

Traditional knowledge based management and utilization of bio-resources by *war khasi* tribe of Meghalaya, North-east India

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Abstract

The survival of mankind depends upon the availability of bioresources and their proper management. *War Khasi* tribe of Meghalaya nurtured bioresources in the vicinity of their habitations, near water sources, on steep slopes and other ecologically sensitive lands. Traditional knowledge based management practices can be seen in forest management in the form of sacred groves, village restricted forests, village supply forests, clan forests, traditional fish harvesting, traditional bird harvesting, water conservation and traditional herbal treatment. In this paper, we investigate and document, traditional knowledge associated with management and utilization of various bioresources by *War Khasi* tribe of south Meghalaya.

Key words: Community Forest Management; Bird resource; Fish Resource; Traditional Health Care; Sacred Groves.

Introduction

Bioresources include all products and services emanating from natural environment that satisfies the needs and wants of humans. The survival of mankind depends upon the availability of bioresources and their proper management. Over-exploitation of bioresources by growing population has given birth to many environmental problems the humanity is facing today. Destruction of vegetation has resulted in land degradation, denudation, soil erosion, landslides, floods, drought and distorted ecosystem processes. Traditional resource management systems are considered as unbiased system and often ensure equitable sharing of benefits from forests and other natural resources (Nongbri, 2003; Fitzpatrick, 2005). The Community Forest Management is one of those types (Hunnam *et al.*, 1996). India is bestowed with rich reserve of bioresources and forests are one among them. For generations these forests have been managed by the indigenous communities for enhancing the productivity and maintaining their integrity. Human practice of setting aside areas for the conservation of bioresources can be seen in

several examples of sacred groves, royal hunting forests and sacred gardens (Gadgil *et al.*, 1993). These practices involve a variety of restraints on harvesting in term of quantity, locality, season and age, sex and social class (Gadgil *et al.*, 1992). Norms are set up for the use of these resources by community institutions. These institutions regulate the use and preservation of bioresources like forests through decentralized community control system (Krishnan, 2000). In all, prudent use of the resource was practiced which served as a common good for the communities who in turn shared common interest and understanding towards the sustainable use of the resource.

In the hill region of north-east India, large tracts of lands remained under the control of local communities. Several communities continued to manage their forests through community institutions (Poffenberger, 2007). Like many indigenous communities, the *War* community of south Meghalaya has a long tradition of natural resources conservation based on customs and religious beliefs which have been passed on from one generation to the other. These communities set

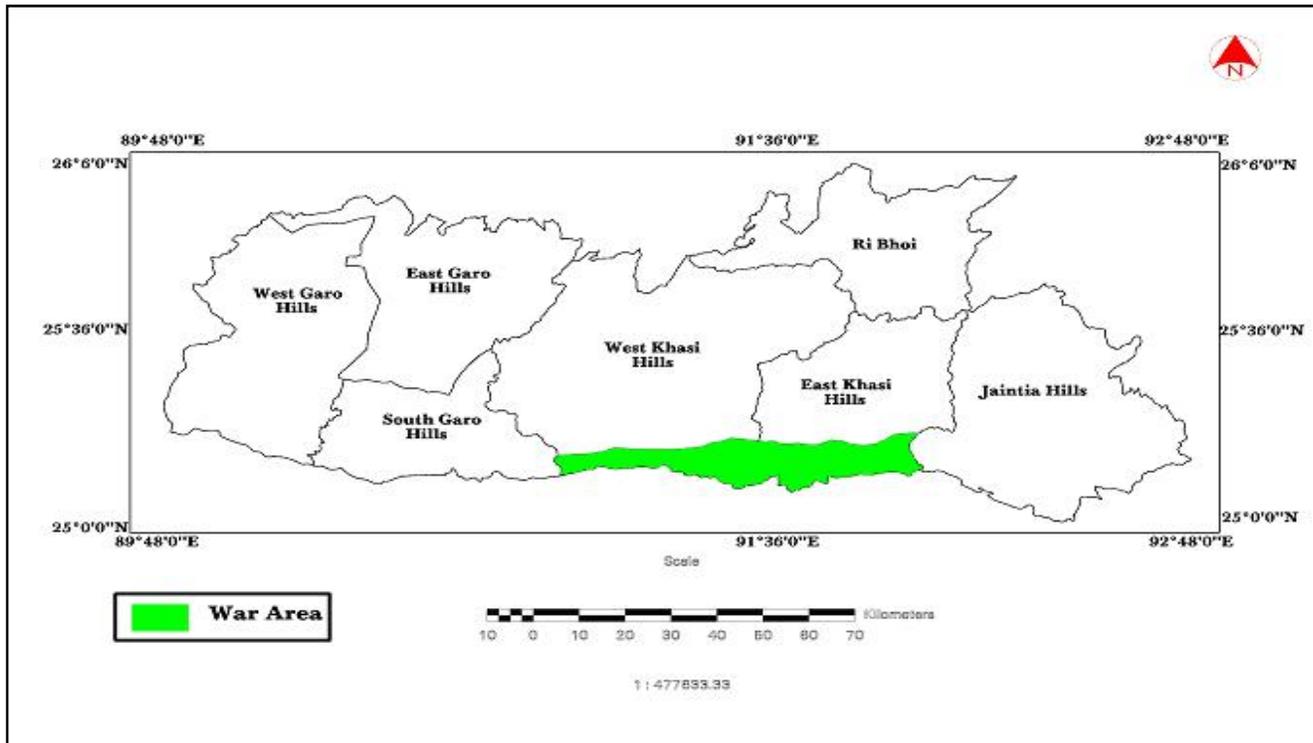


Fig. 1. Location of the study area

aside patches of village forests for religious purposes under the traditional land tenure system (Gurdon, 1975). Traditionally such forests are called as *Law Kyntang* and *Law Lyngdoh*. Ethnic groups across the globe possess tremendous amounts of traditional knowledge (TK), most of which are poorly documented and hence are largely unknown. Meghalaya situated in the northeastern region of India is a treasure house of TK on various disciplines including flora and fauna. The traditional knowledge has been reported on health-care, fisheries, forest management, pest management, etc. (Tynsong and Tiwari 2008). Such knowledge still remains largely unreported especially from the northeastern region of India. Recording such knowledge is crucial before they get lost forever in the rapid drive of modernization and globalization. The role of TK in meeting larger goals of biodiversity conservation and to understand the impacts of climate changes at small scales is gaining importance in the current mainstream conservation paradigms. Overexploitation in conjunction with intense habitat transformation represents one of the main

worldwide threats to wildlife. In the tropics, this problem acquires greater significance due to overlapping of high biodiversity with high human population and the greater dependence of human on bioresources for subsistence and profiteering. Hence the threat is not only to the biodiversity but also to the large number of people who depend on wildlife for their survival and subsistence (Tynsong *et al.*, 2009). The present research was undertaken to document and discuss the traditional knowledge associated with management and utilization of bioresources by *War* community of south Meghalaya.

Study area

The study was conducted in south Meghalaya, locally known as *War* area. The area is located between 25°6'25"-25°18'29" N latitude and 91°57'38"-92°1'26" E longitudes (Fig 1). The surveyed villages included: Lyting Lyngdoh, Mawkria, Mawlat, Mawpran, Mawshun, Mawriang, Myllat, Nohron, Nolikata, Nongkhleng, Nongkwai, Nongsder, Pongtung, Pynursla, Ranikor, Siatbakon, Umkrem, Wahumrem, Wahlakhiat and Wahlyngdoh. Cherrapunjee-

Mawsynram plateau, one of the wettest places on earth is located in this region. The altitude of the study area varies from 10 m to 1200 m asl. The mean annual maximum and minimum temperature is 23°C and 13°C respectively. The mean annual rainfall is 11565 mm. The slope of the area is predominantly towards the south and the angle of the slope varies between 10°-40°. 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 one hill range from the other. The population density is sparse. Horticulture, forestry and fisheries are the principal occupation of the people. Agriculture is limited to some small valleys where mainly tuber crops are grown. Arecanut, orange, betel leaf, jack fruit, bay leaf, honey and broom grass are the important produce of the region. The area is inhabited by *War Khasi* people, a tribal community having long tradition of forest conservation. People gather a variety of edibles from the water bodies found inside and near the forests which include fish, frog, crustaceans, mollusks, bushmeats, tubers, wild fruits, medicinal plants and wild vegetables. The staple diet of the local inhabitants is rice, fish and meat. People collect process and market a large variety of non-timber forest products (NTFPs) and medicinal and aromatic plants (MAPs) such as *Cinnamomum tamala*, *Piper peepuloides*, *Phrynium capitatum*, bamboo, honey, mushrooms, nuts, tubers, edible worms, insects and leafy vegetables from the forests (Tiwari 2000). Farmers of south Meghalaya have developed a system in which arecanut groves are deliberately and intensively grown while maintaining most biodiversity elements of the natural forests (Tiwari 2005), (Fig.1).

The natural vegetation of south Meghalaya ranges from tropical evergreen to sub-tropical evergreen forests (Balakrishnan 1981-1983). The plant species in the forests are distributed in distinct vegetation layers. The important evergreen trees found in the south Meghalaya include: *Cinnamomum tamala*, *Daphniphyllum himalayense*, *Myrica esculenta*, *Sarcosperma griffithii*, and *Syzygium tetragonum*. The deciduous elements include: *Betula alnoides*, *Cedrela toona*, *Engelhartia spicata* and *Ficus roxburghii*. The shrub layer is thick and is predominantly composed of *Ardisia griffithii*, *Boehmeria malabarica*, *Goniothalamus sesquipidalis*, *Mahonia pycnophylla* and *Wallichia densiflora*. The ground vegetation (herb) is dominated by *Borreria pilosa*, *Commelina benghalensis*, *Impatiens* spp., *Ophiorrhiza hispida*, *Sonerila khasiana* and a large number of ferns. There are a good number of lianas and

other climbers seen twining on the trees. The tree trunk and branches are covered with large number of mosses, epiphytic ferns and a variety of orchids. The invasive weedy species like *Artemisia* spp., *Eupatorium* spp. and *Mikania micrantha* are also present in good number.

Methodology

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 and the heads of traditional institutions. Various participatory research tools such as group discussion, semi-structured interviews, key informant survey and on-site observation were used to acquire insight into various traditional practices followed by the community. Attendance of the bird hunting sites, fishing sites, irrigation sites etc. allowed us to observe directly the construction of structures and procedures followed in these traditional practices. During the interviews, the hunters answered questions about each of the bird species they hunted, their hunting techniques and reason for hunting the bird species etc. Prior informed consent was obtained from all interviewees. Plant species were identified with the help of the Flora of Jowai (Balakrishnan 1981-1983), Forest Flora of Meghalaya (Haridasan & Rao 1985-1987) and Flora of Assam (Kanjilal *et al.* 1934-1940). The birds were identified by local people in their local languages and then we verified for their zoological names by consulting with the preserved bird specimen available in the Zoological Survey of India, Shillong. The fishes were also identified with the help of Zoological Survey of India, Shillong.

Results

Forest Management Practices

Seven different types of community forests were recorded from south Meghalaya managed by the *War* community. Some of the community managed forests found in the study area are briefly described in Table 1. The typologies of these forests are described subsequently.

i. Law Raid (Group of village forest)

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 the other. Such type of forests is managed by a council which comprises of the Head of the group of villages

Table 1. Community forests and their management type found in the study area

Name of forests	Size	Management Type	Dominant sp.	Products Extracted	Remarks/History
<i>Kharai Law Lyngdoh Nongkqlieng</i> (Sacred forest)	1.5 km ²	Raidship	<i>Ficus</i> spp., <i>Toona</i> spp., <i>Lithocarpus elegans</i> , <i>Artocarpus heterophyllus</i> , <i>Sarcosperma griffithii</i> and <i>Bischofia javanica</i> .	No extractions are allowed.	It was told by the village elders that about 20yrs ago rituals used to perform by the <i>Lyngdoh</i> (priest), who stayed inside the forest and never cut even his hair. During that time, nothing was allowed to be collected from the forest; the forest was looked after by the <i>Khongtyngkut</i> clan but now the forest is under the <i>Raid Nongkqlieng</i> . During that time people believed that if someone destroyed or collected any things from the forest fire will burn his/her house.
<i>Law Lyngdoh Mawshun</i> (Sacred forest)	1km ²	Clanship	<i>Bambusa</i> spp., <i>Quercus</i> spp., <i>Schima wallichii</i> , <i>Castanopsis hystrix</i> , <i>Oroxyrum indicum</i> and <i>Sarcosperma griffithii</i> .	No extractions are allowed.	Originally this forest was owned by the 5 clans (<i>Khongdkhar</i> , <i>Rynjah</i> , <i>Khongbuh</i> , <i>Massar</i> and <i>Nongsteng</i>). But as the village grew the forest fell under the control of the 10 clans. For performing the rituals these clans empowered to either <i>Khongdkhar</i> or <i>Rynjah</i> clan. Which clan actually performed was decided by performing rituals. For the expenditure incurred during the ritual the whole village had to contribute money and even the <i>Raid Mawshun</i> also contributed for the purpose. If some one destroyed or collected any things from the forest fire will burn his/her house.
<i>Law Lyngdoh Lyting Lyngdoh</i> (Sacred forest)	1km ²	Raidship	<i>Quercus</i> spp, <i>Schima wallichii</i> , <i>Castanopsis hystrix</i> , <i>Machilus khasyana</i> , <i>Bridelia retusa</i> and <i>Calicarpa arborea</i> .	No extractions are allowed.	This forest situated near the market way (<i>Lynti iew</i>), before rituals were performed by the <i>Dkhar</i> clan, during this time even entering inside the forest was not allowed. Now it falls under the <i>Raid Lyting</i> .
<i>Law Kyntang Mawkliaw</i> (Sacred forest)	2km ²	Village Durbar	<i>Castanopsis</i> spp., <i>Quercus</i> spp., <i>Schima wallichii</i> , <i>Calicarpa arborea</i> , <i>Sarcosperma griffithii</i> and <i>Glochidion thomsoni</i>	No extractions are allowed.	This forest is under the control of <i>Mawkliaw</i> village Durbar.

<i>Law Shnong Mawshun</i> (Village forest)	2.5km ²	Village Durbar	<i>Bambusa</i> sp., <i>Quercus</i> sp., <i>Schima wallichii</i> , <i>Castanopsis hystrix</i> , <i>Oroxylum indicum</i> and <i>Sarcosperma griffithii</i>	Firewood, Bamboos, Medicinal plants	This forest is protected with the main aim of serving the day to day biomass need of the people in the village.
<i>Law adong Pynter</i> (Protected forest)	3 km ²	Village Durbar	<i>Schima wallichii</i> , <i>Quercus</i> spp., <i>Callicarpa arborea</i> , <i>Bischofia javanica</i> , <i>Sarcosperma griffithii</i> and <i>Glochidion thomsoni</i>	No extractions are allowed.	This forest belongs to Pynter village. On special permission from the headmen of the village, people can collect any things from the forest, especially if there is fire outbreak in the village and other natural calamities.
<i>Law adong Pongtung</i> (Protected forest)	1km ²	Village Durbar	<i>Castanopsis</i> spp., <i>Schima wallichii</i> , <i>Actinodaphne abovate</i> , <i>Quercus dealbata</i> , <i>Quercus dilatata</i> and <i>Syzygium tetragonum</i>	Firewood, Broom, Medicinal plants.	On special permission from the headmen of the village, people can collect any things from the forest. Especially if there is fire outbreak and other natural calamities in the village.
<i>Law adong Wahtyrjut Raid Nongkhlieng</i> (Protected forest)	2.5km ²	Raidship	<i>Castanopsis</i> spp., <i>Myrica esculenta</i> , <i>Schima wallichii</i> , <i>Quercus dealbata</i> , <i>Quercus dilatata</i> and <i>Syzygium tetragonum</i> .	Medicinal plants, Fruits, Firewood	This forest is under the control of the Raid Nongkhlieng, a local traditional institution having jurisdiction over a group of villages.
<i>Law adong Wahumrem</i> (Protected forest)	500m ²	Raidship	<i>Castanopsis</i> spp., <i>Quercus</i> spp., <i>Actinodaphne abovate</i> , <i>Sarcosperma griffithii</i> and <i>Glochidion thomsoni</i> .	Medicinal plants, Fruits, Firewood	This forest was under the control of the Raid Nongkhlieng, but it was looked after by Wahumrem Village Durbar.
<i>Raid Shabong Law adong</i> (Protected forest)	7km ²	Raidship	<i>Sezygium</i> spp., <i>Castanopsis</i> spp., <i>Quercus</i> spp., <i>Myrica esculenta</i> , <i>Schima wallichii</i> and <i>Glochidion thomsoni</i> .	Medicinal Plant, Mushrooms, Fruits, Nuts.	This forest is looked after by the Wahpathew-Urksew village durbar, while the rituals and sacrifices are performed by the Raid Shabong.
<i>Law adong Siatbakon</i> (Protected forest)	9km ²	Village Durbar	<i>Castanopsis</i> spp., <i>Schima wallichii</i> , <i>Actinodaphne abovate</i> , <i>Quercus dealbata</i> , <i>Quercus dilatata</i> and <i>Syzygium tetragonum</i>	Medicinal Plants, poles, firewood, fruits, nuts	This forest previously known as Phlang U Diah, but now is known as the Law adong Siatbakon. The rituals and sacrifices are performed by the Raid Shabong.
<i>Lawadong Wahphadar</i> (Protected forest)	500m ²	Village Durbar	<i>Sezygium</i> spp., <i>Castanopsis</i> spp., <i>Quercus</i> spp., <i>Myrica esculenta</i> , <i>Schima wallichii</i> and <i>Glochidion thomsoni</i> .	Medicinal Plants, poles, firewood, fruits, nuts	This forest is looked after by the Umkor Village Durbar.
<i>Ri Tynsong</i> (Private forest)	10km ²	Family	<i>Ficus</i> spp., <i>Toona</i> spp. , <i>Lithocarpus elegans</i> , <i>Artocarpus heterophyllus</i> , <i>Sarcosperma griffithii</i> and <i>Bischofia javanica</i> .	Poles, Medicinal plants, Brooms	This forest belongs to one family of Tynsong's clan.

<i>Law Raid Mawja</i> (Group of village forest)	4km ²	Raidship	<i>Sezygium</i> spp., <i>Castanopsis</i> spp., <i>Quercus</i> spp., <i>Myrica esculenta</i> , <i>Schima wallichii</i> and <i>Glochidion thomsoni</i> .	Firewood, fruits, medicinal plants	Any extraction made from this forest need prior permission from the <i>Sordar</i> of Raid Mawja.
<i>Ri Sawkur Nonglyngdia ng Mawpran</i> (Clan forest)	6km ²	Clanship	<i>Castanopsis</i> spp., <i>Schima wallichii</i> , <i>Ostodes paniculata</i> , <i>Quercus</i> spp. and <i>Myrica esculenta</i> .	Firewood, fruits, medicinal plants	This forest is jointly owned by the 4 clans viz., Khongmawloh Diengdoh, Khongmawloh Syntiew, Khongmawloh Khongiar and Khongmawloh Khongthngan
<i>Khlaw Khongmawloh</i> Nongmadan Mawpran (Clan forest)	2km ²	Clanship	<i>Castanopsis</i> spp., <i>Schima wallichii</i> , <i>Actinodaphne abovate</i> , <i>Quercus dealbata</i> , <i>Quercus dilatata</i> and <i>Syzygium tetragonum</i>	Firewood, Medicinal plants, Wild fruit	This forest is jointly owned by all families belonging to Khongmawloh clan.
Sohlong Arecanut agroforest (Forest garden)	2-4km ²	Family	<i>Areca catechu</i> , <i>Cinnamomum tamala</i> , <i>Piper peepuloides</i> , <i>Artocarpus heterophyllus</i> , <i>Quercus dilatata</i> and <i>Syzygium tetragonum</i>	<i>Cinnamomum tamala</i> , <i>Piper peepuloides</i> , fuelwood, <i>Phrynium</i> leaf	People manage it mainly for arecanut, but also manage many NTFPs and wild native plants.

ii. *Law Shnong (Village forest)*

(Sordar), and the headmen of all the villages within the territory (Raid) are members of the council. No village can claim an ownership for this type of forest. Although located in a particular village, all people within the Raid can access, collect and use the resource from these forests with prior permission from the Sordar if they are not protected or sacred forests. Such type of forests mainly benefits the poor people 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. For example *Law Raid Mawja* (Table 1).

These forests belong to and are the common property of a particular village, mostly found within the village boundary, and are usually set aside to meet bonafied, day to day needs of the villagers. They are under the control and management of the village council (Village Durbar). Villagers can collect both timber and Non-Timber Forest Products (NTFPs) from these forests. In most villages, land under village forest is allotted for house construction for landless and poor people of the village. Collection of timber and fuelwood is restricted to personal use only and not for commercial purposes, where as NTFPs such as mushrooms, wild vegetables and fruits can be collected for sale in local markets. Some villages have more than one village forest. In such cases, the village council has the responsibility to ensure sustainability of these 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 particularly collection of fuelwood. At the end of this period, extraction from this forest patch is prohibited to enable its regeneration while another forest patch is opened for extraction. In this way, the regeneration of the forest is ensured and the resource is conserved without affecting the availability of the forest produce for the people. For example *Law Shnong Mawshun* (Table 1).

iii. *Law Adong (Village/Raid restricted forest)*

Law Adong is either under the control of a particular village or under the control of a *Raid* (group of villages). This category of forests is similar to village forest in terms of their overall management. The only difference is in the degree of protection. These forests are given a higher degree of protection, and access to forest resources is restricted. They are 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 such type of forest, but there are no restrictions for NTFPs that can be extracted without affecting the health of the forest, i.e., mushrooms, edible fruits and vegetables. Extraction of timber from such forests is allowed only when acute needs arise such as for construction of houses for the poor and needy, for making coffins in the case a villager's death, for construction of community structures (a hall or school, for example) 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 it was noted that mature trees were extracted for raising funds for a village or in other that revenues generated from the proceeds was shared equally among the villagers. In all such cases the integrity of the forest was maintained and under no circumstances was forests converted to other land uses. The examples of Village restricted forest: *Law Adong Siatbakon*, *Law Adong Pongtung*, *Law Adong Wahphadar*, *Law Adong Pynter* etc. and Raid restricted forest: *Law Adong Wahtyrjut* Raid Nongkhlieng and Raid Shabong *Law Adong* (Table 1).

iv. *Law Kur (Clan forest)*

This type of forest belongs to either one particular clan or more than one clans located within the village boundary. Some clans may own forests which are

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 a land which belongs to the clan. Decisions that need to be taken regarding these forests 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 is permitted only for the 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 land use as it is thought to be their ancestral property which is to be preserved for future generations. The example clan forest owned by one clan: *Khlaw Khongmawloh Nongmadan Mawpran* and clan forest owned by more than one clans: *Ri Sawkur Nonglyngdiang Mawpran* (Table 1).

v. *Law Ri-Kynti (Private forests)*

Generally small in size, these types of forests are owned by individuals and are scattered within the village boundary. Most of the forests in Meghalaya belong to this category. They are managed and used according to the requirement and wishes of the owner. These forests are mostly maintained for productive purpose and are often subjected to over-exploitation. Poorly stocked private forests are often converted to other land uses (for example, for agriculture or charcoal burning activities) by the owners. In south Meghalaya, most private forests have been converted into agroforests (forest gardens or home gardens). While collection of forest products by people other than owners' family members is strictly prohibited, in few cases it was noted that the owners allowed fellow villagers to extract dead and fallen wood and NTFPs for their personal use. For example *Ri Tynsong* (Table 1).

vi *Law Lyngdoh or Law Kyntang (Sacred Forests)*

These forests may belong to Village, Clans or Raid and 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 villages are entrusted in accordance with customary practices. No timber or NTFPs are removed for any purposes except for those connected with religious functions or ceremonies recognized and sanctioned by the *Lyngdoh*. Sacred forests are mostly

natural forest, and are well preserved, often in their pristine state, and are very rich in biodiversity. In the past, almost every village in the Khasi Hills had a sacred forest (Gurdon, 1975). The examples Village sacred forest: *Law Kyntang Mawkliaw*, Clan sacred forest: *Law Lyngdoh Mawshun* and Raid sacred forest: *Kharai Law Lyngdoh Nongkhlieng* and *Law Lyngdoh Lyting Lyngdoh* (Table 1).

vii. Forest Gardens

Tribal people living in southern Meghalaya where the climate and topography is not conducive to agriculture, due to extreme rainfall (>6000 mm) and steep slopes (40-60°), have developed a unique production system called forest gardens 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 forest gardens are sources of cash income as they include economically important plants such as bayleaf (*Cinnamomum tamala*, *Piper peepuloides*, and *Phrynium capitatum*) for which a ready market exists (Tynsong and Tiwari, 2010). The maintenance of these complex agroforests in an otherwise fragile environment (very high rainfall and steep slopes) is an example of perpetuation and utilization of forest related knowledge for enhancing livelihoods. Example: Sohlong Arecanut agroforest (Table 1).

Traditional Health Care System

Tradition of health care based on folk medicines is widespread and popular in south Meghalaya. The *War* communities are very knowledgeable about the wild medicinal plants and depend on the herbal product for treatment of most of their common ailments and diseases. Medicinal plants mostly collected from the community forests are the most vital resource for the traditional health care systems. A total number of 85 medicinal plants were recorded from south Meghalaya (Tynsong *et al.*, 2006). Almost every village has one or more such herbal practitioners. As many as 70 percent of medicinal plants used for the traditional health care systems in the state come from natural forest (village restricted forests and village forests), 10 percent from forest gardens and 20 percent from homegardens. Folk knowledge related to medicine and health care exists in almost all the rural communities of the state and also support the livelihood for many people. Majority of the

people of the state use some form of folk medicine which includes housewives and elders, traditional birth attendants, herbal healer 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 (Tiwari *et al.*, 2004).

Betel Leaf Cultivation

In south Meghalaya, the betel leaf is grown on slopes inside forest or under the shade of trees. The growers prune the tree canopy at right time for making the openings for light. In some places the growers make bamboo channels for irrigation of the betel vines planted at the base of the trees also known as bamboo drip irrigation. The betel leaf growers observe strict hygiene of self, the implements and tools used for tendering of the plant and harvesting of leaf. Thus they prevent infection and maintain the plantation disease free without using any pesticide. Within few years the trees sprout and develop a thick canopy and provide support and desired shade to the betel vine. These plantations provide most forest ecosystem goods and services while also providing economic return to the planters. The cultivation of betel leaf inside forest without clear felling the forest is probably the most sustainable agroforestry practice evolved by the people in fragile slopes of southern Meghalaya that receives very high rainfall (Tynsong 2009).

Bamboo drip irrigation

In the south Meghalaya because of the sloping condition of the area, irrigating is one of the main problems faced by the farmers. People have to devise an ingenious system of tapping of water resources by using bamboo pipes to irrigate their plantations. Bamboo pipes are used to divert perennial springs on the hilltops to the lower reaches by gravity. Depending upon the size of bamboo (*Bambusa vulgaris*), about 18-20 liters of water entering the bamboo pipe system per minute gets transported over several kilometers distance. This water has to be judiciously used by dividing to 20-30 drops per minute at the site of the plant. Bamboos of smaller diameters (*Bambusa tulda*) are used for diversion and distribution of water from the main channel to specific plant. This traditional irrigation system is used mainly by the farmers involved in cultivation of betel leaf (*Piper betle*), arecanut (*Areca catechu*) and orange (*Citrus reticulata*) in *War* area of Meghalaya.

Table 2. Community forests and number of water source

Community forests	Water source (No.)		Water pipe (No.)		Village benefited
	Spring	Stream	Individual Households	Govt. water supply	
<i>Law Lyngdoh</i> Mawshun	3	-	4	-	Mawshun
<i>Law Kyantang</i> Mawkliaw	2	2	4	-	Mawkliaw
<i>Law adong</i> Pynter	1	-	6	-	Pynter
<i>Law adong</i> Pongtung	1	-	2	-	Pongtung
<i>Raid Shabong Law adong</i> Pynursla	3	-	15	-	Urksew, Wahpathaw
<i>Law adong</i> Siatbakon	3	2	14	1	Siatbakon
<i>Lawadong</i> Wahphadar	1	-	-	-	Umkor
Ri Sawkur Nonglyngdiang Mawpran	4	-	10	2	Nongmadan Mawpran and Nonglyngdiang Mawpran
Khlaw Khongmawloh Nongmadan Mawpran	10	-	12	-	Nongsder, Pynter and Nongmadan Mawpran
Khlaw Khongmawloh Nongmadan Mawpran	10	-	12	-	Nongsder, Pynter and Nongmadan Mawpran
Sohlong Arecanut agroforest	1	-	5	-	Sohlong and Mawriang

Community forests as source of water

Spring and stream are the principal source of water in south Meghalaya. Villagers pay ample regard to these water sources. They use this water for drinking and make efforts to keep them clean and unpolluted. They have their own traditional system for the management of drinking water. They do not permit their cattle at the places from which they collect drinking water; do not allow anyone to throw garbage in its source/current to avoid pollution and infection. In villages where government supplies water are inadequate or absent, water from these community forests play an important role in their daily requirements. Ponds and wells are made at most water sources, where in some villages a signboard is put up having cautionary notes on how to use the water. A number of water pipes in most of these forests can be easily seen, which draw water to the people's houses. Some community forests act as a source for government water supply. For example, from *Ri Sawkur* Nonglyngdiang Mawpran (Clan forest) two government water pipes draw water which is supplied to two villages viz., Nongmadan Mawpran and Nonglyngdiang Mawpran and from *Law Adong* Siatbakon (community protected forest) at Siatbakon there is one government water pipe supplying water to nearby habitations. A few community forests supplying water to nearby villages are listed in [Table 2](#).

Fish Resources

War Khasi community of south Meghalaya possesses a wealth of knowledge related to ethnofisheries techniques. The community has evolved a number of techniques for harvesting fishes. These techniques are specialized according to structure and size of stream, season and species of fish intended to be harvested. The fishermen have evolved several specialized & innovative hunting techniques for fishes. Principal among them are locally known as: *Riam kriaah*, *Riam khohka*, *Buh kroh*, *Riam kyllong*, *Ring khashiar*, *Buh ruh*, *Krang Wah* and *Bia dohpieh*. Thirteen edible animals collected from forest streams and rivers are given in [Table 3](#).

The people living in the study area have thorough knowledge of the habit, habitat, reproductive behaviour, food preferences and life cycle of the fishes found in the region. The communities also have a very good understanding of the plants that can be used as sedatives or as baits for catching the fishes. During recent years they have taken several decisions pertaining to management and conservation of stream fishes. These include ban on chemicals and explosives for catching the fish in the streams. The village durbars do not allow fishing in bigger rivers during breeding seasons of the fishes. The fishing is done on a small scale mostly for

Table 3. Fishes and other edible animals collected from forest streams and rivers of south Meghalaya

Scientific name	English Name	Local name	Season/month of collection	River
<i>Neolissocheilus hexagonolepis</i> (McClelland)	Katli	Kha-saw	Whole year	Umsong, Umsi, Umshrei, Durit, Umjar and Umkhat
<i>Neolissocheilus</i> sp.	Not available	Kha shi-iar	Dec-January	Umsong and Umsi
Unidentified	Not available	Kha shbiar	Whole year	Umsong, and Umsi
<i>Anguilla bengalensis bengalensis</i> (Gray)	Indian longfin eel	Kha bsein	Whole year	Umsong, and Umsi
<i>Cyprinus carpio</i> (Linnaeus)	Common carp	Kha bten	May-August	Umsong and Umsi
<i>Garra lamta</i> (Hamilton-Buchanan)	Lamta Garra	Dohkew	Whole year	Umsong, Umsi, Umshrei, Durit, Umjar and Umkhat
<i>Garra lissorhynchus</i> (McClelland)	Khasi Garra	Doh sher	Whole year	Umsong, Umsi, Umshrei, Durit, Umjar and Umkhat
<i>Lepidocephalus caudofurcatus</i> (Tilak & Husain)	Tilak loach	Syngkai	Whole year	Umsong, Umsi, Umshrei, Durit, Umjar and Umkhat
<i>Channa orientalis</i> (Bloch & Schneider)	Asiatic snakehead	Doh thli	Whole year	Umsong, Umsi, Umshrei, Durit, Umjar and Umkhat
Unidentified	Not available	Kha shyrimit	Whole year	Umsong, Umsi, Umshrei, Durit, Umjar and Umkhat
<i>Pseudecheneis sulcatus</i> (McClelland)	Sulcatus catfish	Briang	Whole year	Umsong, Umsi, Umshrei, Durit, Umjar and Umkhat
<i>Crangon crangon</i> (Linnaeus)	Brown Shrimp	Shymbrong	Whole year	Umsong, Umsi, Umshrei, Durit, Umjar and Umkhat
<i>Uca</i> sp.	Crab	Katham	Whole year	Umsong, Umsi, Umshrei, Durit, Umjar and Umkhat

self consumption to maintain the stock and prevent from over harvesting. The decisions of village councils are respected by every member of the community. Thus the fishes are considered as a community resource on which every member of the community has equal right but no one has ownership. The community control over the resource has helped in perpetuation and conservation of the river fishes of *War Khasi* region of Meghalaya.

Bird Resources

In south Meghalaya, the art and science of bird hunting have evolved with the local communities and are being passed on from generation to generation. The *War Khasi* community possesses a wealth of knowledge related to bird-hunting. There are few studies conducted in Meghalaya regarding the wild fauna resource population especially on birds: their extraction rate, season of availability and social demand. In an effort to

understand the importance of birds as a wild resource of rural tribal of Meghalaya, we documented the local hunting techniques, season of availability of birds, tools used in hunting and purpose of hunting. It was found that bird-hunting in the forests has been practised since time immemorial and represents not just a form of resource extraction but also a traditional form of wild life management. Thirty species of birds were found to be most hunted and were used by the local communities for various purposes of food, pet, recreation, sports and cash income (Table 4).

The hunters have evolved several specialized and innovative hunting techniques for birds. Principal among them are locally known as *Suh Sim*, *Suh Sim Um*, *Suh Lynglit*, *Riam Shynroh* and *Riam Dkhoh*. *Suh Sim* and *Suh Sim Um* was found to be the most successful and yielded maximum birds. Hunting could have negative impacts on the bird population and might

Table 4. Bird species, common name, local name and uses of birds by *War Khasi* community, Meghalaya

Bird species	English name	Local name	Purpose of hunting
<i>Alcippe vinipectus</i> (Hodgson)	White-Browed Fulvetta	Ruria	Food
<i>Alophoixus</i> sp.	-	Sim Ad	Food
<i>Aprosmictus erythropterus</i> (Gmelin)	Red-Winged Parrot	Khlung	Food, Pet, Sale
<i>Arachnothera longirostra</i> (Latham)	Little Spiderhunter	Jiriak Padung	Food
<i>Arachnothera magna</i> (Hodgson)	Streaked Spiderhunter	Jiriak Padung	Food
<i>Athene noctua</i> (Scopoli)	Little Owl	Dkhoh Rit	Food , Pet
<i>Blythipicus pyrrhotis</i> (Hodgson)	Bay Woodpecker	Kumpiat	Food
<i>Cettia flavolivacea</i> (Blyth)	Aberrant Bush-Warbler	Sim Um	Food
<i>Chalcophaps</i> sp.	-	Lyngtliew	Food
<i>Chloropsis cochinchinensis</i> (Gmelin)	Blue-Winged Leafbird	Sim Jalaeit	Food, Pet
<i>Chloropsis hardwickii</i> (Jardine& Selby)	Long-Tailed Minivet	Jala Eit	Food, Pet
<i>Dicrurus leucophaeus</i> (Vieillot)	Ashy Drongo	Shyrwat	Food
<i>Dicrurus</i> sp.	Racket-Tailed Drongo	Risei	Food
<i>Lonchura punctulata</i> (Linnaeus)	Scaly-Breasted Munia	Pdit	Food, Pet
<i>Macropygia</i> sp.	-	Shiar	Food
<i>Megalaima asiatica</i> (Latham)	Blue-Throated Barbet	Pohrong	Food
<i>Megalaima virens</i> (Boddaert)	Great Barbet	Jyllup	Food
<i>Niltava sundara</i> (Hodgson)	Rufous-Bellied	Thabalong	Food
<i>Otus sunia</i> (Hodgson)	Oriental Scops-Owl	Dkhoh Heh	Food
<i>Pericrocotus ethologus</i> (Bangs & Phillips)	Long-Tailed Minivet	Jaraitsiaw Stem	Food
<i>Pericrocotus</i> sp.	-	Jaraitsiaw Saw	Food
<i>Picus canus</i> (Gmelin)	Grey-Faced Woodpecker	Kynjar	Food
<i>Psarisomus dalhousiae</i> (Jameson)	Long-Tailed Broadbill	Lakadia	Food
<i>Psittacula columboides</i> (Vigors)	Malabar Parakeet	Kyrkhiah	Food, Pet
<i>Psittacula himalayana</i> (Lesson)	Slaty-Headed Parakeet	Shynrang	Food, Pet, Sale
<i>Pycnonotus leucotis</i> (Gould)	White-Eared Bulbul	Pait Puraw	Food
<i>Pycnonotus melanicterus</i> (Gmelin)	Black-Crested Bulbul	Sim Klong	Food
<i>Seicercus</i> sp.	-	Sim Rit	Food
<i>Treron apicauda</i> (Blyth)	Pin-Tailed Green Pigeon	Kuwo	Food
Unidentified1	-	Sim Kdait	Food
Unidentified2	-	Sim Iong	Food
Unidentified3	-	Phreit	Pet

prove unsustainable as many bird species were hunted during the breeding season. It was found that the choice of hunting technique depended mainly on the habits and habitat of the bird species. The local people are of the opinion that disturbed areas and secondary forests harbour fewer species of birds than primary forests in the same locations which corroborate with recent ecological studies elsewhere (Alves *et al.*, 2009). In our opinion, it is this congruence between TK and conventional scientific studies that can form the basis of a constructive goal-based dialogue among scientist, conservationist and indigenous people. Although hunting might be proving detrimental to the wild animal populations, it is important to note the hunter's perspective on the problem too. The hunter's 'guild' felt

that *jhum* cultivation, commercial logging and conversion of natural forests into agro-forests have led to the depletion of their 'niche'. Such information would be useful to grapple with the issues of setting sustainable limits to use of wild bird resources in this region.

Discussion and Conclusion

Traditional forest management contributes to the livelihood, water availability, biodiversity conservation, food security and health care of the people. The system is built upon active participation of the people and equity and social justice is the key ingredient of the management. The management system needs little external inputs, is flexible and evolves with time for

which an in built mechanism in the form of traditional institutions is in place. The forest management is based on traditional ecological knowledge and is characterized by the features such as assurance for the availability of resources to herbalists, fulfillment of spiritual, social and ecological needs without neglecting its ability to generate cash income for the needy. 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. It is hoped that with improvement of income and livelihood the values of ecosystem services will get preponderance over the forest products and then the traditional knowledge based bioresource management systems will gain added strength.

This most fascinating traditional community, who lived in this region for thousand of years have build a precious knowledge-base about the use and traditional system of protection of bioresources of this region. The community has thorough knowledge of the habit, habitat, reproductive behaviour, food preferences and life cycle of the animal species found in the region. The findings in this study throw light on the wealth of TK of *War Khasi* in hunting bird species, it also gives an insight that such knowledge of other ethnic groups of the Himalayan region should be recognized and documented on priority. The TK of all ethnic communities may serve as valuable data for developing the conservation strategies because their livelihoods bring them in close link with the environment. Most hunters feel that non-sustainable activities such as slash and burn agriculture and conversion of natural forests into agroforests and cash crop cultivation result in loss of habitat for many wild species as well as in loss of fruit trees are principal causes of loss of avian diversity.

While people in most part of the country as well as in the world have already forgotten the use of wild plants for edible and medicinal purposes, it is still well preserved and practiced by local communities. The conservation and sustainable use of biological diversity is of critical importance in meeting of food, fodder, fiber, health, water and other needs of growing population for which purpose, access to and sharing of both genetic resources and technologies are essential. It should be determined to conserve and sustainable use of biological diversity for the benefit of present and future generations. Involving people in a participatory mode including local people, ecologists and illiterate villagers, for the conservation and protection of bioresource

wealth of this area will be better serve the conservation than law enforcing forces and regulations of the Governments. Awareness creation among people, school children, students and teachers in the colleges and universities is very important to conserve the biodiversity wealth. Participatory mode of involvement of the people at grassroots level to acquire more knowledge about the biodiversity conservation will help maintain and sustain the bioresources and biodiversity of this region.

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