and Goraya G S 2008. Demand and Supply of Medicinal Plants in India. BSMPS Dehradun.
36. Ved D K, Kinhal G A, Haridasan K, Ravikumar, Utkarsh Ghate, Vijaya Shankar R and Indresha J H 2003. Conservation Assessment and management Prioritisation for the medicinal plants of Arunachal Pradesh, Assam, Meghalaya and Sikkim FRLHT, Bangalore.