Forest Biodiversity Management and Livelihood Enhancing Practices of War Khasis of Meghalaya, India

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Abstract

The traditional forest management practice of War Khasi, a small tribe inhabiting the southern slopes of Meghalaya (India) bordering Bangladesh, has several attributes, which favours the management of high levels of biodiversity and enhances livelihoods of the people. This study documents species diversity viz., trees, epiphytes, climbers, wild relatives of crops, birds, reptiles, amphibians, fish, mammals and insects, and describes the traditional NTFPs and MAPs based forest management of War Khasi tribe by way of a case study of Bay Leaf (Cinnamomum tamala Nees ex Eberm). It has been found that people promote regeneration and growth of Bay Leaf trees in natural forests. The productivity of Bay Leaf ranges between 12,950 - 44,400 kg/ha/harvest. The study on pricing mechanisms revealed that growers share about one-fourth of the price paid by the consumers. There is a huge national market for the produce; however, the market is largely regulated by the traders. There is heavy taxation on the produce, which is collected by traditional institutions (Syiemship) district council and local government. Annually an estimated amount of INR 20 million cash flows to Bay Leaf growers of the state and about INR 5 million cash is accrued to the tax collectors. Ecological value of the NTFPs and MAPs based forest management practice in terms of conservation of soil, water and biodiversity in a fragile ecosystem receiving exceptionally high rainfall, has been discussed in the light of similar studies elsewhere.

Introduction

The southern slopes of Khasi and Jaintia Hills, Meghalaya, India are popularly known as War area and the people living in the region are known as War Khasi, a sub-tribe of Khasi community (Gurdon: 1975, Bareh, 1967: Rana, 1989). About 0.15 million people inhabit the War area. People of this area, are largely dependent on forests for their subsistence. War Khasis are skilled in land based livelihood activities viz., agriculture, horticulture, forestry and fisheries. They collect, process and market a large variety of non-timber forest products (NTFPs) and medicinal and aromatic plants (MAPs) such as Bay Leaf (*Cinnamomum tamala* Nees ex Eberm), broom

grass, wild pepper, bamboo, honey, mushrooms, nuts, tubers, edible worms, insects and leafy vegetables from the forests (Tiwari, 2000). The forests are criss-crossed by a number of streams richly endowed with aquatic plants and animals including several edible amphibians, snakes and fish. The forested landscape harbors rich biodiversity and provides habitat for the native flora and fauna. Local communities have evolved a unique NTFP/MAPs management practice without degrading their forests. The marketable MAPs, such as Bay Leaf have helped in improving the economy of the local tribals. The NTFPs like wild fruits, nuts, tubers leafy vegetables etc. contribute substantially to improving the nutrition of the people. Ethnobotany and ethnomedicines of northeastern India have received some attention of researchers (Jain, 1981: Hajra, 1981: Rao, 1981: Chankija and Kumar, 1996: Singh et. al., 2003). However, most of these studies are restricted to documentation of the uses of plants by the tribals of the region. There is a conspicuous lacuna in our knowledge about traditional forest management practices of the tribes of this region as a whole and Meghalaya in particular (Tiwari et al., 1998). The present study was undertaken to document the traditional forest management practice of War Khasis, which has withstood the population pressure as well as economic and market forces. The paper attempts to analyze biodiversity enriching and livelihood enhancing characteristics of this traditional forest management practice of War Khasis of Meghalaya, India.

Study Area, Climate, Flora and Fauna

The study area is situated in the southern part of Meghalaya between 25°7'-25°18'N latitude and 91°-92° E longitude covering an area of about 1,350 sq km. The region receives very high rainfall. Mean annual rainfall ranges from 6,000mm to 10,000mm. The altitude ranges from 100 to 1,200m asl. The soil of the area is very fertile and rich in humus. The important soil types are red and yellow, red loamy soil and alluvial soil. The land is sloped at an angle ranging from 10^0 - 40^0. The area has a large number of rivers and rivulets, which drain into the plains of Bangladesh. At times, narrow and deep river valleys separate the ranges from one another. The population is sparse, with the people predominantly working in plantations and forestry. Agriculture is limited to some small valleys where mainly tuber crops are grown. Areca nut, orange, betel leaf, jackfruit, Bay Leaf, honey and broom grass are the principal produce of the region.

The vegetation of the area is composed of mixed semi-deciduous and evergreen forests predominantly composed of evergreen elements. The plant species in the forest are distributed in distinct vegetation layers. The top layer is composed of tall trees, and the middle layer, composed of young trees, forms a dense canopy at many places and is characterized by the presence of a large number of lianas and other climbers. Shrubs and herbs represent the third and lower layers. The shrubs

are scattered and the herbaceous species are also dense at the ground level. High humidity during most part of the year provides conditions suitable for luxuriant growth of epiphytes and ferns. Wild bananas also grow in many places. The vegetation is particularly luxuriant and dense near the brooks and water bodies.

Methods

The data and information were collected through key informant surveys in a cluster of villages viz., Pongshurtia, Wahkdiat and Sohlong. Interviews and group discussions were held using questionnaires. Interviewees included forest owners, traders, and officials of the Mawiong Regulated Market and owners of agro-industries. For studying the vegetation structure and plant species composition, quadrats of 10x10-m size were randomly laid in the traditionally managed forests and data were collected on frequency, density, girth at breast height (GBH), dominance and species composition using standard vegetation analysis methods (Misra, 1968). Marketing channels were investigated using methods described by Karki et al., (2001).

Results

The flora and fauna of the area were studied. The number of plants and animal species recorded were: - trees - 37, epiphytic plants -15, climbers and lianas -18, wild relatives of crops and medicinal plants - 14, birds - 43, insects - 59, snakes and lizards – six, amphibians – five, fish - eight and mammals – six. The data indicates immense biodiversity richness of these forests. The plants and animals found in the village are listed in Appendix 1. Mean density and GBH of trees growing in the forests was found to be 1,640 and 184 cm respectively.

Forest Management

The forests in the area are nearly contiguous. Small patches of forests are owned by individual families who manage it in a way to maximize the production of NTFPs/MAPs which directly or indirectly conserves soil and water resources. Large trees are pruned to give space for the growth of preferred trees. NTFP/MAP yielding trees are promoted while less valuable trees and shrubs are cleared. Seedlings of preferred trees are retained during annual clearing and weeding of the forest. Vines of betel leaf (*Piper* sp) are planted at the base of selected trees. Medicinal plants like wild pepper and Bay Leaf are promoted by clearing weeds and removing of trees that create too much shade. Cutting old branches of the Bay Leaf plant is usually done when the plant has attained a height of about four to six meters. Epiphytes like orchids, aroids and lichens that grow on the stem of

the Bay Leaf tree are removed manually. The parasitic plants that grow on their branches are also removed by cutting and burning the infected branches. Sometimes preferred trees such as Bay Leaf and Jack Fruit are allowed to regenerate in the forest gaps which are caused by the death of old trees. Thus the population of NTFP species increases year after year. Weeding is repeated two to three times a year, when regenerating trees are three to five years old, but once these trees have grown older, weeding is done only once a year. Fire lines are cut annually and maintained properly. The forests near the village and on the roadsides are more intensely managed. In such plantations the cultivation of betel nut, pineapple and orange is done by several farmers. A survey of the region's forests revealed that there exists a continuum of pure plantation - predominantly pure plantations with a few forest trees - to a purely closed canopy semi-evergreen forest. All types of vegetation in this continuum can be seen within a few km distances. However, areas under pure plantations are smaller as they need more intensive management interventions, which are difficult due to a scarcity of labour. The forests are frequently visited by the owners and looked after like a farm or an extended home garden.

NTFP and MAP based forest management: A case study of Bay Leaf

Bay Leaf Tree

Bay Leaf (*Cinnamomum tamala* Nees ex Eberm) is an aromatic plant belonging to the family Myrtaceae. It is a medium size tree that grows naturally in the subtropical humid forests of northeast India and its leaves are used as a condiment. In *War* area of Meghalaya, it has emerged as a husbanded wild tree. The trees growing in the wild are protected and promoted to regenerate and grow in their natural habitat. It grows in association with a variety of other native trees. In areas where more intensive management is in place, its cultivation is considered to be ecologically sound because it is grown in poly-culture along with betel-nut, betel-leaf, jackfruit, timber tree and a host of shrubs and herbs. This practice helps in the maintenance of biodiversity and the optimum of the use of resources such as, light, nutrients, moisture and space by the plant community. In fact it has emerged as a semi-domesticated tree that provides supplementary income to the forest dwellers.

Production of Bay Leaf

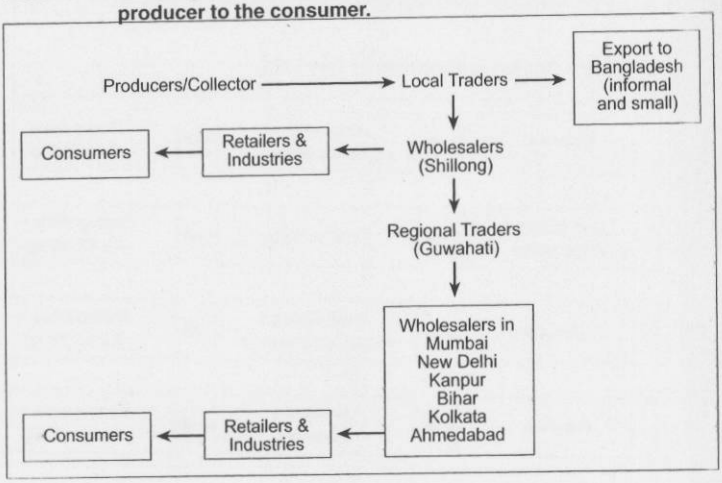
The yield depends upon the age of the plant and also the size of the tree. Production from small trees ranges from 30-40 kg/tree/harvest and 55-65 kg/tree/harvest from the bigger trees. Based on the data collected, it was found that at lower altitudes a one hectare Bay Leaf garden can yield up to 350 quintals of dry leaf annually. However, at higher elevations (above 1,000m) the yield may be about half.

Harvesting Methods

Leaves are harvested during November to February in a sustainable manner. This is considered to be a specialized job and only skilled men can do it. The older branches that have attained a particular diameter are cut, while younger branches are left. Harvesting can be done after a gap of one to two years depending on the age of the tree and fertility of soil. The older branches of the trees are cut, usually in the months of November to February. After harvesting, they are threshed by beating. The cut/plucked branches are left to wither, after which they are spread out on sloping ground for about two weeks. The main object of withering is to reduce the moisture content of the leaves by about 50%. Withering and drying is done in such a way that the leaves retain their light green colour and luster. Infected, discolored and broken leaves are removed manually. The leaves are then loosely packed in gunny bags of approximately 30 kg each. These bags are then ready to be transported to market.

Production and marketing of Bay Leaf involves a number of stakeholders viz., forest owners, skilled and semi-skilled labourers, village traders, women workers, wholesalers, transporters, small scale industry owners, regional traders and exporters. The small forest owners perform all the management including pruning, weeding, harvesting, threshing, etc by themselves. However, large forest owners engage labourers for various operations. The labourers are normally poor villagers who do not have their own plantations and include both men and women. For cutting the branches (harvesting) require experienced skilled workers. The prevailing daily wages of the workers are: skilled labourers

FIGURE 1: **The Bay Leaf market channel: path of the produce from producer to the consumer.**



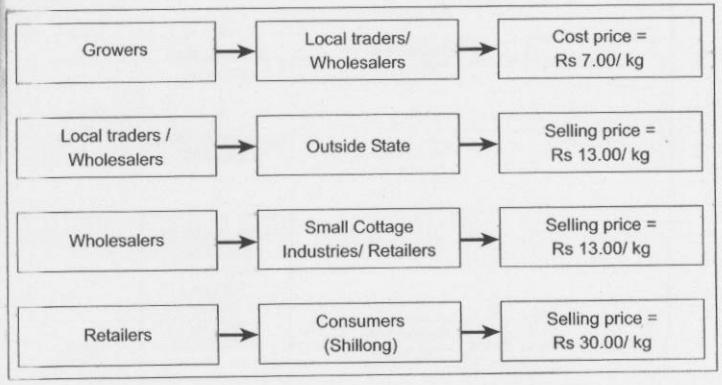
Men Rs.120./-, Unskilled labourers- men =Rs.80./- and Women =Rs.40/- The labourers are employed for a number of activities such as harvesting, drying, plucking, packing, carrying to roadsides, sorting, repacking, loading and unloading and transporting. Thus it is a labour intensive business and creates employment for the poor and disadvantaged section of the society. Labour is scarce and therefore, sharing of labour is common. Most labour forces come from the village itself or from neighboring villages. After processing, the packed leaves are sold to village traders. The village traders then sell to the regional traders who dispatch the goods in bulk to major Indian metropolises. The market channel is shown diagrammatically in Fig 1.

Marketing Practices

The growers usually sell their produce to the traders, of which there are two types: 1) those who sell the produce within the state and 2) those who transport and sell the produce outside the state. Market demand and price depends upon the quality of leaf and availability of goods. The marketing mechanism has not been properly developed, and it is by and large controlled by the external demands. Being a perishable and bulk good it is also subject to the vagaries of weather.

Bay Leaf prices are mostly controlled by regional traders (the business men who supply goods outside the state). These traders control the market and are often determine the price at which the cultivators sell their produce. Relatively rich growers, who can afford to store their produce, can some times bargain for a better deal. The producers however, generally do not have any say in deciding the price. The price and cash flow is given in Fig 2. The average exchange rate of the Indian rupee to US $ during the period of study was US$ 1 was equivalent to INR 45.

FIGURE 2: **Pricing mechanism of Bay Leaf.**



The collector or producer sells to the local trader at the price fixed by them and the local traders buy the goods at the price fixed by the regional traders. It is the regional trader who has access to market information and thus to a large extent controls the market and price. The local traders transport the goods to Shillong, from where it goes to other states via Guwahati. From Guwahati the goods are transported to Mumbai, New Delhi, Kanpur, Bihar and Kolkata. The demands for Bay Leaf are mostly as a spice and/or condiment. No information is available as to whether it is exported to other countries except that a small quantity is exported to Bangladesh. In the national market, it is mostly sold in the leaf form while in some eastern states it is sold in bunches.

Taxes and Royalties

Bay Leaf is a notified tree species and the government levies tax on the sale and purchase of its produce. The traders have to pay these taxes to the *Syiem* (Traditional Chief), District Council and the State Government. Besides these, alleged illegal collections from the transporters at various check points are also prevalent. These taxes and illegal collections lower the sale price of growers. The state government collects tax at two levels: i) purchase from the growers and ii) sale to outside agency.

TABLE 3: **Taxes paid by the Bay Leaf traders to different agencies**

Collecting agencies	Amount paid
Syiem	= Rs. 75.00/truck (4.5 MT)
District Council	= Rs. 50.00/truck
State Government	a) Purchase tax = 10% b) Sales tax = 8%

1 truck load =4.5 MT

TABLE 4: **Annual production of Bay Leaf** (Source: Mawiong Regulated Market)

Year	Annual production (Metric tones)	Total value (in Rupees)	
		Purchase price	Sale price
1997-98	2,699	1,88,93,000	35087000
1998-99	2,772	1,94,04,000	36036000
1999-00	2,472	1,73,04,000	32136000
2000-01	3,138	2,19,66,000	40794000
2001-02	2,911	2,03,77,000	37843000
Average	2,798.4	1,95,88,800	36379200

TABLE 5: **Annual revenue accrued to the *Syiem*, District Council and Government of Meghalaya**

Year	No of truck loads	Taxes collected (in Rupees)				Total revenue (approx.)
		Syiem	District Council	State Government.		
				Purchase tax	Sales tax	
1997-98	600	45,000	30,000	18,89,300	28,06,960	4771260
1998-99	616	46,200	30,800	19,40,400	28,82,880	4900280
1999-00	549	41,200	27,466	17,30,400	25,70,880	4369946
2000-01	697	52,300	34,850	21,96,600	32,63,520	5547270
2001-02	647	48,525	32,350	20,37,700	30,27,440	5146015
Average	622	46,645	31,093	19,58,880	29,10,337	49,46,954

The price also depends on the colour of the leaf; light green leaves are considered to be the best quality. The colour of the leaf depends on the time of drying after it has been removed from the tree. At the time of drying, the leaves should not be spread in damp places and dew should not fall on them, which causes a brown discolouration of the leaves, which would then result in the produce fetching a lower price. Rains during the drying process also cause browning of leaves. To obtain the produce's maximum value, the leaves should be loosely packed to avoid damage, and infected and broken leaves should be discarded.

Economic Impact of NTFP/MAP Forests of Meghalaya

About 2,800 MT of Bay Leaf reaches the regulated market every year (Table 4). Most of it comes from the *War* area. At an average purchase price of Rs 7/kg, Bay Leaf brings approximately Rs 20 million cash to the growers. Since most management activities are done by the growers themselves, a sizable part of this money adds to the income of growers. Apart from this, in the past five years on an average annually the *Syiem* and the District Council got a royalty of Rs 46,645 and Rs 31,093 respectively. The average tax collected by the state government was Rs 4,94,6954 (Table 5). The Bay Leaf has thus helped in improving the economy of all sectors of the society. The forests provide an additional source of income to the landowners, whereas the landless locals obtain daily wages. The processing and marketing of this forest product also create opportunities for setting up of small-scale industries at the local and regional level. However, the lack of knowledge

concerning the marketing of the products outside the region has inhibited growth of its production. The above income from the forest comes from Bay Leaf only. The forest owners also maintain a number of other NTFP/MAPs, which adds to the overall income of the growers.

Ecological Importance of NTFP/MAP Forests of Meghalaya

Biodiversity value

Traditional management practices have enabled the community to make the best use of the resources in the most sustainable manner. It has also helped in protecting the rich biodiversity of the area (Appendix 1). The sustainable harvesting practices developed by the growers of the NTFPs/MAPs also helps in maintaining the desired level of production required for the market and industry.

Soil and Water Conservation

The *War* area receives very high rainfall. The geological formations are composed of limestone and sand stone type of rocks of tertiary origin. The region consists of a variety of landforms and is endowed with rich and varied natural resources. The area has dense forest cover and a number of rivers and rivulets drain through the region. The geological formation and high rainfall make the soil of the region very prone to erosion. The vegetal cover plays a crucial role in the conservation of soil and water resources of the region. The traditional forest management has contributed a great deal towards maintaining the aquatic ecosystem's health. The brooks and streams inside these forests are quite well protected and the vegetation nearby are set aside. The management of the forest is also reflected in the quality of rivers. Most rivers carry a minimal silt load even though they pass through undulating topography. The practice of NTFP/MAP based forestry and raising of tree plantations are the most suitable land use for the region. This has been realized by the forefathers of *War* Khasis. It is estimated that domestication is not be more than 100 years old as plenty of Bay Leaf was available in the wild until recently. Domestication or protection in wild may have started when the market became available and prices became remunerative. The present practice of forest management has therefore evolved through experience and transfer of knowledge through oral traditions.

Desired Interventions

The collectors and growers should be provided with credit and storage facilities to avoid distress sales. Fixing a minimum floor price also works as a strong incentive for collectors and growers as they can rest assured of a certain level of income through the sale of their produce. In the current marketing scenario there is a lack of transparency, equal opportunity and incentive. Also, powerful outside and local

traders have distorted the markets in their favour. Information on price and markets is important to the collectors and small scale producers to make appropriate decisions. Establishment of local institutions like growers' cooperatives can help increase the bargaining power of growers. Development of communication network is also desirable for market information. As of now most produce is used as raw spice or it is used by the spice industries located out side the region. Value addition at the local level will increase employment and also assure market and remunerative price to the growers.

Discussion

The traditional forest management system described above is probably the most suitable land use for the edapho-climatic conditions prevailing in the area. In fact, the NTFP/MAP enriched forests of *War* area look like extended homesteads. Looking at the intensity of involvement and level of care people take, the management practice can be called 'forest husbandry'. Aumeeruddy and Sansonnens (1994) documented similar dynamics of forest management in Central Sumatra with the main economic species there being *Cinnamomum burmanii*. Such systems and other very similar ones described in Indonesia have been termed complex agroforestry systems. Ramakrishnan (2001) considers such forest management system an example of traditional ecological knowledge (TEK) evolved over centuries of experience in the fragile ecosystem like this. These forests are also akin to oligotrophic tropical rain forests described by Jordan and Herrera (1981) and (Medina et al., 1977). The soil is covered with a thick mat of roots and humus, and it is in this layer that most available nutrients are found. Such forests are also found in the eastern and central portions of the Amazon Basin (Fittkau et al., 1975). High rainfall and sloped topography make the ecosystem very fragile. Clearing forests/vegetation may cause irreversible change in the structure of the ecosystem and rapid decline in ecosystem fertility. Ample areas of neighboring uplands have most possibly experienced such change (Plate 1). These degraded barren lands presently cover a sizable stretch in Khasi and Jaintia Hills of Meghalaya. The area has experienced high population growth, and a modest socio-economic development, which has increased the demand and aroused the aspirations of local tribal people. The traditional system of a bioresource-based economy may not be able to fulfill the increasing needs of the people, therefore it is desirable to improve the productivity and sustainability of the system through inputs of technology, management and finances. The production and marketing mechanism are poor and there is vast scope for its improvement. There are no facilities for processing, value addition, and credit. The pricing is in the hands of regional traders. Promotion of *Killiang* (a traditional system of credit) and development of self help groups and microcredit facilities can make the system more remunerative for the growers.

Conclusions

The present NTFP/MAP based forest management practiced by the *War* people is successful because of the availability of a market, local skill, cheap labour, and a reasonable infrastructure. Also, the people are hard working and have learnt the acumen of business. However, the population seems to be at the threshold of exceeding its carrying capacity and therefore intervention is required to make the practice more remunerative and sustainable. The practice can be scaled up and replicated in other areas of Meghalaya as well as elsewhere, though some local specific modifications may be required. Recent establishment of Meghalaya Board of Commercial Plantations, and Regulated Market by the local Government are steps in the right direction. There is also a need to reduce taxes and royalties on forest produce to increase the share of cash flow to the growers. The present higher taxes and royalty regimes are based on the consideration that Bay Leaf is a forest tree and grows wild and is therefore a free good collected from the forests. Over the years the scenario has changed but the tax regime remains the same. There is also a gap in the scientific knowledge about the system as no systematic study has been conducted so far on the ecology and economics of this traditional natural resource management system. There is ample scope and possibility for making this a bio-resource based livelihood model for promotion among traditional societies where it can complement their income while serving the vital functions of biodiversity enrichment and conservation of natural resources. This TEK of *War* Khasis can be replicated in places where indigenous communities are managing biodiverse natural forests particularly in ecologically sensitive areas like mountains and oligotrophic tropical rain forests.

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annex 1

List of common plants and animals found in the forests of War area of Meghalaya, India

Tree Species

Albizzia spp *(Mimosaceae), Alstonia scholaris* R.Br. *(Apocynaceae), Aprosa dioica, Muell.*Arg. *(Euphorbiaceae), Bauhinia perspurea (Ceaesalpiniaceae), Callicarpa arborea* Roxb. *(Verbenaceae), Castronopsis* spp. *(Fagaceae), Croton joufra* Roxb. *(Euphorbiaceae), Cynometra polyandra* Roxb. *(Caelpiniaceae), Dillenia indica (Dilleniaceae), D. pentagyna (Dilleniaceae), Duabanga grandiflora (Soneratiaceae), Erythrina stricta (Papilionaceae), Ficus* spp. *(Moraceae), Garcinia* spp. *(Clusiaceae), Glochidion* spp. *(Euphorbiaceae), Gmelina arborea (Verbenaceae), Hibiscus macrophullus (Malvaceae), Holarrhaena antidysenterica (Apocynaceae), Heriliera* spp. *(Sterculiaceae), Knema angustifolia* Roxb. *(Myristicaceae), Kydiacalycina* Roxb. *(Malvaceae),Leea* spp. *(leeaceae), Mallutus* spp. *(Euphorbiaceae), Micromedum* spp. *(Rutaceae),Milettia* spp.*(Papilionaceae) Morus* spp. *(Moraceae) Oroxylum indicum Vent. (Bignoniaceae), Pinanga gracilis* Bl. *(Arecacceae) Pterospermum lacefolium* DC. *(Sterculiaceae) Rhus javanica (Anacardiaceae) Sterculia villosa (Sterculiaceae) Tetramcles nudiflora (Tetraimelaceae) Toona ciliata (Meliaceae) Trema orientalis (Ulmaceae) Trewia nudiflora (Euphorbiaceae) Wallichianas densiflora* Mart *(Arecaceae) Xanthoxylum* spp. *(Rutaceae)*

Epiphytic Plants

Important epiphytic and parasitic plants: *Aerides fildangi, A. multiflora, Aeschhynantes* spp., *Bulbophyllum cayrianum, coelogyne* spp., *Cymbidium* spp., *Dendrobium aphyllium, D. transparens and Eria* spp. *(*Orchidaceae*) Ficus* spp. *(Moraceae), Loranthus* spp. *(*Loranthaceae*), Pothos scanden (*Araceae*), Raphidophora* spp. *(Araceae), Viscum (*Loranthaceae*), Vitex* spp. *(*Vitaceae*)| etc.*

Climbers and lianas

Argyreia spp. (Convolvulaceae), *Bauhinia* spp. (Caesalpin iaceae), *Cissus* spp. (Vitaceae),*Combretum* spp.(Coenbretaceae) *Cyclea peltata(* Memispermaceae*), Dioscorea* spp.(Dioscoreaceae), *Entada* spp.(Mimosaceae), *Fiscus* spp. (Moraceae), *Ipoemea* spp.(Convolvulaceae), *Jasminium* spp.(Oleaceae), *Millettia* spp.(Papilionaceae), *Phanera khasiana* (Caesalpinianaceae*),* Piper spp. (Piperaceae*), Pothos* spp.*(*Aracaceae*), Raphidophera* spp.*(*Araceae*), Smilax* spp. *(*Smilaceae*), Thunbergia* spp*(*Aranthaceae*), Vitex* spp.*(*Vitaceae*).*

Rare Wild Relatives of Crops and Medicinal Plants

*Bauhinia khasiana (*Caesalpiniaceae), *Berberis* spp. *(*Berberidaceae), *Bulbophyllum* spp

(Orchidaceae), *Ceropegia* spp. (Asclepidaceae), *Clerodendron* spp. (Verbenaceae), *Dendrobium* spp. (Orchidaceae), *Dioscorea* spp. (Dioscoreaceae), *Eria* spp. (Orchidaceae), *Hoya* spp. (Asclepidaceae), *Musa* spp. (Musaceae), *Paederia foetida* (Rubiaceae), *Piper* spp. (Piperaceae), *Wallichina* spp (Palmae), *Xanthoxylum* spp (Rutaceae).

Birds

Some commonly found birds in this areaare:

Heliastur indus, Accipiter badius, Falco peregrinator, Falco chicquera, Threskiornis phoenicoptera, Steptopelia chinensis, Steptopelia transquebaria, Psittcula krameri, Eudynamus scolopacea, Centropus sinensis, Athene brahma, Bubo bubo, Apus affinis, Alcedo atthis, Ceryle rudis, Merops orientalis, Coracias benghalensis, Megalaima haemacephala, Hirundo daurica, Lanius exubitor, Oriolus xanthornus, Dicrurus adsimilia, Acridotheres tristis, Sturnus contra, Corvus splendens, Dendrocitta vagabunda, Pericrocotus flammeus, Rhipidira albogularis, Chrysomma sinensis, Turdoides caudatus, Prinia socialis, Prinia subflava, Copsychus saularis, Saxicola caprata, Saxicoloidea fulicata, Myiophoneus horsefieldii, Parus major, Motacilla caspica, M. maderaspatensis, Anthus trivialis, Carpodacus erythrinus, Lonchura punctulata, Estrilda amandava.

Insects

Lepidoptera: *Catopsilia pomona, Stichopthalma camadeva, Lethe verma, Danaus septintrionis, Childreni, Argyonome laodice, Graphium agetes, Pylura athamas, Papilio demolius, Cetocia biblis, Cetosia crocae, Papilio paris, Danaus sita, Euploea dipeletianus, Graphium bathycles, G. agamemnon, G. serpedon, Venessa cardui, Precis hierta, P. orithya, Danaus genutia.*

Bees: *Apis cerana indica, A. dorsata, A. florae* etc.

Wasp: *Vespa* spp, *Oxybelius* spp, *Eumenes* spp. etc

Ants: *Solenopsis* spp, *Pheidole* spp, *Phonera* spp, *Oecophylla* spp, *Formica* spp.

Isoptera: *Zootermopsis* spp, *Kalotermes* spp, *Reticulotermis* spp, *Odontotermis* spp.

Orthoptera: Various types of Grasshoppars: *Melanopus* spp. (Acridinae)

Phasmida: *Phyllium* spp, Stick insects, *Carausius morosus* etc.

Soil insects and arthropods: Spider mites, Termites, Ants etc,

Playing mantis: *Mantis religiosa* etc.

Aquatic Insects

Odonata: *Lestes* spp, *Ischnae* spp, *Sympetrum* spp.

Coleoptera: *Cicinidelis, Carabids, Dysticids, Staphylinids, Buprestids, Coccinellids* are very common beetles.

Diptera: Very commonly found along with *Culex* and *Anopheles* spp.

Reptiles

Python molurus.

Amphibians

Limnonectes limnocharis, Hyla, Limnonectes cyanophlyctis, Rana hexadactyla, Bufo melanostictus.

Gastropoda

Lymnea spp

Fish

Garra gotyla, Neolissocheilus hexagonolepis, Danio dangila, Channa orientalis, C. stewartii, C. punctatus, C. murulius.

Mammals

Indian Fox, *Vulpes bengalensis*, Indian Jackals, *Canis aureus*, Porcupine, *Hystrix indica.*

ENDNOTE

1 B.K. Tiwari is an ecologist working in the field of natural resource management systems of indigenous societies. His current research areas include NTFP & MAP management, conservation of biological diversity, shifting cultivation and sacred groves. He is Professor of Environmental Science at North Eastern Hill University, Shillong, India.