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FOREST MANAGEMENT PRACTICES OF THE TRIBAL PEOPLE OF MEGHALAYA, NORTH-EAST INDIA

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TIWARI BK, TYNSONG H & LYNSER MB. 2010. Forest management practices of the tribal people of Meghalaya, north-east India. The tribal communities of Meghalaya nurture forests in the vicinity of their habitations, near water sources, on steep slopes and other ecologically sensitive lands. Their forest conservation practices can be seen in sacred groves, village restricted forests, village supply forests, clan forests and other traditionally managed forests, which comprise about 90% of Meghalaya's total forest area. These forests are protected and managed by the tribal people through institutional arrangements developed to benefit the community as a whole. The classification, protection, regeneration and extraction procedures practised for management of these forests are among the best examples of traditional ecological knowledge. Often including a variety of water bodies, these forests are very rich in aquatic as well as terrestrial biodiversity, including innumerable species of medicinal plants, wild foods and other economically important plants and animals. This study documented and analysed the role played by these traditionally managed forests and associated knowledge in conservation of biodiversity in general and of medicinal plants in particular. The paper also highlights aspects of the traditional forest management systems of the local tribal people and their contributions to food security, health care and also perpetuation of forest-related knowledge.

Keywords: Community forest, traditional knowledge, biodiversity, medicinal plants, non-timber forest products

TIWARI BK, TYNSONG H & LYNSER MB. 2010. Amalan pengurusan hutan oleh suku kaum di Meghalaya, timur laut India. Suku kaum di Meghalaya memelihara hutan yang terdapat di sekeliling kediaman mereka, berdekatan sumber air, di lereng curam dan di kawasan yang sensitif terhadap unsur-unsur ekologi. Amalan pemuliharaan hutan dapat dilihat di kebun suci, hutan yang terhad penggunaannya, hutan hasil, hutan kaum kerabat dan hutan lain yang diuruskan secara tradisional. Hutan-hutan ini membentuk 90% daripada jumlah kawasan hutan di Meghalaya. Hutan-hutan ini dilindungi dan diuruskan oleh suku kaum di situ mengikut persetujuan yang memberi manfaat kepada komuniti keseluruhan. Prosedur pengelasan, perlindungan, pemuliharaan dan pengeluaran yang diamalkan untuk pengurusan hutan adalah antara contoh ilmu ekologi tradisional yang terbaik. Hutan-hutan ini yang biasanya mengandungi pelbagai badan air yang sangat kaya dengan biodiversiti akuatik dan daratan. Hutan-hutan ini juga kaya dengan tumbuhan ubatan, makanan hutan serta tumbuhan dan haiwan yang penting dari segi ekonomi. Kajian ini mendokumen dan menganalisis peranan hutan yang diuruskan secara tradisional. Ilmu yang berkaitan dengan pemuliharaan biodiversiti secara umum dan pemuliharaan tumbuhan ubatan secara khusus juga diperoleh. Kertas kerja ini juga menonjolkan aspek sistem pengurusan hutan tradisional oleh suku kaum tempatan serta sumbangan mereka terhadap jaminan makanan, penjagaan kesihatan dan pengabadian ilmu tentang hutan.

INTRODUCTION

Forests are an important source of food, fibre, freshwater and construction materials for subsistence as well as cash income for the tribal people and act as 'safety net' in times of hardship (Wollenberg & Ingles 1999, Campbell & Luckert 2002). In the developing world, an estimated 80% of the population depends on non-timber forest products (NTFPs) for primary health care and nutritional needs (Chandrasekharan 1995). For these reasons, communities dwelling in or near forests have in the past ensured that rich and diverse forest areas are preserved and protected. Close proximity to these resources and their constant utilisation have enabled traditional communities to develop an understanding of the conservation and sustainable utilisation of forests. This knowledge is expressed in the diverse cultural practices of the local people and forms part of their human heritage. Popularly known as traditional ecological knowledge, such knowledge is widely used by local and indigenous communities to develop various

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resource management techniques, rules and practices in order to ensure uninterrupted supply of forest products and other benefits from the forests (Phuthego & Chanda 2004). Traditional ecological knowledge in forest management practices is attracting greater attention of late because if it is combined with scientific knowledge, it can play a far greater role in sustaining biodiversity and ecosystem services as well as increase forest productivity (Becker & Ghimire 2003).

Many important benefits have resulted from protecting relatively intact relationships between indigenous people and natural ecosystems. In many developing countries, for example in India and Nepal, a number of new local institutions, e.g. Joint Forest Management Committees (JFMCs) and Forest User Groups (FUGs) at the community level have been established, while traditional local institutions have been strengthened to protect and manage community and village forests (Balooni *et al.* 2007). Success of local resource management depends very much on the status of local institutions; the weakening of such institutions often results in forest resource degradation and deforestation (Berkes *et al.* 2000, Watson *et al.* 2003).

The conservation of different types of forests is part of community conservation practices evolved over centuries and passed down from generation to generation. There is a great variability in the management practices followed by traditional societies as these practices have evolved under different biophysical and cultural environments (Nongkynrih 2001). There is a general lack of scientific research on the forest management practices of traditional and tribal societies other than those concerning the sacred groves (Ramakrishnan *et al.* 1998, Tiwari *et al.* 1998), home gardens and agroforests (Cairns 2007).

This paper examines various types of traditional forest management practices and associated institutional arrangements of the tribal communities inhabiting the state of Meghalaya in north-east India. The analyses included the role of traditionally managed forests and associated knowledge in the conservation of biodiversity and medicinal plants in particular. The study also examined the interdependence of forests and local health care systems among tribal societies of the state.

MATERIALS AND METHODS

Study area

The state of Meghalaya, situated in north-eastern India, is a land-locked territory with a geographical area of 22 429 km^2, lying between 25° 47' and 26° 10' N latitude, and 89° 45' and 92° 47' E longitude (Figure 1). Bordering Bangladesh to the south and west, and the Indian state of Assam to the north and east, the altitude ranges from 100 to 1900 m asl. The state encompasses three major hill regions—the Khasi Hills, the Jaintia Hills and the Garo Hills. The Meghalaya plateau is highly dissected with irregular terrain in the western and northern regions, and a continuous escarpment with steep slopes to the south.

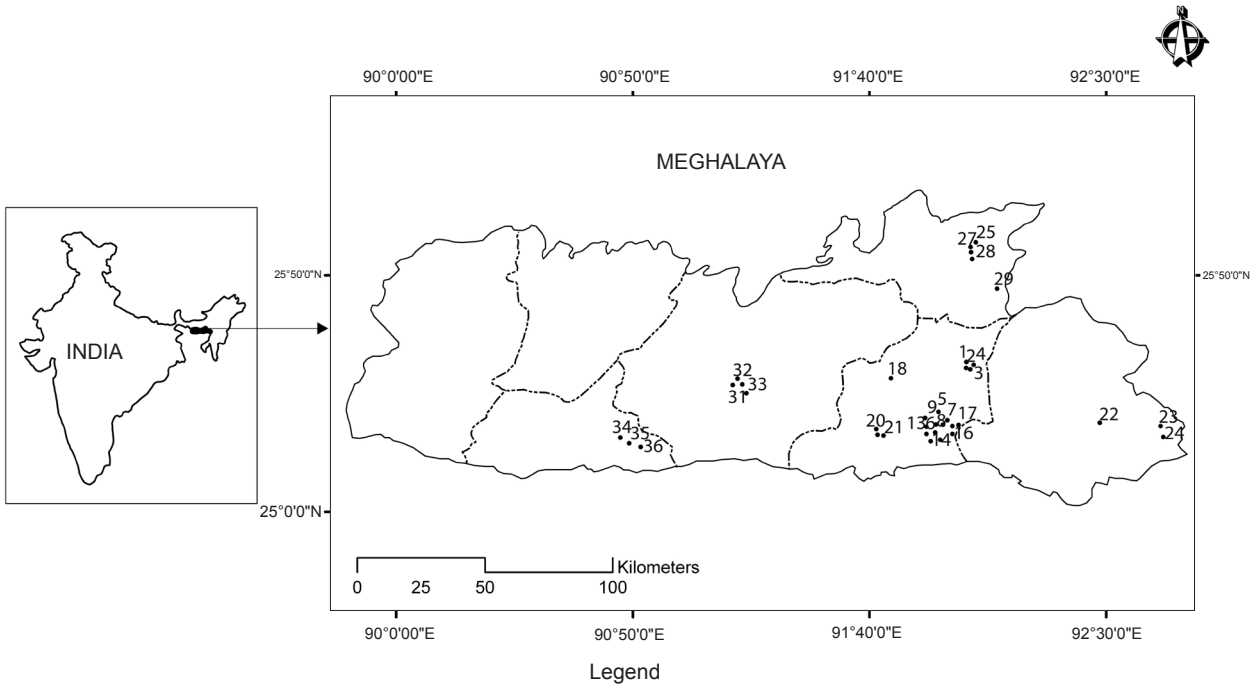
Meghalaya is inhabited by three main tribal groups, the Khasi (42%), the Jaintia (12%) and the Garo (32%), which together comprise 86% of the state's total population of 2.3 million. A high percentage of the population is engaged in occupations related to utilisation of forests, specifically agriculture (85%), collection of NTFPs (57%), timber harvesting (10%) and charcoal making (10%).

Meghalaya is exceptionally rich in biodiversity. The Khasi and Jaintia Hill districts of the state are described as some of the richest botanical habitats of Asia (Hooker 1872–1897). Unique vegetation types ranging from tropical, subtropical and temperate forests, arising from the diverse topography, varied climatic and edaphic conditions that favour development of habitat and species diversity are found in the state. The state is rich in forest resources with 75.7% (16 988 km^2) of the total geographical area under forest cover (FSI 2005). About 90% of the forest in the state belongs to communities and private individuals (Poffenberger 2007).

Methods

Management practices

Data on management practices, institutional arrangements and typology of traditionally managed forests were collected from government records and through interviews with officials engaged in management of forests in the state forest departments, autonomous district councils



Legend

1 . Pingwait	2. Umsning	3. Tanglei	4. Mawlein	5. Myllat	6. Pynursla
7 . Umkrem	8. Tangmang	9. Saitbakon	10. Mynring	11. Thohri	12. Korblang
13. Nongkwai	14. Mawshwn	15. Mawdang	16. Rangud	17. Nongskhen	18. Mawphlang
19. Nongpriang	20. Pdengshnong	21. Pomsohmen	22. Lumshnong	23. Mukroh	24. Loksi
25. Umlakhar	26. Mawlong	27. Umkon	28. Umden	29. Umpohwin	30. Nongpyndeng
31. Nongsyllieh	32. Siejlieh	33. Lawse	34. Wagekona	35. Chikasin	36. Bolsilgre

Figure 1 Map of the study area

and the heads of traditional institutions. These data were further confirmed through field survey in nine villages, *viz.* Pdengshnong, Nongpriang, Pomsohmen, Pingwait, Umsning, Tanglei, Mawlein, Mynring and Thohri. These villages were located in similar physiographic conditions and were selected based on contiguity and interdependence for forest resources. Thus, the qualitative data were collected at three hierarchal levels of management institutions. The data were analysed for consensus and disagreement between interviewees and only those with full agreement were considered reliable and included in the results.

Vegetation survey

Vegetation surveys of floristic biodiversity and phytosociology were conducted in two types of forests, *viz.* the village restricted forest and agroforest following the methods described by Mueller-Dombois and Ellenberg (1974), and Misra (1968). In each case, at least three replicate forests located in the area were studied. Three village protected forests covering an area of approximately 700 ha (Raid Shabong Law Adong), 500 ha (Law Adong Saitbakon) and 500 ha (Law Adong Pongtung) and three agroforests covering an area of 1600 ha (Nongkwai), 610 ha (Mawriang) and 560 ha (Sohlong) near Pynursla were surveyed for the vegetation analysis. For trees, shrubs and herbs, 10 × 10, 5 × 5 and 1 × 1 m quadrats respectively were used. The number of quadrats studied for trees, shrubs and herbs in each of the village protected forest and agroforest were 100 and 20, 160 and 40, and 20 and 160 respectively. The quadrats were laid along transects criss-crossing the vegetation with the object of making the samples representative. Species dominance and diversity were calculated using the Simpson index (Simpson 1949) and the Shannon–Wiener index (Shannon & Wiener 1963). For calculating evenness, Pielou's index (Pielou 1975) was used. Plant species were collected and identified using the *Flora of Assam* (Kanjilal *et al.* 1934–1940), *Flora of Jowai*

(Balakrishnan 1981–1983) and *Forest Flora of Meghalaya* (Haridasan & Rao 1985–1987). The herbaria of the Botanical Survey of India, North-Eastern Circle, Shillong were consulted for confirmation of the plant identifications.

Utilisation of NTFPs

The study on utilisation of NTFPs was conducted in five different types of forests—sacred forest, agroforest, village restricted forest, village forest and private or pine forest. A combination of semi-structured interviews with key resource users and focused group discussions involving 10 or more people/stakeholders from the village was used for collecting data for the types of forest products collected from the forests. Participatory rural appraisal (PRA) techniques were also used for conducting inventories of village resources. Household surveys were conducted in the villages of South Meghalaya, *viz.* Umkrem, Nongkwai and Rangud to study the contributions of three important NTFPs—bay leaf (*Cinnamomum tamala*), packing leaf (*Phrynium capitatum*) and wild pepper (*Piper peepuloides*) to the household income. From each village, 30 households were randomly selected and data on total income of the household from all the sources, income from the sale of the NTFPs, and expenditure incurred in management and marketing of the NTFPs were collected using questionnaires. The mean size of agroforests per household was 4 ha. This micro-analysis was aimed at gaining insights into local management and utilisation of forest products particularly the items used as food and medicine.

Health care

Data on folk medicines such as medicinal plant species, parts used, types of ailments cured and types of forests for the source of these plants were collected using focus group discussions with the villagers and semi-structured interviews with the local herbal practitioners and other key resource users. A survey investigating the use of folk medicines was conducted in Pynursla and Myllat in East Khasi Hills, Mukroh, Lumshnong in Jaintia Hills and Bolsilgre, Wagekona and Chikasin in South Garo Hills. Prior to the survey, the headman of each village was contacted and informed about the objective of the data collection and its possible publication. After getting his consent, a date was set for the visit and group discussions with the villagers. One resident from each village assisted researchers and introduced them to the herbal practitioner(s) for the interview. Researchers also visited herbal practitioners in their shops on market days and conducted interviews. Plant species used in the folk medicines were collected by the researchers and identified. A census survey on the number of herbal practitioners and forest area was conducted in the villages of south Meghalaya (Saitbakon, Myllat, Pynursla and Nongkwai). The dependence of herbal practitioners on forests for these medicines was assessed by analysing the source from where the medicinal plants were collected.

RESULTS

Forest management practices

On the basis of ownership, the forests of the state can be broadly grouped into two categories: (i) state government managed forests and (ii) autonomous district council forests. The state managed forests comprise reserve forests, national parks and wildlife sanctuaries which are controlled and managed by, and subject to, Indian union or state laws. The total forest area controlled and managed by the state government is 1112 km^2 or 12% of recorded forest area. According to official records, the remaining 88% of forest in the state (8372 km^2) is autonomous district council forest. In practice, the authority over and management of these forests rest with the concerned owners and the communities. While official records indicate these as autonomous district council forests, they are in fact community forests, managed and controlled either by the clans, individuals, groups or traditional institutions according to the prevailing customary laws and practices. The district councils do not exert any management control over most of these forests (apart from very small areas of autonomous district council reserve forest).

Modern forest management practices

Modern forest management in Meghalaya began in 1876 with the creation of the first reserve forest in Saipung, part of the Jaintia Hills District. The reserve forests together with the national

parks and wildlife sanctuaries follow modern forest management practices as prescribed in working plans prepared by the state forest department. These areas were established for wildlife management and to protect timber, soil and water resources. A small area of state forest has been classified as protected forests which are managed for protection of the catchments of water sources around the city of Shillong.

Traditional forest management practices

While there is a huge market demand for high quality timber in Meghalaya, large tracts of dense and well protected patches of community owned primary forests can still be seen in many parts of the state. This can be attributed to the traditional forest management practices followed by the tribal communities since time immemorial. Under customary law, these forests are classified into different types depending on their intended use. Locally these forests are known as *Law Kyntang* (sacred forest), *Law Shnong* (village forest), *Law Adong* (village restricted forest), *Law Raid* (forests belonging to a group of villages), *Law Ri-Sumar* (private forest on community land), *Law Ri-Kynti* (private forest on private land) *Law Lum Jingtep* (cemetery forest) and *Law Kur* (clan forest). The sacred forest and village restricted forests provide ecosystem services such as protection of the upper catchments of watersheds, conservation of biodiversity and medicinal plants. These forests are currently called community forests or community conserved areas. Most villages in the state have one or more types of community forests. Distribution of these forests are illustrated in three clusters of nine villages in Table 1.

The traditional management practices not only helped in conserving the resource as evident from the presence of large patches of well protected forests (for example 700 ha village protected forest in Pynursla) and ensuring its sustainable use but also serve as a common good and 'safety net' for the communities. This is demonstrated in the village of Nongpyndeng where a large portion of forest is being managed by the village council for the benefit of all inhabitants of the village. In Mawshun village, three types of forests are managed: sacred forest, village forest and agroforest. Each forest type provides different services to the people in the village. The sacred forest is the home of a deity who, according to the local belief, protects the village from natural calamities, famine and diseases. Village forests provide firewood, wild edible plants and poles for house construction and repairs. Agroforests are the primary source of cash income. The land use of Mawshun village depicting the location of different forest types is shown in Figure 2.

Institutional arrangements for forest management

Traditional institutions of Meghalaya are varied and organised in a hierarchical manner. Due to this, they generally include a head assisted by a council of elders and other knowledgeable people, a secretary, an assistant secretary and a treasurer. In larger villages, the council may have several additional members with expertise in

Table 1 Types of forest and their areas in three clusters of villages

Forest	Area (ha)		
	Cluster 1	Cluster 2	Cluster 3
Sacred forest	65	10	–
Village restricted forest	35	100	–
Village forest	20	253	20
Private forest	180	70	10
Clan forest	20	–	100
Group of village forest	–	–	30
Total	320	433	160

Villages in cluster 1: Pdengshnong, Nongpriang and Pomsohmen; cluster 2: Pingwait, Umsning, Mawlein and Tanglei; cluster 3: Mynring and Thohri

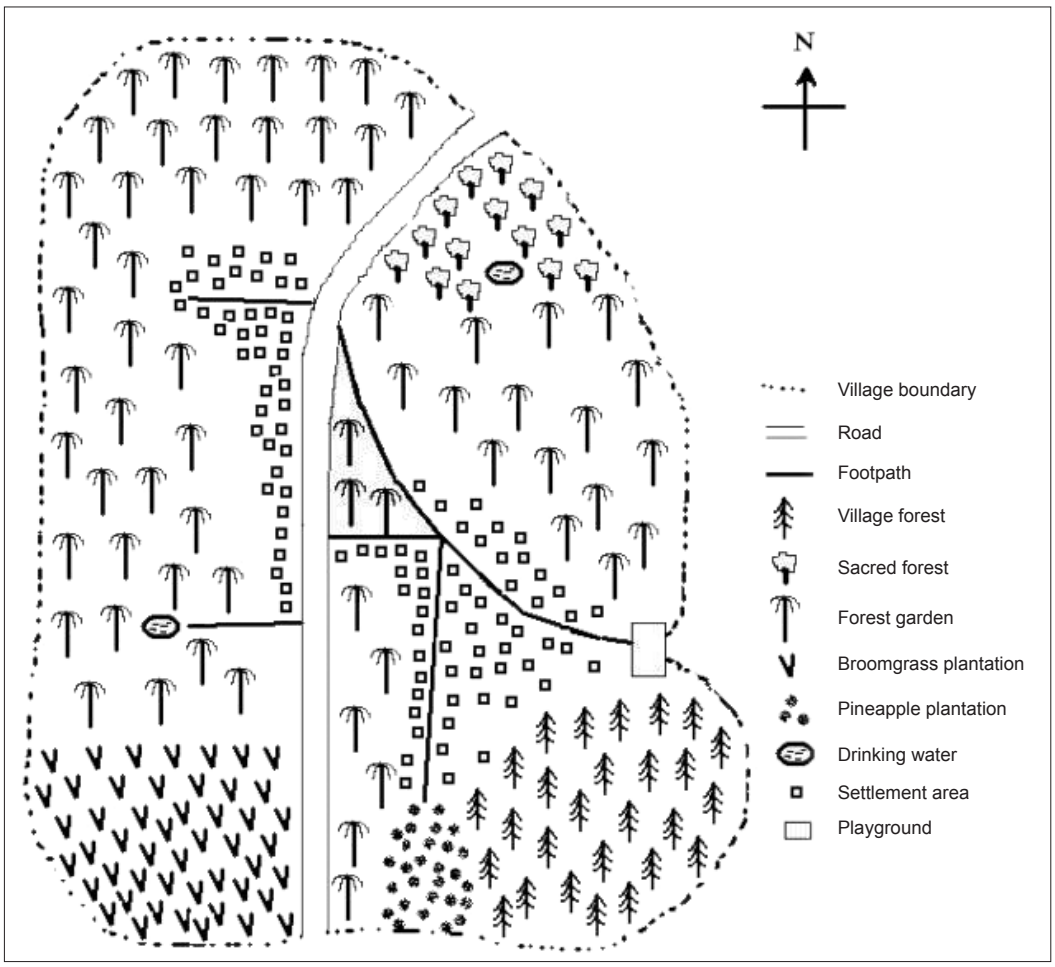


Figure 2 Landuse of Mawshun Village (based on PRA exercises; not to scale)

forest management, education and construction. It is mostly the male members of communities who are involved in governance. One of the traditional institutions commonly found is known as the *Hima*. This is a larger territorial and political unit comprising several villages. The role of the *Hima* is very important as it is the highest authority and all issues concerning policy and regulation of land and forests are discussed and decided at this level. Under the *Hima,* there are villages which function as autonomous units. Each village (*Shnong*) has its own territory and is represented by a headman selected from among male adults. A typical organisation of traditional institutions of the Khasi Hills of Meghalaya is shown in Figure 3. In many cases, a large *Hima* is divided into smaller territorial units (*Raid)* which comprise several villages. Every village has a general body known as village council (*Dorbar*), of which all adult males are members. In villages inhabited by households belonging to more than one clan, each clan may have an elder of the clan as head of the clan who may represent the clan in higher bodies. The lowest unit of the hierarchy of traditional institutions is the family (*Iing*).

Tribal management as tradition

The tribal people of the state manage these forests through traditional institutions. These local administrative units look after the well-being of the communities as well as the management of natural resources of the area under their jurisdiction. Traditional institutions manage and control their territory according to local customs and traditions. Their main task is to formulate rules and laws for smooth administration and for managing the common property resources (e.g. forest resources) and oversee the effective implementation of the customary laws. In relation to management of the forests, very clear terms and conditions are laid down regarding the

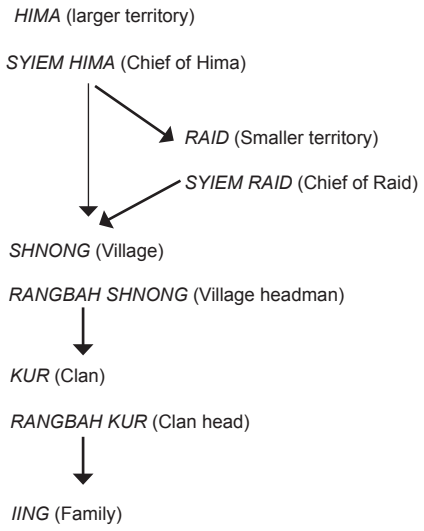


Figure 3 Typical hierarchy of traditional institutions in Khasi Hills, Meghalaya

access and use of resources. Normally, violators of the regulations have to pay fixed penalties with in-kind services or cash. Sometimes the traditional institutions have flexibility and punish the offender depending on the nature and gravity of the offence committed. For example, in one of the villages, it was recorded in one case a person was caught felling a small tree for fuelwood and a fine of INR100 (USD2) was imposed. Illegal felling and selling of mature trees, burning of forests and charcoal making result in higher fines which vary from INR500 to 2000 (USD10 to 40). Subject to the conditions laid down by these institutions, the communities enjoy rights to access and use the community forests and other common property resources. People can collect fuelwood, fell trees for construction of houses, collect wild fruits, vegetables, orchids and medicinal herbs, and can quarry sand and stones from permitted sites.

In a few of the villages studied in recent years, the role of traditional institutions in management of forest and other natural resources is weakening and giving way to privatisation of forest lands. For instance, in Umpowin village of Ri Bhoi District, the community forest land was distributed among the residents of the village by the village council about a decade ago. However, in other places, such as in Nongpyndeng village, more than 200 ha of degraded community forest had been regenerated through the intervention of a rejuvenated traditional institution. Prior to 1981, most of the land mass of Nongpyndeng village was barren, with degraded grassland and scrub as the dominant species. This was attributed mainly to the practice of shifting cultivation before 1970s and the timber trade in the late 1970s and early 1980s. The management practices changed drastically following the rejuvenation of traditional institution (village council) and appointment of a *Myntri* (representative of the village in the *Hima*). The people were motivated to hand over their land and place it under the management and control of the village council which was later approved by the *Syiem* (chief of *Hima*) of Nongstoin. Hence, more than 200 ha of scrub land were converted into common property and regenerated as *Law Shnong* (village forest). All the residents of the village have access and rights to use the forest for extraction of NTFPs. Furthermore, in order to ensure sustainable use, the forest has been divided into 19 compartments. To accomplish this, the village council opens a compartment of the village forest for use which can include the harvesting of timber and firewood from the area for a period of 10 to 15 years. Old and mature trees are selectively harvested without affecting the regeneration of the forest. When all the mature trees are harvested, the compartment is closed and allowed to regenerate and a new site is opened for extraction of timber and firewood. The rotational use and division of forests into compartments, selective felling of trees and promotion of natural regeneration of forests are among the best practices of forest management.

Typology of traditionally managed forests

Group of village forest (Law Raid)

These forests are jointly owned by a group of contiguous villages. The area under this type of forest is generally large and stretches from one village to another. These forests are managed by a council comprising the head of the group of villages (*Syiem Raid* or *Sordar*) and the headmen of all the villages within the territory (*Raid*). No one village can claim ownership for this type of forest. All people within the *Raid* can freely access, collect and use the resources from these forests without any restriction. This type of forest mainly benefits the poor who do not own any forest land. The forest land belonging to the *Raid*

can be allocated to families for shifting cultivation and other livelihood-related activities in case the village council is not in a position to do so. Any village or its residents can approach the *Raid* for land and forest resources, and if available, the needy are provided resources by the *Raid* to enable them to meet their livelihood needs.

Village supply forest (Law Shnong)

These forests belong to and are the common property of a particular village and are mostly found within the village boundary. They are usually set aside to meet genuine needs of the villagers. They are under the control and management of the village council. Villagers can collect both timber and NTFPs from these forests. In most villages, collection of timber and NTFPs such as fuelwood is restricted to personal use only and not for commercial purposes. NTFPs including mushrooms, wild vegetables and fruits can be collected for sale in local markets. Some villages have more than one village forest. In these cases, the village council has the responsibility to ensure sustainability of the forests. Towards this end, a certain period is fixed (typically 5–10 years) during which a forest area will remain open for extraction of forest products. At the end of this period, extraction is prohibited to enable its regeneration while another forest area is opened for extraction. In this way, the regeneration of the forest is ensured and the resource is conserved without affecting its availability for the people.

Village restricted forest (Law Adong)

This category of forest is similar to village forest in terms of their overall management. The only difference is the degree of protection. These forests are given a higher degree of protection, and access to forest resources is restricted and reserved particularly for the poorer families in the village and for some occasional needs by the village as a whole. Extraction of timber and fuelwood is usually restricted from this type of forest, but there are no restrictions for NTFPs that can be extracted without affecting the health of the forest, e.g. mushrooms, edible fruits and vegetables. Extraction of timber from these forests is allowed only when acute needs arise such as for constructing houses for the poor and needy, for making coffin in the case of a villager's death, for construction of community structures (a hall or school) or in the case of natural calamities. The decision to allow extraction of timber from such forests is made by the village council. Mature trees are usually harvested for timber using selective felling methods. In certain cases, mature trees are extracted for raising funds for a village or the revenues generated are shared equally among the villagers. In all cases, the integrity of the forest is maintained and under no circumstances are forests converted to other landuses.

Clan forest (Law Kur)

At times, more than one clan inhabit a village and many of them own an area of forest. Some clans may own forests located outside their village. All members of the clan are entitled to get a share of the benefits which are derived from the use of these forests. The management of clan forests is the responsibility of the whole clan and no individual can sell lands which belong to the clan. Decisions that need to be taken regarding these forests are dealt with by the clan council, which is usually led by the eldest uncle from the maternal side of the clan. Access to the forest and collection of forest products are permitted only for households belonging to the particular clan. In some villages, collection of dead branches for fuelwood, dry leaves and manure are allowed for other villagers but only for their personal use. Most of the clan forests are well protected and are rarely converted to other landuse as it is thought to be their ancestral property which is to be preserved for future generations.

Private forests (Law Ri-Kynti)

Generally small in size, these types of forests are owned by individuals and are scattered within the village boundary. They are managed and used according to the requirements and wishes of the owner. These forests are mostly maintained for forest production. Private forests are the principal source of 76 870 m^3 of timber valued at INR284.5 million (USD5.7 million) extracted from the forests of Meghalaya annually. Poorly stocked private forests are often converted to other landuses (e.g. for agriculture or charcoal burning activities) by the owners. Many private forests are secondary forests or pine (*Pinus kesiya*) plantations. In some cases, the owners have converted these forests into agroforests or home

gardens. While collection of forest products by people other than the owners' family members is strictly prohibited, in few cases the owners allow fellow villagers to extract dead and fallen wood, and NTFPs for their personal use.

Sacred forests/groves (Law Kyntang)

These forests, which may belong to individuals, clans or communities, are set aside for religious purposes. They are managed by the *Lyngdoh* (religious head) or persons to whom the religious ceremonies for the particular locality or village are entrusted in accordance with customary practice. No timber or NTFPs are removed for any purposes except for those connected with religious functions or ceremonies recognised and sanctioned by the *Lyngdoh*. Sacred forests are mostly primary forest and are well preserved, often in their pristine state and are rich in biodiversity. In our study, however, we found that only seven villages out of a total of 36 surveyed had a sacred forest. In some villages (e.g. Mukroh), more than one sacred forest were recorded. The size of sacred forests in our study varied from a grove of a few trees to more than 100 ha.

Agroforests

Tribal people living in southern Meghalaya, where the climate and topography are not conducive to agriculture, due to extreme rainfall (> 6000 mm) and steep slopes (40–60°), have developed a unique production system in which economically useful trees are managed within natural forests. These complex agroforests provide high level of productive benefits and the biodiversity values are similar to those in village restricted forests or sacred forests of the area. The vegetation surveys conducted in the village restricted forests and agroforests revealed that in the case of trees, basal area and density were higher in the village restricted forest than in the agroforests. The density, number of genera and species of shrubs were significantly higher in the village restricted forests. In the case of herbs, the density was significantly higher in the agroforests, while family, genera, evenness, diversity and species number did not vary significantly between the two forest types. Overall, diversity was significantly higher in the village restricted forests as compared with the agroforests with the exception of herb species (Table 2).

Agroforests are primary sources of cash income which include economically important plants illustrated in Table 3 such as bay leaf, wild pepper and packing leaf. The maintenance of these complex agroforests in an otherwise fragile environment (very high rainfall and steep slopes) is an example of perpetuation and utilisation of forest related knowledge for enhancing livelihoods.

When different types of traditionally managed forests are compared with regard to their degree of protection and productive benefits, sacred forests are the most protected but yield negligible productive benefits since no extraction is allowed as they are set aside for religious purposes. However, these forest ecosystems do provide a variety of ecosystem services, including drinking water. In many villages, it was found that the sacred forests and village restricted forests protected sources of drinking water. For example, the sacred forest of Mawshun, village restricted forest of Pynursla and sacred forest of Mawphlang have perennial sources of water from which the residents collect their drinking water. However, in the case of agroforests and private forests, the owners of such forests obtain maximum productive benefit as they are open for extraction of timber and other forest products. These forests sustain 1900 forest-based industries such as wooden furniture and fixtures, sawmills, and cane, bamboo and handicraft industries employing over 11 000 people in the state.

Utilisation

The tribal communities studied depended extensively on the forests for their varied needs for timber and NTFPs. The availability of NTFPs differed between forests, with the greatest number of species extracted from the village forests and village restricted forests, fewer extracted from clan forests, and the least from private forests (Table 4). Collection, processing and marketing of NTFPs from these forests play an important role in the economy of the tribal communities as they provide subsistence as well as source of cash income (Tables 3 and 5). The processing and marketing of NTFPs also create opportunities for setting up of small-scale industries at the local and regional levels generating employment to the people.

Table 2 Plant community characteristics of village restricted forests and agroforests in southern Meghalaya

Parameter	Village restricted forest				Agroforest			
	Tree	Shrub	Herb	Total	Tree	Shrub	Herb	Total
Sampling size (ha)	1	0.05	0.02		0.4	0.05	0.02	
Number of families	36	22	33	91	36	14	27	77
Number of genera	65	36*	48	149	66	18	38	122
Number of species	81	45*	54	180	83	18	41	142
Density (ha^{-1})	2005*	18 987*	468 105*		1807	6527	622 542	
Basal area ($m^2 ha^{-1}$)	61.7*	–	–		53.95	–	–	
Shannon's diversity index	3.9	3.5	3.0		3.5	2.8	3.5	
Pielou's evenness index	0.8*	0.9*	0.7		0.7	0.8	0.9	
Simpson's dominance index	0.01	0.01	0.01		0.01	0.01	0.01	

* Significant at $p < 0.01$

Three village restricted forests: Raid Shabong Law Adong(700 ha), Law Adong Saitbakon(500 ha) and Law Adong Pongtung (500 ha) and three agroforests: Nongkwai(1600 ha), Mawriang (610 ha) and Sohlong (560 ha) near Pynursla village.

Values are means of three forests of each type.

Table 3 Mean annual income (INR/household) from selected forest products derived from agroforest

Forest product	Village	Gross income	Management and marketing cost	Net income	% Total income
Cinnamomum tamala	Umkrem	22 500	5374	17 126	15
Phrynium capitatum	Nongkwai	2880	870	2010	5
Piper peepuloides	Rangud	30 000	4150	25 850	42

Mean size of forest garden: 4 ha per household.

Based on studies of 90 households in three villages.

Forest and health care

The study reveals that the tradition of health care based on folk medicines is widespread and popular in Meghalaya. The tribal communities seem to be quite knowledgeable about wild medicinal plants and depend on the herbal product for treatment of most of their common ailments and diseases. Medicinal plants are a vital resource for the traditional health care system as the modern health care infrastructure is not adequate in rural areas of the state. Of a total of more than 200 medicinal plant species recorded in the state in the present study, only 18 were found to be used by all the three tribes (*viz.* Khasi, Jaintia and Garo) of Meghalaya, while 107 species were used by the Khasi, 53 by the Garo and 18 by the Jaintia. Eighteen plant species were found to be used by the three tribes for treatment of more than one ailment. The medicinal plants used for treatment of more than two ailments were *Acorus calamus* (6 ailments), *Aegle marmelos* (6 ailments), *Centella asiatica* (4 ailments) and *Emblica officinalis* (3 ailments). Some ailments were treated by more than one medicinal plant. These included fever (18), headache (19), diarrhoea and dysentery (19), cough and cold (14), stomachache (11). The state has a large number of herbal practitioners. It was observed that density of forests and abundance of herbal practitioners often overlapped with each other (Table 6). Traditionally managed forests are the treasure houses of innumerable medicinal plants utilised in the health care systems (Figure 4). The sacred forests are home to many medicinal plants. Since nothing is extracted from such forests, they serve as the repository of germplasm of medicinal plants. The study revealed that 70% of medicinal plants used for the traditional health care systems in the state came from village restricted forests

Table 4 Forest products extracted from different types of forests

Forest type				
Sacred forest	Forest garden	Village restricted forest, group of village forest, clan forest	Village forest	Private forest
Salient characteristic				
Natural/ primary forest	Enriched forest	Natural/primary forests with low level of extraction	Primary or secondary forest with high level of extraction	Secondary pine forest/monoculture with rotational extraction of timber
Principal forest product				
Nil	Timber, bamboo, rattan, bay leaf, lichen, wild nuts, fruits, packing leaf, mushrooms, vegetables, wild pepper, medicinal plants, edible insects, fish, snails, crab, frogs, reptiles, etc.	Timber, bamboo, rattan, lichen, wild nuts, fruits, mushrooms, leafy vegetables, medicinal plants, edible insects, fish, snails, crab, frogs, reptiles, etc.	Bamboo, fuel wood, poles, medicinal plants, wild fruits, mushrooms, leafy vegetable, etc.	Timber, lichens, mushrooms, medicinal plants, etc.

and village forests, 10% from agroforests and 20% from home gardens.

The household survey revealed that the common belief that folk medicine was used only by the poor and/or uneducated was a myth. In Meghalaya, a majority of the people use some form of folk medicine. They include housewives, elders, traditional birth attendants, herbal practitioners and bone setters. The use of such knowledge and herbal ingredients in the treatment of common ailments and in some cases even major diseases or chronic ailments cut across social and economic strata. Even well-to-do urbanites visit the herbal healers in the study villages.

DISCUSSION

Traditional ecological knowledge systems and institutions of many indigenous communities worldwide have contributed significantly towards sustainable natural resource utilisation and management of forests (Posey 1985, Herrmann 2006). The categorisation of forests into functional groups by the traditional societies as seen in the study is an example of traditional ecological knowledge. Their management practices have been in existence for many centuries and certainly long before the introduction of modern forest management to India in 1876 (Poffenberger 1996). Tiwari *et al.* (1998) found that community forests in the form of sacred groves were homes to many medicinal plants. It is found that the traditional management practices not only help in conserving the resource as evident from the presence of large patches of well protected forests (for example 700 ha village protected forest in Pynursla) and ensuring its sustainable use, but at the same time serve as a common good and 'safety net' for the communities as seen in the village Nongpyndeng, where a large proportion of forest is being managed by the village council for the benefit of all inhabitants of the village. Often, more than one category of forest is found within the boundary of a single village or a group of villages. Over time, these communities have evolved a system of combining forest conservation and sustainable use at a micro level (Malhotra 1990), unlike much of national and international efforts which are aimed at meeting these requirements at national or global scales.

Possessing traditional ecological knowledge of the resource, users themselves and local institutions can help in ecosystem management (Gadgil *et al.* 1993, Becker & Ostrom 1995,

Table 5 Important edible plant species collected by the people from the forests of Meghalaya for subsistence and household consumption

Scientific name	Part used	Use
Anacardium oxidentale	Nut	Food
Bambusa tulda	Shoot, stem	Vegetable
Bambusa vulgaris	Shoot, stem	Vegetable
Boletus edulis	Fruiting body	Vegetable
Cantherellus cibarius	Fruiting body	Vegetable
Castanopsis indica	Nut	Food
Cinnamomum tamala	Leaf	Spice
Cinnamomum zeylanicum	Bark	Spice
Collybia allegretti	Fruiting body	Vegetable
Colocasia sp.	Tuber	Vegetable
Dendrocalamus hamiltonii	Shoot, stem	Vegetable
Discoria sp.	Tuber	Vegetable
Docynia indica	Fruit	Food
Entoloma euthelem	Fruiting body	Vegetable
Garcinia sp.	Fruit	Food
Gmelia arborea	Flower	Vegetable
Gomphus floccosus	Fruiting body	Vegetable
Inocyba cutifracta	Fruiting body	Vegetable
Lactarius sp.	Fruiting body	Vegetable
Lentinus sp.	Fruiting body	Vegetable
Litsea citrata	Seeds/pod	Vegetable
Melocanna bambusoides	Shoot, stem	Vegetable
Momordica lochinchinensis	Fruit	Vegetable
Musa sp.	Fruit and stem	Food
Myrica esculanta	Fruit	Food
Parkia roxburghii	Seed/pod	Vegetable
Podophyllum hexandrum	Fruit	Food
Ramaria formosa	Fruiting body	Vegetable
Romaria holorubella	Fruiting body	Vegetable
Scleroderma vercossum	Fruiting body	Vegetable
Solanum sp.	Fruit	Food
Suillus granulatus	Fruiting body	Vegetable
Tapioca sp.	Tuber	Vegetable
Tricholoma imbricctum	Fruiting body	Vegetable
Tricholoma terrum	Fruiting body	Vegetable
Usnea sp.	Whole plant	Spice
Zingiber sp.	Tuber	Spice

Table 6 Forest area and number of herbal practitioners in four study villages

Village	Forest area (km^2)	Number of herbal practitioners	Principal source of medicinal plants
Nongkwai	17	25	Village restricted forest and agroforest
Siatbakon	12	7	Village restricted forest
Pynursla	18	31	Village restricted forest
Myllat	14	20	Village restricted forest and agroforest

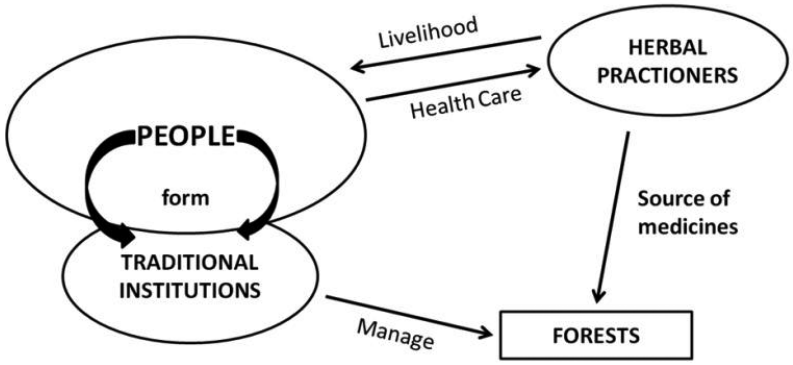


Figure 4 Diagrammatic representation of the dependence of people and herbal practitioners on forest

Colding & Folke 2001). It can contribute to the enhancement of livelihood and provision of ecosystem services (Tiwari 2005). Benefits obtained by the communities from forest management, *viz.* cash generation, drinking water availability, biodiversity conservation, food security and health care of the people were revealed by the study. This system was developed from active participation of the people. Equity and social justice is the key objective of the management. The management system needs little external inputs, is flexible and evolves over time with traditional institutions in place. Moreover, there is a need to make appropriate linkages with traditional forest knowledge generated over generations by communities for sustainable forestry (Ramakrishnan 2007).

This study illustrated that cultural and ecological forest management in rural India was based on traditional ecological knowledge and characterised by features such as assurance for the availability of resources to herbalists, fulfilment of spiritual, social and ecological needs without neglecting its ability in generating cash income. It is believed that the forefathers of these communities designated these forests keeping equity concerns in mind especially to safeguard the interests of the poor and the landless. The study also revealed that in certain places traditional forest management was weakening and giving way to privatisation of common property resources. It is hoped that by improving the income and livelihood of village people, the values of ecosystem services will get preponderance over the forest products and the traditional management systems will gain added strength.

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REFERENCES

Balakrishnan NP. 1981–1983. *Flora of Jowai, Meghalaya.* Volumes I and II. Botanical Survey of India, Howrah.

Balooni K, Bhallabh V & Inque M. 2007. Declining instituted collective management practices and forest quality in the Central Himalayas. *Economic and Political Weekly* 42: 1443–1452.

Becker CD & Ghimire K. 2003. Synergy between traditional ecological knowledge and conservation science supports forest preservation in Ecuador. http://www.consecol.org/vol8/iss1/art1/.

Becker CD & Ostrom E. 1995. Human ecology and resource sustainability: the importance of institutional diversity. *Annual Review of Ecology and Systematics* 26: 113–133.

Berkes F, Colding J & Folke C. 2000. Rediscovery of traditional ecological knowledge as adaptive management. *Ecological Applications* 10: 1251–1262.

Cairns M (Ed.). 2007. *Voices From the Forest. Integrating Indigenous Knowledge Into Sustainable Upland Farming.* Resources for the Future, Washington DC.

Campbell BM & Luckert MK. 2002. Towards understanding the role of forests in rural livelihood. Pp. 1–3 in Campbell BM & Luckert MK (Eds.) *Uncovering the Hidden Harvest.* Earth Scan Publication Ltd., London.

Chandrasekharan C. 1995. Terminology, definition and classification of forest products other than wood. Pp. 345–380 in *Report of the International Expert Consultation on Non-wood Forest Products.* Food and Agriculture Organization, Rome.

Colding J & Folke C. 2001. Social taboos: "invisible" systems of local resource management systems and biological conservation. *Ecological Applications* 11: 584–600.

FSI (Forest Survey of India). 2005. *State of Forest Report. Forest Survey of India.* Government Publisher of India, Dehra Dun.

Gadgil M, Berkes F & Folke C. 1993. Indigenous knowledge for biodiversity conservation. *Ambio* 22: 151–156.

Gurdon PR. 1975. The Native Races of India: The Khasis. Cosme Publication, New Delhi.

Haridasan K & Rao RR. 1985–1987. *Forest Flora of Meghalaya.* Volumes I and II. Bishen Singh and Mahandrapal Singh, Dehra Dun.

Herrmann TH. 2006. Indigenous knowledge and management of *Araucaria araucana* forest in the Chilean Andes: implications for native forest conservation. *Biodiversity and Conservation* 15: 647–662.

Hooker JD. 1872–1897. *The Flora of British India.* Seven volumes. Reeve and Co. Ltd., Kent.

Kanjilal UN, Kanjilal PC, Das A, De RN & Bor NL. 1934–1940. *Flora of Assam.* Five volumes. Government Press, Shillong.

Malhotra KC. 1990. Village supply and safety forest in Mizoram: a traditional practice of protecting ecosystems. Pp. 439 in *Abstracts of the Fifth International Congress of Ecology.* Yokohama.

Misra R. 1968. *Ecology Work Book.* Oxford & IBH Publishing Co., Calcutta.

Mueller-Dombois D & Ellenberg H. 1974. *Aims and Methods of Vegetation Analysis.* John Wiley and Sons, New York.

Nongkynrih AK. 2001. Ka Shnong: the microcosm of Hynniewtrep society. *Indian Horizons* 48: 121–151.

Phuthego TC & Chanda R. 2004. Traditional ecological knowledge and community-based natural resource management: lessons from a Botswana wildlife management area. *Applied Geography* 24: 57–76.

Pielou EC. 1975. *Population and Community Ecology. Principles and Methods.* Gordon and Breach Science Publishers Inc., New York.

Poffenberger M. 1996. *Communities and Forest Management.* A Report of the IUCN Working Group on Community Involvement in Forest Management. IUCN, Washington DC.

Poffenberger M. 2007. *Indigenous Forest Stewards of Northeast India.* Technical Report. Community Forestry International, Santa Barbara.

Posey DA. 1985. Indigenous management of tropical forest ecosystems: the case of the Kayapo Indians of the Brazilian Amazon. *Agroforestry Systems* 3: 139–158.

Ramakrishnan PS. 2007. Traditional forest knowledge and sustainable forestry: a north-east India perspective. *Forest Ecology and Management* doi:10.1016/j.foreco.2007.04.001.

Ramakrishnan PS, Sexena KG & Chandrashekara UM. 1998. *Conserving the Sacred for Biodiversity Management.* UNESCO and Oxford and IBH, New Delhi.

Shannon CE & Wiener W. 1963 .*The Mathematical Theory of Communication.* University Illinois Press, Urbana.

Simpson EH. 1949. Measurement of diversity. *Nature* 163: 688.

Tiwari BK. 2005. Forest biodiversity management and livelihood enhancing practices of War Khasis of Meghalaya, India. Pp. 240–252 in Thomas *et al.* (Eds.) *Himalayan Medicinal and Aromatic Plants: Balancing Use and Conservation.* His Majesty's Government of Nepal, Kathmandu.

Tiwari BK, Barik SK & Tripathi RS. 1998. Biodiversity value, status, and strategies for conservation of sacred groves of Meghalaya, India. *Ecosystem Health* 4: 20–32.

Watson A, Alessa L & Glaspell B. 2003. The relationship between traditional ecological knowledge, evolving cultures, and wilderness protection in the circumpolar north. http://www.consecol.org/vol8/iss1/art2/.

Wollenberg E & Ingles A. 1999. *Incomes From Forest: Methods for the Development and Conservation of Forest Products for Local Communities.* Centre for International Forestry Research and IUCN, Bogor.