

Status of socio-ethnobotanical resources of Tawi Wildlife Sanctuary and adjoining villages in Mizoram, India

Lallawmkimi and H. Lalramnghinglova¹

Department of Environmental Science, Mizoram University, Aizawl – 796004, India

¹Corresponding author: E-mail: febesmzu@yahoo.co.in

[Received 10.03.2013; accepted 11.12.2013]

Abstract

Tawi Wildlife Sanctuary is situated in the extreme south-east corner of Aizawl District in Mizoram, Northeast India. The sanctuary covers an area of 35.75 km² in the Tawi Hill range in Mizoram. This study investigates the socio-economic conditions and plant resources in the adjoining villages of Tawi Wildlife Sanctuary. A detailed study was conducted among the village communities during 2006 – 2008 and presented agriculture, horticulture, livestock, timber, fuel wood, medicinal plants, edible plants, bamboo and canes.

Key words: Plant resources, social-ethnobotany, conservation, Tawi Wildlife Sanctuary

INTRODUCTION

Northeast India (comprising the 8 sister states of India: Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura) represents a distinct biogeographic zone (excluding Sikkim), rich in biodiversity, ethnic cultures and folklore traditions. The flora of this region is remarkably rich and diverse and is known as the 'Cradle of Flowering Plants' (Takhtajan 1969; Rao 1974). About 8000 species of flowering plants (approximately 45 % of an estimated 17, 500 flowering plants reported in India) occur in this zone. The region is considered as the primary and secondary centers of origin and diversity of about 50 crop plants and about 190 wild relatives. Important crop plants originated in this zone include Citrus, banana and plantain, mango, rice and several species of legumes, cucurbits, orchids, bamboos and medicinal and aromatic plants. Northeast India (and contiguous areas of Myanmar) is recognized as one among the 35 global Hotspot centers of *biodiversity*' (Myers *et al* 2000; CI 2012).

Study area

Tawi Wildlife Sanctuary (TWS) is located in the Southeastern part of the Aizawl District, Mizoram (Latitude - 23°30' N and Longitude 93° E), with altitude ranging between 500 m and 1894 m amsl. It occupies an area of 35.75 sq km and is situated at a distance of 101 km from the state capital Aizawl towards the east. The sanctuary was notified as a reserve forest in 1978, [*vide* Government of Mizoram Notification No. FOR. 15-C/74-78/21 dt.29.11.1978] and a preliminary notification to declare an area of 35.75 sq km of this reserve forest as 'Tawi Wildlife Sanctuary' has been issued [*vide* Govt. Notification No.B.12012/15/94-FST dt.8/4/1999]. The sanctuary is surrounded by five villages, viz; *Hmuntha*, *Maite*, *Tawizo*, *Hualtu* and *Lenchim* (Fig. 1).

The vegetation of the study area falls under the Tropical semi-evergreen and Sub-tropical broadleaved hill forests. The area experiences equable warm climate to chilly winter during November – January at the higher altitude. Maximum temperature ranges between 17° C and 28° C and the minimum between 8° C to 16° C with the annual rainfall ranging between 2000 and 2500 mm. June to August experience heavy showers.

TWS is rich in biodiversity and growth of vegetation is luxuriant. A great variety of tree species, palms, canes, bamboos, shrubs, herbs, climbers and epiphytes are found growing inside the forest. A large number of species found in the sanctuary have high economic potential and many of these are used by the locals in their daily life.

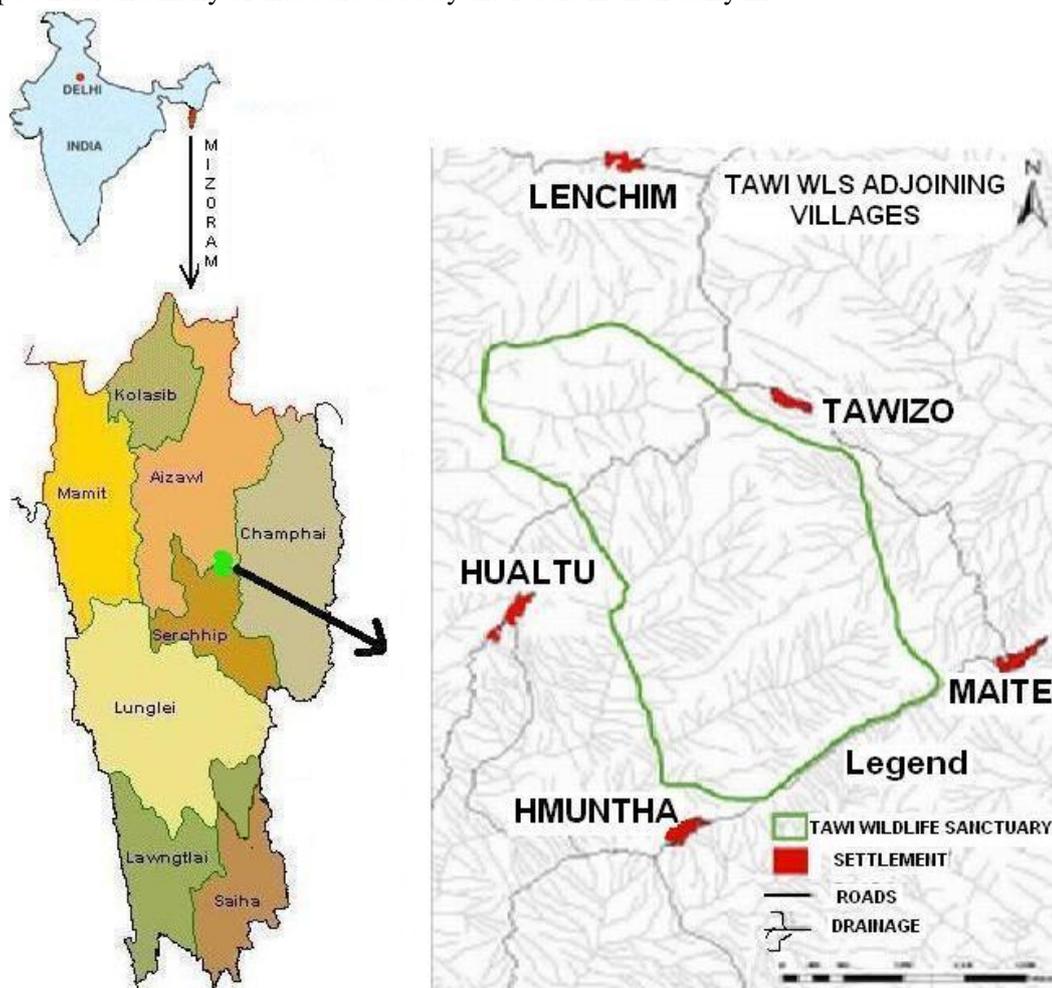


Fig. 1. The study area: adjoining villages of Tawi Wildlife Sanctuary

MATERIALS AND METHODS

Socio-ethnobotanic study was conducted among the village communities in and around the adjoining five villages of TWS. The methods of Participatory Rural Appraisal (PRA) were employed in each village. Information was gathered from each village through personal/group interviewing from the people of different categories like farmers, village council members, Govt. employees and personal communications. Specimens collected were processed into mounted herbarium specimens and deposited in the Mizoram University Herbarium.

RESULTS AND DISCUSSION

Among the five villages under study, Maite with 971 inhabitants has the highest population and Lenchim has the lowest population with only 365 inhabitants. About 92 % of these families are depending on jhum farming and the rest 8 % are engaged in Govt. services, small business and cottage industries.

Regarding the livestock, animal rearing in the five villages is dominated by piggery and poultry. 59 % of the villagers are engaged in poultry and 90 % of the families are also engaged in poultry. Few families own cattle and none of the villagers were having large cattle herd. Veterinary services and dispensaries are not available in the study area; the nearest veterinary facilities being located at Saitual.

In the adjoining villages of TWS viz., Hmuntha, Maite, Tawizo Hualtu and Lenchim all the inhabitants are Mizo. Each village is under the rule of Village Council. The local institutional level is still backward, there is only one Government Primary School, one Government Middle School in each of the villages, one High School (Government aided) in Hmuntha and Hualtu and 1 Private High School in Maite. So, setting up of at least one Higher Secondary School is very much essential.

No industry has been set up so far in all of these villages except few cottage industries (Furniture Workshop) one each in Lenchim and Hualtu. All the houses in Hmuntha, Maite and Lenchim are electrified. Only two houses are not electrified out of 80 houses in Tawizo and 12 houses are not electrified out of 162 houses in Hmuntha. Apart from Tawizo and Lenchim more than half of the families have LPG connection as the Environment & Forest Department had distributed LPG connection under the program of Forest Development Agency. But the use of firewood is still popular even among the LPG holder families; transportation is a big hindrance as it is difficult to replace the cylinder once it is used up. So, it is clear that majority of the families are still depending on firewood for cooking. Regarding the water supply, there are many water points in all of the four villages so scarcity of water is not a problem except during the very dry seasons. The people living in these villages are hard working so their socio-economic condition is not very low comparing to many villages in Mizoram.

Timber and Fuel Wood Resources

There is only one cement-concrete house in Hualtu. 97 % of the houses in the five villages are wooden with tin-roofs and the rest are also wooden but with thatched-roofs. Construction of these wooden houses and their regular maintenance under the prevalent climatic conditions consume good amount of timber. Common timber and fuel-wood species recorded from the five villages are shown in Table 1.

Though half of the households have LPG connection the use of firewood is still highly popular, mainly because of poor road conditions which made it extremely difficult to collect a new gas-filled cylinder once one cylinder is used up. Besides, large amount of fuel wood is also extracted for making charcoal that is sold in the cities and is an important source of income for the poor villagers.

Medicinal and Edible Plants

Medicinal and aromatic plants play very important role in their life support systems. Their traditional knowledge is of local inheritance and is of worldwide importance (Purohit 2004). The plant parts used for different purposes were bark, flower, fruit, leaf, root, rhizome, tuber, seed, shoot etc. and in some cases the whole plant. These are used to treat diseases like

Table 1. Common timber and fuel wood species from the TWS study areas

Botanical name; [Family]; 'Local Name'	Category/ Class	Place of occurrence
<i>Acrocarpus fraxinifolius</i> Wight & Arnott [Caesalpinaceae]; 'Nganbawm'	Wood moderately hard used for planking, flooring, shingles	HM, M, HU, T, L
<i>Albizia procera</i> (Roxburgh) Bentham [Mimosaceae]; 'Kangtek'	Firewood	HM, HU
<i>Alseodaphne petiolaris</i> Hooker f. [Lauraceae]; 'Khuangthulh'	Wood used for building, furniture and firewood	M, HU, T
<i>Artocarpus chama</i> Buchanon-Hamilton [Moraceae]; 'Tatkawng'	Wood for furniture and fuel.	HM, HU, T, L
<i>Artocarpus heterophyllus</i> Lamarck [Moraceae]; 'Lamkhuang'	Timber	HM
<i>Bombax insigne</i> Wallich [Bombacaceae]; 'Pang'	Timber and furniture	HM, M, HU, T, L
<i>Callicarpa arborea</i> Roxburgh [Verbenaceae]; 'Hnahkiah'	Firewood	HM
<i>Calophyllum polyanthum</i> Wallich ex Choisy [Clusiaceae] 'Sentezel'	Timber and Firewood	HM, M, HU, T
<i>Castanopsis echinocarpa</i> Miquel [Fagaceae]; 'Thenngo'	Firewood	HU
<i>Castanopsis indica</i> (Roxburgh ex Lindley) A.DC. [Fagaceae]; 'Sehawr'	Wood, used for building, furniture, axe handles, firewood etc	HM, T
<i>Castanopsistribuloides</i> (Smith) DC. [Fagaceae]; 'Thingsia'	Firewood and the whitish kernel of nuts edible.	HM, HU
<i>Cephalotaxus griffithii</i> Hooker f. [Taxaceae]; 'Thinglenbuang'	Wood used for building, furniture, Firewood etc.	HM
<i>Choerospondias axillaris</i> (Roxburgh) B.L. Burt & A.W. Hill [Anacardiaceae]; 'Theikuangchawm'	Wood used for house building, tea boxes etc. Ripe fruit eaten by man & wild animals	M, T
<i>Chukrasia tabularis</i> A. Jussieu [Meliaceae]; 'Zawngtei'	Wood used for construction purposes, high class furniture, paneling, plywood etc	M, T
<i>Cinnamomum tamala</i> Nees [Lauraceae]; 'Tespata'	Wood as firewood. Leaves as condiment, colic and diarrhoea.	M
<i>Derris robusta</i> Bentham [Fabaceae]	Firewood	M, T, L
<i>Duabanga grandiflora</i> (Roxburgh ex DC.) Walpers [Lythraceae] 'Zuang'	Timber	HM, M, HU, T, L
<i>Eleocarpus lanceaefolius</i> Roxburgh [Tiliaceae] 'Kharuan'	Firewood	M
<i>Eriobotrya bengalensis</i> (Roxburgh) Hooker f. [Rosaceae] 'Nghalchhun'	Firewood	M, T

Botanical name; [Family]; 'Local Name'	Category/ Class	Place of occurrence
<i>Eurya cerasifolia</i> (D. Don) Kobuski [Theaceae] 'Sihneh'	Firewood	HM, M, HU
<i>Garuga floribunda</i> J. Decaisne [Burseraceae] 'Tuairam'	Timber	L
<i>Glochidion khasicum</i> (Mueller Argoviensis) Hooker f. [Euphorbiaceae] 'Thingpawchhia'	Firewood	M, T
<i>Lithocarpus dealbata</i> (Hooker f. & Thomson ex Miquel) Rehder [Fagaceae] 'Fah'	Firewood	HM, M, HU, T, L
<i>Lithocarpus elegans</i> (Blume) Hatusima ex Soepadmo [Fagaceae] 'Thingpuithing'	Wood very hard, used for building, rice pestle, firewood, charcoal;	M, T
<i>Lithocarpus pachyphylla</i> (Kurz) Rehder [Fagaceae] 'Thensen/Thil'	Wood durable, used for planking shingles, firewood etc.	HU
<i>Litsea lancifolia</i> Hooker f. [Lauraceae] 'Hnahpawte'	Wood for firewood and charcoal.	M, T
<i>Macaranga indica</i> Wight [Euphorbiaceae] 'Hnahkhar'	Firewood	HM, M, HU, T, L
<i>Magnolia champaca</i> (Linnaeus) Baillon ex Pierre [Magnoliaceae]; 'Vai-Ngiau'	Timber used for house building, furniture	HM, M, HU, T, L
<i>Magnolia doltsopa</i> (Buchanan-Hamilton ex DC.) Figlar [Magnoliaceae] 'Zo-Ngiau'	Timber durable and suitable for furniture and planking; leaves as fodder; fruits eaten by birds	M, HU, T,
<i>Mangifera indica</i> Linnaeus [Anacardiaceae] 'Theihai'	Timber and fruits eaten by man	HM
<i>Phoebe lanceolata</i> Nees [Lauraceae] 'Bul-fek'	Firewood, house post, leaves for cattle fodder	HM, M, HU, T, L
<i>Quercus dilatata</i> Lindley [Fagaceae] 'Thal'	Wood as firewood and construction purposes.	M, T
<i>Quercus glauca</i> Thunberg [Fagaceae] 'Hrumhriau'	Wood very hard used for tool handles, fire-wood and charcoal	M, T
<i>Quercus helferiana</i> A. DC. [Fagaceae] 'Hlai'	Firewood	HM, M, HU, T
<i>Quercus leucotrichophora</i> A. Camus [Fagaceae] 'Then'	Firewood	M, T
<i>Quercus polystachya</i> Wallich ex A. DC. [Fagaceae] 'Thil'	Firewood	HM, M, HU, T, L
<i>Schima wallichii</i> (DC.) Korthals [Theaceae] 'Khiang'	Firewood	HM, M, T, L
<i>Syzygium cuminii</i> (Linnaeus) Skeels [Myrtaceae] 'Lenhmui'	Wood used for plywood, gun stocks, tool handles, posts, rafters, door frames and panels, firewood	M, T

Botanical name; [Family]; 'Local Name'	Category/ Class	Place of occurrence
<i>Terminalia bellirica</i> . (Gaertner) Roxburgh [Combretaceae] 'Thingvandawt'	Construction purposes	M, HU, T,
<i>Terminalia myriocarpa</i> Heurck et Mueller Argoviensis [Combretaceae] 'Char'	Wood used for construction, furniture and plywood.	HM, M, H, T, L
<i>Wendlandia grandis</i> (Hooker f.) Cowan [Rubiaceae] 'Batling'	Wood used for gun powder, charcoal, firewood etc. The pole is also used for fencing post.	M, HU, T

fever, headache, cough, intestinal pain, stomachache, skin diseases etc. Some plant species were also used as tonic, astringent, antidote etc. The preparation methods include decoction, infusion, juice, root powder and leave extract.

The present study area has high number of commercially exploitable medicinal species; 22 species are recorded (Table 2). However, harvesting medicinal plants can have both positive or negative impact on the conservation of biodiversity (Bhattarai 1996). It has been known that people from Myanmar used to come to these villages looking for orchids, which were collected by the villagers and were selling to these people. Though local people do not have much scientific knowledge on sustainable harvesting of these resources, they are familiar with habitat specificity and phenology of plants. Due to poverty in the area, people are compelled to over harvest resources for commercial purpose.

The study area also harbors many edible plants (Table - 2) which include *Dysoxylum gobara*, *Amomum dealbatum*, *Gynura bicolor*, *Amaranthus spinosus*, *Marsdenia formosana*, *Acacia pennata*, *Lepionurus sylvestris*, *Crotalaria tetragona*, *Musa spp.*, *Parkia timoriana*, *Trevesia palmata* and a great variety of edible *Agaricus* spp. Besides these, fresh bamboo shoots like *Bambusa tulda*, *Dendrocalamus hamiltonii*, *Dendrocalamus longispatus*, *Melocanna baccifera* were collected for daily subsistence.

Since the people living in and around the sanctuary depends on forest sources as source of their livelihood and it is being recognized that no legal provision can be effective unless local communities are involved in planning and monitoring conservation programs. Hence the local communities need to be involved in development and conservation programs launched by the Government agencies.

Table 2. Medicinal and wild edible plants recorded from the study area

Botanical Name; [Family]; 'Local Name'	Category/Class	Place of occurrence
<i>Acacia pennata</i> (Linnaeus) Willdenow; [Mimosaceae] 'Khanghu'	Shoots used as vegetable	HM, M, HU, T, L
<i>Agaricus sp.</i> ; [Agaricaceae] 'Changelpa'	Edible mushroom	M, T, L
<i>Agaricus sp.</i> ; [Agaricaceae] 'Luangpa'	Edible mushroom	HM, M, HU, T, L
<i>Agaricus sp.</i> ; [Agaricaceae] 'Mau-pa'	Edible mushroom	HM, M, HU, T, L
<i>Agaricus sp.</i> ; [Agaricaceae] 'Pa-ar-dang'	Edible mushroom	HM, M, HU, T
<i>Agaricus sp.</i> ; [Agaricaceae] 'Pachang'	Edible mushroom	HM, M, HU, T,L
<i>Agaricus sp.</i> ; [Agaricaceae] 'Papar'	Edible mushroom	HM, L
<i>Agaricus sp.</i> [Agaricaceae] 'Pasawntlung'	Edible mushroom	HM, M, HU, T, L
<i>Agaricus sp.</i> [Agaricaceae] 'Pasi'	Edible mushroom	HM, M, HU, T, L
<i>Agaricus sp.</i> [Agaricaceae] 'Pauithin'	Edible mushroom	HM, N, HU, T

Botanical Name; [Family]; 'Local Name'	Category/Class	Place of occurrence
<i>Amaranthus spinosus</i> Linnaeus [Amaranthaceae] 'Lenhling'	Herb; tender leaves eaten as vegetable	HU, T
<i>Amomum dealbatum</i> Roxburgh [Zingiberaceae] 'Aidu'	Roots and buds eaten as vegetable	HM, M, HU, T, L
<i>Aporosa dioica</i> (Roxburgh) Mueller Argoviensis [Euphorbiaceae] 'Chhawntual'	Young leaves eaten as vegetable; leaves medicinal	HU, T
<i>Bambusa tulda</i> Roxburgh [Poaceae] 'Rawthing'	Young shoots as vegetable; frayed outer skin is applied to stop bleeding.	HM, M, HU, T, L
<i>Bergenia ciliata</i> (Haworth) Sternberg f. [Saxifragaceae] 'Khamdamdawi'	Roots are medicinal	HM, M, HU, T
<i>Blumea lanceolaria</i> (Roxburgh) Druce [Asteraceae] 'Buarze'	Tender leaves as vegetable & medicinal	HM, M, HU, T
<i>Calamus flagellum</i> Griffith ex Martius [Arecaceae] 'Hruipui'	The cane is used for chairs, baskets, containers, etc. The top shoots are eaten as vegetable;	HM, M, L
<i>Caryota urens</i> Linnaeus [Arecaceae] 'Tum'	Fiber used for making ropes, brooms, baskets etc. The terminal bud is cooked as vegetable	HM, M, L
<i>Cassia nodosa</i> Buchanon-Hamilton ex Roxburgh [Caesalpiniaceae] 'Makpazangkang'	Decoction of bark used against enlargement of liver	M
<i>Centella asiatica</i> (Linnaeus) Urban [Apiaceae] 'Lambak'	Infusion of plant for gastro-enteritis; leaves with petiole for high blood pressure	HM, M, HU, T
<i>Costus speciosus</i> (Koenig) J.E. Smith [Zingiberaceae] 'Sumbul'	Roots as astringent, purgative, depurative, stimulant, tonic, anthelmintic and in snake bite.	HM, M, HU, T
<i>Crotalaria tetragona</i> Roxburgh ex Andréanszky [Papilionaceae] 'Tumthang'	Buds & flowers cooked as vegetables	HU, HM
<i>Dendrocalamus hamiltonii</i> Nees & Arnott ex Munro [Poaceae] 'Phulrua'	Young shoots as vegetables; fruits eaten in time of famine and also for low blood pressure	HM, M, HU, T, L
<i>Dendrocalamus longispathus</i> Kurz [Poaceae] 'Rawnal'	Young shoots as vegetable	HM, M HU, T, L
<i>Dillenia pentagyna</i> Roxburgh [Dilleniaceae] 'Kaihzawl'	Bark and leaves medicinal	HU, T, L
<i>Dysoxylum gobara</i> (Buchanon-Hamilton) Merrill [Meliaceae] 'Thingthupui'	Young leaves, shoots as vegetables. Decoction of leaves and buds in diarrhoea and dysentery.	HM, M, HU, T, L
<i>Embelia ribes</i> Burman f. [Myrsinaceae] 'Naufadawntuai'	Roots for cough and diarrhoea; decoction of dried fruits for fever, heart problems and skin diseases.	HU, M
<i>Gynura bicolor</i> (Roxburgh ex Willdenow) DC. [Asteraceae] 'Tlangnal'	Tender leaves cooked as vegetable	M, T
<i>Haldinia cordifolia</i> (Roxburgh) Ridsdale [Rubiaceae] 'Lungkhup'	Bark dust as antiseptic and febrifuge; bark juice in sores; dysentery & diarrhea, also as vegetable	M, T
<i>Hedyotis scandens</i> Roxburgh [Rubiaceae] 'Kelhnamtur'	Root paste in sprain; plant juice in eye problem	HM, M, HU, T, L
<i>Helicia robusta</i> (Roxburgh) R. Brown ex Blume [Proteaceae] 'Pasaltakaza'	Plant used for poulticing; leaves for sores; decoction of bark for stomachic	HM, M, HU, T, L
<i>Lepionurus sylvestris</i> Blume [Opiliaceae] 'Anpangthuam'	Decoction of leaves for throat pain	HM, HU

Botanical Name; [Family]; 'Local Name'	Category/Class	Place of occurrence
<i>Lindernia ruellioides</i> (Colmann) Pennel [Scrophulariaceae] 'Tha-suih'	Plant paste is applied externally in skin worms	HM, M, HU, T, L
<i>Marsdenia maculata</i> Hooker [Asclepiadaceae] 'Ankhapui'	Young stem and leaves cooked as vegetable	HU, L
<i>Melocanna baccifera</i> (Roxburgh) Kurz [Poaceae] 'Mautak'	Young shoots cooked as vegetable	HM, M, HU, T, L
<i>Mimosa pudica</i> Linnaeus [Mimosaceae] 'Hlonuar'	Leaves and roots in piles and fistula; leaves and stem in scorpion sting; leaves paste in hydroceol	HU
<i>Musa sp.</i> [Musaceae] 'Tumbu'	Fruit cooked as vegetable	HM, M, HU, T, L
<i>Oroxylum indicum</i> (Linnaeus) Kurz [Bignoniaceae] 'Archangkawm'	Roots bark as astringent, tonic, in dysentery; stems in scorpion sting; fruits as carminative; seeds as purgative	M, T
<i>Osbeckia chinensis</i> Linnaeus [Melastomataceae] 'Builukham'	Decoction of roots in kidney problems, dysuria, stomach complaints, dysentery and for expelling thread worms from the body.	M
<i>Parkia timoriana</i> (DC.) Merrill [Mimosaceae] 'Zawngtah'	Young pods eaten as vegetable	HM, M, HU, T, L
<i>Phyllanthus fraternus</i> Webster [Euphorbiaceae] 'Mitthi sunhlu'	Decoction of plants for diabetes and jaundice; leaves chewed to check hiccup	HM, M, HU, T
<i>Securinega virosa</i> (Roxburgh ex Willdenow) Baillon [Euphorbiaceae] 'Saisiak'	Leaves boiled with water and used for bathing children suffering from scabies and measles; leaves juice with tobacco leaves used as vermifuge.	HM, M, HU, T
<i>Senecio scandens</i> Buchanon-Hamilton [Asteraceae] 'Sai- ek-hlo'	Decoction of the leaves used against stomach troubles, cancer etc. Juice of the leaves for chronic ulcers.	T, L
<i>Smilax glabra</i> Roxburgh [Smilacaceae] 'Tluangngil'	Decoction of rhizome is taken for gynaecological problems.	HU, L
<i>Trevesia palmata</i> (Roxburgh) Vis. [Araliaceae] 'Kawhtebel'	Shoots, flower buds & young fruits eaten as vegetable	HM, M, HU, T, L
<i>Vitex peduncularis</i> Wallich ex Schauer [Verbenaceae] 'Thinghawilu'	Stem bark boiled in water used for patients suffering from malarial fever and black fever. Bark is also used as an external application to relieve pain in the chest.	M, T
<i>Zanonia indica</i> Linnaeus [Cucurbitaceae] 'Lalruanga dawibur'	Empty fruit is filled with water and taken for stomachache, fever & urinary problems	HM, M, HU

Bamboos, Canes and Palms

The study area is also rich in canes and palms species that are of great economic value (Table – 3). 14 species of bamboos and 11 species of canes and palms are recorded. Bamboos, canes and palms are commercially multipurpose species that has tremendous potential of production. Bamboo based industries and usage of bamboo and cane products are innumerable. These are with very highly economic importance.

From the above discussion it is clear that the day-to-day need of forest resources has increased the pressure on forest plants of different habit groups to a great extent. Furthermore, the over-exploitation of species for fuel, timber for house construction, medicine, food (wild

edibles) may lead to the extinction of many species from the area. Therefore, there is a need to develop adequate strategy and action plan for the conservation and management of habitats and species so that sustainable utilization of different useful species could be ensured.

Table 3. Useful bamboos, canes and palms recorded from the study area

Botanical name; [Family]; 'Local Name'	Category/Class	Place of occurrence
<i>Arundinaria callosa</i> Munro [Poaceae]; 'Phar'	Culms used for fencing and tying purposes; young shoots as vegetables.	HM, M, HU, T, L
<i>Bambusa khasiana</i> Munro [Poaceae]; 'Rawte'	The culms are used in building and for basket work; young shoots eaten as vegetable.	HM, M, HU, T
<i>Bambusa tulda</i> Roxburgh [Poaceae]; 'Rawthing'	Young shoots as vegetable; frayed outer skin is applied to stop bleeding.	HM, M, HU, T, L
<i>Dendrocalamus hamiltonii</i> Nees & Arnott ex Munro [Poaceae]; 'Phulrua'	The culm is used for temporary building, mats, baskets, gutters, water vessels, fuel and paper making. Young shoots as vegetables; fruits eaten in time of famine and also for low blood pressure.	HM, M, HU, T, L
<i>Dendrocalamus hookeri</i> Munro [Poaceae]; 'Rawlak'	The culm is used for building, construction, baskets, water buckets etc.	HM, M, HU, T
<i>Dendrocalamus longispathus</i> Kurz [Poaceae]; 'Rawnal'	Young shoots as vegetable	HM, M
<i>Dendrocalamus manipurianus</i> Naithani & Bisht [Poaceae]; 'Rawchhechangdam'	Construction purposes	M, T
<i>Dendrocalamus strictus</i> (Roxburgh) Nees [Poaceae]; 'Tursing'	The culm is used in paper mills, for building rafter, roofing, flooring, walling, scaffolding, tent poles, matting, basket making etc. Young shoots as vegetable; leaves as fodder. Silicious matter as tonic and astringent; leaves ecobolics to animals.	M
<i>Dinochloa compactiflora</i> (Kurz) McClure [Poaceae]; 'Sairil'	Used for making baskets, hats etc. Juice of the stem is taken for influenza, curing dandruff, falling hair and baldness.	HM, M, HU, T, L
<i>Melocanna baccifera</i> (Roxburgh) Kurz [Poaceae]; 'Mautak'	The culm is used for building, paper pulp, house walls, thatching, mats, baskets etc. Tender shoots as vegetable; glossy surface of the stem is scraped and the powder is applied to new cuts; fruits eaten by cattle and wild animals.	HM, M, HU, T, L
<i>Pseudostachyum polymorphum</i> Munro [Poaceae]; 'Chal'	The culm is used for making baskets, mats, umbrella handles, walking sticks and tying purposes; young shoots as vegetable.	HM, M, HU, T, L
<i>Schizostachyum capitatum</i> (Munro) R. Majumdar [Poaceae]; 'Rawngal'	The culm is used for making baskets, mizo hats, blow guns, tying fences etc. Leaves used for fodder and also good for stomachache.	HM, M, HU, T, L
<i>Schizostachyum dullooa</i> (Gamble) R. Majumdar [Poaceae]; 'Rawthla'	The culm is used for making baskets, mats, mizo looms, ceiling, partition walls, hut's purlins etc; young shoots as vegetable; glutinous rice is also cooked in the joints.	HU, L
<i>Sinarundinaria falcate</i> (Nees) Chao & Renvoize [Poaceae]; 'Lik'	Used for fish rods and hedge plant	M, HU, T
<i>Arenga pinnata</i> (O. Kuntze) Merrill [Arecaceae]; 'Thangtung'	Roots used in stomachic and in bronchitis; outer fleshy layer of fruit used as fish poison; young shoots eaten raw	HM, M, HU, T, L

Botanical name; [Family]; 'Local Name'	Category/Class	Place of occurrence
<i>Calamus acanthospathus</i> Griffith [Arecaceae]; 'Thilte'	The cane is used for chair making, walking sticks, baskets, containers, handles of umbrellas, etc. and also as a substitute for ropes and cables in suspension bridges; tender pith of the upper part of the stem is eaten as vegetable; fruits used as purgative and also curing chronic stomach ulcer	M, HU, T, L
<i>Calamus erectus</i> Roxburgh [Arecaceae]; 'Thilthek'	Young shoot eaten as vegetable	HM, M, HU, T
<i>Calamus flagellum</i> Griffith ex Martius [Arecaceae]; 'Hruipui'	The cane is used for chairs, baskets, containers, etc. The top shoots are eaten as vegetable; fruits eaten by man, monkeys, langur, squirrels etc	HM, M, HU, T, L
<i>Calamus gracilis</i> Roxburgh [Arecaceae]; 'Kawrtai'	Handicrafts and young shoots are edible	HM, M, HU, T, L
<i>Calamus guruba</i> Buchanon-Hamilton ex Martius [Arecaceae]; 'Taite/Tairua'	The cane is used for making baskets etc	M, HU, T
<i>Calamus tenuis</i> Roxburgh [Arecaceae]; 'Thilte'	Used for making baskets etc; Undeveloped shoots cooked as vegetable & boiled water is taken for dysentery	HU, T, L
<i>Calamus khasianus</i> Beccari [Arecaceae]; 'Mawt'	Handicrafts and furniture	HM, M, HU, T, L
<i>Caryota mitis</i> Linnaeus [Arecaceae]; 'Meihle'	Starch rich food. White fleshy part edible. Fiber used in the manufacture of brushes and brooms	M, T
<i>Caryota urens</i> Linnaeus [Arecaceae]; 'Tum'	Nuts applied externally on head in case of hemicrania	HU, L
<i>Zalacca secunda</i> Griffith [Arecaceae]; 'Hruitung'	Leaves for roofing; seeds edible	M, HU, T, L

Agriculture and Horticulture Crops

Majority of the people *i.e.*, 92 % of the surrounding five villages depend on agriculture and related activities connected to land. The vegetables were grown using seeds produced from the previous season. All cultural operations were manual and seeds were line sown. The agriculture production system in the area is mostly mono-cropped and at a subsistence level. The cropping pattern in the area is characterized by predominance of rice as it is the staple food. The productivity of total vegetables in Mizoram (2.0 MT/Ha; IHD 2005) is quite low as compared to the national average productivity. Vegetables, besides providing nutritional security, are also major sources of income especially for small and marginal farmers. The vegetable crops, apart from higher productivity and high value produce, provide more food per unit time and area can improve the economic condition of the growers as compared to cereal crops. Hence, they are becoming a potential commodity to provide economic security to the resource poor farmers of the country. Newly developed short duration varieties crops like cabbage, tomato, capsicum, pea, french bean, etc. fit in the fold. The scope for horizontal expansion of area is very much limited for want of suitable land and thus the only option available is to increase the productivity (Rai *et al* 2008). The common agriculture and horticultural crops grown in the adjoining 5 villages are shown in Table – 4.

The crops, which are neither grown commercially on large scale nor traded widely, may be termed as underutilized horticultural crops (UUHC). These crops are cultivated, traded and consumed locally. The popularity of these horticultural crops varies from crop to crop and locality to locality, which however, can be enhanced to a greater extent through

Table 5. Fruit plants recorded from the study area

Botanical name; [Family]; ‘Local Name’	Category/Class	Place of occurrence
<i>Artocarpus heterophyllus</i> Lamarck [Moraceae] ‘Lamkhuang’	Wild and cultivated for its fruits	M, L
<i>Baccaurea ramiflora</i> Loureiro [Euphorbiaceae] ‘Pangkai’	Fruits edible; bark dust as purgative	HU, T
<i>Carallia brachiata</i> (Loureiro) Merrill [Rhizophoraceae] ‘Theiria’	Wood good for furniture, fruits edible and used for ulcers. Bark for itch	HM, M, T
<i>Citrus grandis</i> (Linnaeus) Osbeck [Rutaceae] ‘Sertawk’	Cultivated for its fruit	HM, M, HU, T, L
<i>Citrus sp.</i> [Rutaceae] ‘Sisu’	Cultivated for its fruit	M, L
<i>Citrus sp.</i> [Rutaceae] ‘Zammir’	Cultivated for its fruit	M
<i>Cyathocalyx martabanicus</i> Hooker f. & Thomson [Annonaceae] ‘Hrei-rawt	Wild fruit	HU
<i>Elaeagnus caudata</i> Schlecht. ex Jackson [Elaeagnaceae] ‘Sarzuk’	Wild fruit	HM, M, HU, T, L
<i>Embelia vestita</i> Roxburgh [Myrsinaceae] ‘Tling’	Wild fruit	HU
<i>Emblia officinalis</i> Gaertner, [Euphorbiaceae] ‘Sunhlu’	Wild fruit	HM, M, HU, T, L
<i>Euphoria longan</i> Steudel [Sapindaceae] ‘Theifeimung’	Fruit is edible	HU
<i>Garcinia lanceaefolia</i> Roxburgh [Clusiaceae] ‘Chengkek’	Wild fruit	HU, T
<i>Garcinia sopsopia</i> (Buchanon-Hamilton) Mabberley [Clusiaceae] ‘Vawmva’	Fruit edible	HU
<i>Haematocarpus thomsoni</i> Miers [Menispermaceae] ‘Theichhungsen’	Fruit edible	HU, T
<i>Kadsura heteroclite</i> (Roxburgh) Craib [Annonaceae] ‘Theiarbawm’	Wild fruits eaten by man, animals and birds	M, HU, T
<i>Mangifera indica</i> Linnaeus [Anacardiaceae] ‘Theihai’	Fruit edible	HM, M, HU, T, L
<i>Myrica esculenta</i> Buchanon-Hamilton [Myricaceae] ‘Keifang’	Fruits eaten by man and birds	HM, M, HU T
<i>Pentanura khasiana</i> Kurz [Asclepiadaceae] ‘Theikelki’	Fruit edible	HU
<i>Protium serratum</i> Wallich ex Colebrook [Burseraceae] ‘Bil-thei’	Fruit edible	HU
<i>Prunus jenkinsii</i> Hooker f. ‘Keipui’	Fruit edible	HU, T
<i>Prunus persica</i> Linnaeus cv. Jiubao [Rosaceae]	Fruit edible	HM, M, T
<i>Prunus undulata</i> Buchanon-Hamilton ex D. Don [Rosaceae] ‘Theiarlung’	Wild fruit	HU, T
<i>Psidium guajava</i> Linnaeus [Myrtaceae] ‘Kawlthei’	Cultivated for its fruit	HM, M, HU, T, L
<i>Rubus acuminatus</i> Smith [Rosaceae] ‘Theihmu’	Wild fruit	HM, M, T

publicity. The UUHCs have many merits. These hardy plants grow easily and produce crop even under adverse soil and climatic conditions. Most of them are very rich sources of vitamins, minerals, and other nutrients such as carbohydrates, proteins and fats. Moreover, these are cheap and readily available. The horticultural crops are contributing 3.14 % of the total geographical area of the North East region. The region is one of the richest reservoirs of genetic variability and diversity of different horticultural crops, which exist in plant types, morphological and physiological variations, reactions to diseases and pests, adaptability and distribution (Rai *et al* 2005).

There are 24 species of wild fruit plants found in the surrounding five villages of the sanctuary. These fruit plants fall under UUHCs as shown in Table - 5.

The above result shows that the study area is rich in plant diversity and has a large number of underutilized horticultural crop species. So for the development of these crops domestication of potential wild species through homestead cultivation should be encouraged for avoiding over-exploitation from natural sources. Supports are required in terms of multiplication of planting materials and their distribution besides providing market access through marketing network for perishables. Rapid expansion of infrastructure facilities with priority on market development, transport and communication needs to be done. At the very onset, there is a necessity to make the farming community aware about the nutritional importance of unexploited horticultural crops, *viz.*, fruits, vegetables and medicinal plants (Sharma 2003).

CONCLUSION

The study of the socio economic conditions of the adjoining villages of Tawi Wildlife Sanctuary revealed that the socio-economic condition is not very bad. The most important issue of agricultural development is accessibility to market and transport systems. Because of bad transport system, encroachment from the surrounding villagers is frequent inside the sanctuary as the forest is rich in flora and fauna. The use of mass media like radio, TV, newspaper and other printed literature can play effective role in creating awareness among the farmers. For proper exploitation and better economic returns from underutilized horticultural crops emphasis should be given on developing processing unit at a common point through eco-development program. It would also provide employment opportunities to the villagers that in turn would result into a safer conservation of the sanctuary.

LITERATURE CITED

- Bhattarai, N.K. 1996. Biodiversity: People Interface in Nepal. In: Medicinal Plants for Forest Conservation and Health Care. *Non-wood Forest Product Series. Biol.* 10: 1 – 67.
- CI 2012. Website of Conservation International. www.conservation.org/hotspots [accessed on 17.12.2012]
- Indian Horticulture Database* 2005. NHB Ministry of Agric. GOI. Institute of Vegetable Research, Jakhini, Varanasi-221305. U.P., India and ICAR Research Complex for NEH Region, Umiam, Meghalaya-793103, India.
- Myers, N.; Mittermeier, R.A.; Mittermeier, C.G.; da Fonseca, Y.A.B. & Kent, J. 2000. Biodiversity hotspots for conservation priorities. *Nature* vol. 403
- Purohit, S.S. & Vyas, S.P. 2004. Medicinal Plant Cultivation: A Scientific Approach. *Agrobois*, India.

468 Socio-ethnobotanical resources of Tawi Wildlife Sanctuary

Rao, A.S. 1974. Vegetation and phytogeography of Assam, Burma: In: Mani, M.S. (ed.) *Ecology and Biogeography of India*.

Sharma, D.V. 2003. *Transfer of technology for increasing the scope of unexploited horticultural crops*. Winter School on "Exploitation of Underutilized Horticultural crops. 5-25th November, Department of Horticulture, College of Agriculture, MPUAT, Rajasthan, 313-320 pp. The Hague, pp. 204 - 246.

Takhtajan, A. 1969. *Flowering Plants, Origin and Dispersal* (Translation by Jeffery), Edinburgh.

Yadav, D.S.; Rai, A.B.; Rai, M.; Yadav, R.K. & Sanwal, S.K. 2008. Indian Institute of Vegetable Research, Jakhini, Varanasi-221305. U.P., India and ICAR Research Complex for NEH Region, Umiam, Meghalaya-793103, India.