Traditional Technology on Medicinal Plants Used by Indigenous People of Nongkhylllem Wildlife Sanctuary, Meghalaya, North East India

Shafiqul I. Bhuyan^{*}, Imrana Laskar

Department of Botany, Pandit Deendayal Upadhyaya Adarsha Mahavidyalaya, India

^{*}Corresponding Author: safibhuyan@gmail.com

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Abstract Meghalaya a state in North Eastern Region of India is a rich source of biodiversity which includes high potential of naturally occurring medicinal plants. The study was conducted in and around the Nongkhylllem Wildlife Sanctuary located in the Ri-Bhoi district of Meghalaya to investigate the uses of medicinal plants and their conservation. The Nongkhylllem wildlife sanctuary was carved out of Nongkhylllem reserve forest in the year 1981 for adequate protection of the floral and faunal species of the area and covers an area of 29 sq. km on steep hill slopes (20° to > 65°). Participation rural appraisal (PRA) methods and tools were used for interacting with them. Information was extracted through key informant interviews and focus group discussions. Plants specimen were collected and identified and preserved as voucher specimens following standard herbarium techniques. The study comprises 71 species of ethnomedicinal plants belonging to 42 families. The most dominant family recorded as a whole is Malvaceae followed by Euphorbiaceae, Fabaceae, Lamiaceae, Rutaceae, Solanaceae. Herbs were found to be the most used plants in preparing traditional medicines. Among the different plant parts, the leaves were most frequently used for the treatment of diseases followed by fruit, root, flower, bark, whole plant, seed, stem, rhizome and tuber. People collect plants from their surrounding plant communities in wild, semi-wild and some are cultivated as well. However, cultivation of medicinal plants in surroundings, home-gardens, agro-forestry systems is a very new and important from conservation point of view in north east India.

Keywords Biodiversity Conservation, Extinction, Climate Change, Deforestation, Sustainable Development

1. Introduction

The use of various parts of plants as indigenous

medicine, food, shelter has been in vogue from ancient times. The ethno-botanical approach is very much important to involve the local people in conservation activities to conserve biodiversity and the environment. Moreover, a healthiest ecosystem with all the available factors on the earth can be controlled by the local communities, and they manage, protect and generate knowledge for which science may not have much information. However, many factors create remarkable stress on the local flora and fauna and cause the environmental degradation. These factors are forest disturbance, over exploitation, over human population, urbanization, agricultural extension, over grazing, deforestation etc. even traditional knowledge of plants utilization and their products are in danger of disappearing forever due above mention threats. However, a strong vice-versa interrelationship between plants and humans is found. Human activities are main responsible factor on plant communities with which they interact, the humans themselves are also influenced by plants. Especially medicinal plants have been using since prehistoric period in traditional healing systems for various diseases. Human knowledge of the medicinal value of plants date back perhaps for more than five thousand years [9]. Different medicinal plants and their uses are greatly well-known to indigenous communities of different parts of the world. They are expert for mounting inventive practices and products from their surroundings [10].

Meghalaya a state in North Eastern Region of India is a rich source of biodiversity which includes high potential of naturally occurring medicinal plants. The state has high concentration of plant species and harbours about 3128 (21%) including 1237 endemic flowering plants in just 0.7% of the country's land area [5]. The state is predominantly hilly with varying climatic and forest vegetation zones which favors the growth of various medicinal plants. Among them a large number of plants have been well thought-out as important therapeutic aid for

alleviate ailments of human kind. Meghalaya is divided into 3 hilly regions - Garo hills (Western Meghalaya), Khasi hills (Central Meghalaya) and Jaintia Hills (Eastern Meghalaya). Meghalaya has an estimated population of about 2,357,510 with a density of 104 people per sq. km. Almost 70% of the total area of the state is covered by forest and 90% of this forest is covered by tribal communities [4].

Exploration on ethnomedicine used by different tribes of Meghalaya was done by many authors [2],[6],[7],[8]. However, a very few studies have been conducted among different tribal populations in addition to different types of protected areas of Meghalaya. Therefore, present study was undertaken to document different plant varieties used by different local people residing in around the Nongkhylllem Wildlife Sanctuary, Meghalaya.

2. Materials and Methods

2.1. Study Site

The study was conducted in and around the Nongkhylllem Wildlife Sanctuary located in the Ri-Bhoi district of Meghalaya. The sanctuary lies between 25°45' - 26°00' N latitude and 91°45' 92°00' E longitude. The Nongkhylllem wildlife sanctuary and Nongkhylllem reserve forest are continuous. The Nongkhylllem reserve forest was constituted in the year 1910 with 96.91 km area. The Nongkhylllem wildlife sanctuary was carved out of Nongkhylllem reserve forest in the year 1981 for adequate protection of the floral and faunal species of the area and covers an area of 29 sq. km on steep hill slopes (20° to > 65°). The Umtrew River is the major river in the study area and it marks the western boundary of the Sanctuary and the Reserve Forest. Umran River forms the dividing boundary between the sanctuary and the reserve forest in the east and joins river Umtrew through the northern half of the sanctuary.

2.2. Data Collection and Sampling Techniques

Extensive fieldwork was carried out in the selected areas. Total four visits during four seasons were made to the study area. Knowledgeable consent was acquired from all village head prior to interviews. They were explained the reasons for conducting the survey and the information that will be collected. By direct contacts with the villagers' information was collected from all the study sites. Participation rural appraisal (PRA) methods and tools were used for interacting with them. Information was extracted through key informant interviews and focus group discussions. To find out the resources used by the local people of the area, sufficient numbers of people from different communities were interviewed. Representative from a minimum of twenty five percent of the total households were selection for interaction. In some villages

up to forty percent were interacted. People of different ages, both male and female, traditional local doctors, plants collectors were interacted. A semi-structured questionnaire was used for the interviews. Information on plant use, plant parts used, processing, dosages, purpose of use, formulations, and side-effects, if any and storage were collected with the help of proper questionnaires. The collected information was evaluated for different genera and species of the medicinal plants in order to understand the pattern in medicinal plant uses and occurrences. With the help of information, field visits and collection of ethno-medicinal plants were done in all seasons. Plants were collected for herbarium records. Identification of collected plants species were done using vernacular names, published literatures and floras. Plants specimen were collected and identified and preserved as voucher specimens following standard herbarium techniques [3]. Herbarium was preserved in the department of Botany, PDUAM-Behali.

3. Results and Discussion

Ethno-botanical survey on traditional practices of medicinal plants was carried out in and around the Nongkhylllem Wildlife Sanctuary, Meghalaya. Local people reside near to the sanctuary have provided vast information regarding medicines and traditional health care practiced by them. Details result of the survey is presented in Table 1, the list of medicinal plants recorded from the tribal communities. The scientific name of the plants are arranged in alphabetical order, followed by its local name, family, habit, parts used, mode of use and disease classification. The study comprises 71 species of ethnomedicinal plants belonging to 42 families. The most dominant family recorded as a whole is Malvaceae (5 species); followed by Euphorbiaceae, Fabaceae, Lamiaceae, Rutaceae, Solanaceae (4 species), Begoniaceae, Asteraceae, Begoniaceae, Zingiberaceae (3 species), Anacardiaceae, Araceae, Papaveraceae, Plantaginaceae, Urticaceae (2 species), Amaranthaceae, Apiaceae, Apocynaceae, Araliaceae, Arecaceae, Asparagaceae, Betulaceae, Burseraceae, Caricaceae, Cephalolaxaceae (1 species) etc. (figure 4). Traditional healers belong to local communities are using the medicinal plant species to cure different disease such as Stomach problem, Diarrhoea, Rheumatism, Constipation, Wounds and cuts, Blood Pressure, Diabetes, Fever, Skin problems (skin, eczema, leprosy, ring worm, scabies, abscess, boils, burns, cut, wounds), Indigestion, Food poisoning, Toothache, Poison bites (dog bite, scorpion bite, snake-bite), Pneumonia, Jaundice, Cholera, Cough & cold etc. (figure 1 & 3). Herbs were found to be the most used plants in preparing traditional medicines i.e. 30 plant species, followed by shrub (22 species), tree (19 species), and climber (figure 2). Different plant parts were used as traditional medicine by the local people.

Figure 1. Number of plants used in different diseases

Figure 2. Habits of the plants used in medicines

Figure 3. Diseases cured by plants

Figure 4. Number of plant species per family

Table 1. List of Medicinal Plants used by local people of NWLS Meghalaya

SI No.	Botanical Name	Family	Habit	Parts Used	Mode of Use	Disease Classification
1	<i>Achyranthes aspera</i> Linn.	Amaranthaceae	Herb	entire plant	Plant is boiled, water extract is used as a drink	Pneumonia, Blood pressure, diabetes
2.	<i>Agave americana</i> , Linn	Asparagaceae	Shrub	Leaf	Water extract and boiled leaves is drunk once a day.	T.B, Jaundice.
3	<i>Albizia chinensis</i> (Osbeck.) Merr.	Fabaceae	Tree	Bark	Bark paste applied as antidote.	Insects, snake bite
4	<i>Alcea rosea</i> Linn.	Malvaceae	Shrub	Flower	Mild purgative of the flower is consumed.	Stomach ache and gastric problem
5	<i>Alnus nepalensis</i> D.Don.	Betulaceae	Tree	Root	Juice extract of root is drunk.	Diarrhoea
6	<i>Aloe vera</i> (L.) Burm.f.	Xanthorrhoeaceae	Shrub	Leaf	Fleshy leaves paste applied on skin.	Wounds, cuts
7	<i>Antirrhinum majus</i> Linn.	Scrophulariaceae	Herb	Leaf	Leaves paste applied as poultice.	Tumours and ulcers
8	<i>Arctium lappa</i> , Linn.	Asteraceae	Shrub	Leaf	Leaves are boiled and liquid extract is drunk.	Fever
9	<i>Argemone mexicana</i> Linn.	Papaveraceae	Herb	Leaf	Leaves paste is applied on affected area	Wounds and ulcers
10	<i>Artemisia vulgaris</i> , Linn.	Asteraceae	Herb	Leaf	Leaves paste is applied on skin	Rashes and ringworms
11	<i>Baccaurea ramniflora</i> , Lour.	Phyllanthaceae	Tree	Seed	Paste of seed is consumed with water	Diarrhoea and dysentery.
12	<i>Begonia palmata</i> D. Don.	Begoniaceae	Herb	entire plant	whole plant is crushed, liquid extracted is taken orally after food	Fever, stomach ache
13	<i>Begonia</i> sp	Begoniaceae	Herb	Stem	Stem is eaten in raw form	Food poisoning
14	<i>Borassus aethiopum</i> , Mart.	Arecaceae	Tree	Root	Water extract of boiled root is consumed	Indigestion, stomach problem
15	<i>Butea buteiformis</i> (Voigt) Grierson, syn.	Fabaceae	Shrub	Seed	Pastes of seeds consumed with water	Parasitic worm infections
16	<i>Butea monosperma</i> , Roxb.ex.Willd.	Fabaceae	Tree	Bark	Bark is soaked in water, liquid is drunk	Piles, skin problems
17	<i>Cajanus cajan</i> (Linn.) Mill.	Fabaceae	Shrub	Seed	Boiled seeds are consumed as anthelmintic.	Parasitic worm infections
18	<i>Canarium resiniferum</i> , Bruce.ex.King.	Burseraceae	Tree	Fruit	Fruits are consumed	Indigestion
19	<i>Carica papaya</i> , Linn.	Caricaceae	Tree	Fruit	Unripe fruit is consumed in raw form	Abortion
20	<i>Catharanthus roseus</i> (L.) G.Don.	Apocynaceae	Herb	Leaf	Leaves are consumed in raw form.	Diarrhoea and dysentery
21	<i>Centella asiatica</i> (L.) Urban.	Apiaceae	Herb	entire plant	Whole plant is taken in raw form.	Blood pressure and diabetes
22	<i>Cephalotaxus griffithii</i>	Cephalolaxaceae	Shrub	Leaf	Leaves paste is consumed	Tumour
23	<i>Chenopodium album</i> , Linn.	Chenopodiaceae	Herb	entire plant	Paste is consumed as laxative.	Constipation
24	<i>Citrus maxima</i> , Burn.	Rutaceae	Tree	Fruit	Juice extract is drunk.	Indigestion
25	<i>Clerodendrum serratum</i> , Linn.	Verbenaceae	Shrub	Stem	Juice extract is drunk.	Menstruation problem
26	<i>Colacasia</i> sp	Araceae	Herb	Stem	Juice extract is used	Insect bite
27	<i>Colchicum autumnale</i> , Linn.	Colchicaceae	Herb	Flower	Paste of the flower is used as massaging agent.	Rheumatism and Arthritis

Table 1 Continued

28	<i>Costus Speciosus</i> , Sm.	Costaceae	Herb	entire plant	Paste is applied on the decayed tooth	Toothache
29	<i>Curcuma angustifolia</i> Roxb.	Zingiberaceae	Herb	Rhizome	Paste of rhizome is applied as massaging agent, paste is bound with a cloth on fractures	Rheumatism and fractured bones
30	<i>Curcuma caesia</i> Roxb.	Zingiberaceae	Herb	Rhizome	Rhizome paste is applied locally	Rheumatism and bruises
31	<i>Curcuma domestica</i> , Val.	Zingiberaceae	Herb	Rhizome	Paste of the rhizome is applied on wounds for quick healing.	Wounds and cuts
32	<i>Datura innoxia</i> , Mill.	Solanaceae	Shrub	Leaf, Flower	Both Leaves and flower are crushed together, and used as massaging agent.	Rheumatism
33	<i>Debregeasia longifolia</i> Wedd.	Urticaceae	Tree	Fruit	Fruits are taken	Constipation
34	<i>Euphorbia antiquorum</i> , Linn.	Euphorbiaceae	Tree	Bark	Liquid extract from boiled bark and drank	Constipation
35	<i>Euphorbia pulcherrima</i> , Willd.ex.Klotzs.	Euphorbiaceae	Shrub	Stem	Milky latex of the stem applied	Skin rashes and ringworms
36	<i>Feronia limonia</i> , Linn.	Rutaceae	Tree	Leaf	Leaves boiled, liquid extract is drank.	Fever
37	<i>Ficus Racemosa</i> , Linn.	Moraceae	Tree	Fruit	Fruit is eaten.	Intestinal worms
38	<i>Helianthus annuus</i> , Linn.	Asteraceae	Herb	Flower	Young flowers are crushed and applied as massage ointment.	Rheumatism
39	<i>Hibiscus mutabilis</i> , Linn.	Malvaceae	Shrub	Leaf	Leaves chewed and consumed	Gastric pain
40	<i>Hibiscus rosa-sinensis</i> , Linn.	Malvaceae	Shrub	Flower	Flower is crushed, consumed with water.	Menstruation problem
41	<i>Hibiscus sabdariffa</i> Linn.	Malvaceae	Shrub	Fruit	Fruits are sliced, dried and consumed	Constipation
42	<i>Iris versicolor</i> , Linn.	Iridaceae	Herb	Root	Dried roots are crushed and consumed	Liver infection
43	<i>Lasia spinosa</i> , Thwaites.	Araceae	Herb	immature Shoot	shoots are boiled and consumed	Intestinal worms
44	<i>Leucas aspera</i> , Spreng.	Lamiaceae	Herb	Leaf	Crushed leaves used for inhale	Sinus
45	<i>Litsea citrata</i> , Blume.	Rutaceae	Tree	Leaf	Boiled leaves consumed.	Blood Pressure
46	<i>Manihot esculenta</i> Crantz.	Euphorbiaceae	Shrub	Leaf	Decoctions of the leaves are applied locally	Skin disease
47	<i>Manihot sp.</i>	Euphorbiaceae	Shrub	Tuber	Juice extract of tuber applied	Rashes and skin allergy.
48	<i>Mentha spicata</i> Linn.	Lamiaceae	Herb	Leaf	Juice extract of leaves are consumed.	Diarrhoea and constipation.
49	<i>Mimosa pudica</i> , Linn.	Mimosaceae	Herb	Leaf	Leaves paste is applied on cuts	Wounds and cuts
50	<i>Murraya koenigii</i> , Linn.	Rutaceae	Tree	Leaf	Leaves paste is consumed with water and salt	Diarrhoea and dysentery
51	<i>Musa paradisiaca</i> , Linn.	Musaceae	Herb	Fruit	Ripe fruit is taken	Constipation
52	<i>Mussaenda roxburghii</i> , Hook.F.	Rubiaceae	Shrub	Root	Roots soaked in water for whole night, liquid extract is drunk.	Gastric pain
53	<i>Ocimum basilicum</i> , Linn.	Lamiaceae	Herb	Leaf	Leaves chewed	Stomach pain
54	<i>Oxalis acetosella</i> , Linn.	Oxalidaceae	Herb	Leaf	Consumption of boiled leaves	Kidney and urinary infection.
55	<i>Panax quinquefolius</i> , Linn.	Araliaceae	Herb	Tuber	Dried and crushed powder of the tuber is mixed with water and drank regularly for a few days	Diabetes
56	<i>Papaver somniferum</i> , Linn.	Papaveraceae	Herb	Seed	seed paste is consumed with water.	Stomach pain

Table 1 Continued

57	<i>Passiflora edulis</i> , Sims.	Passifloraceae	Climber	Leaf	Decoction of boiled Leaves consumed.	Blood pressure
58	<i>Plantago asiatica</i> , Linn.	Plantaginaceae	Herb	Seed	Seed paste is massaged on affected area	Fractures and sprains
59	<i>Plantago major</i> , Linn.	Plantaginaceae	Herb	Leaf	Paste of leaves applied.	Wounds and cuts
60	<i>Psidium guajava</i> , Linn.	Myrtaceae	Tree	Leaf	Leaves chewed and consumed	Diarrhoea and dysentery
61	<i>Rhus simialata</i> , Murr.	Anacardiaceae	Tree	Fruit	fruit mixed in water and consume	Food poisoning
62	<i>Rubus ellipticus</i> , Sm.	Rosaceae	Shrub	Root	Juice extract of the root is drunk.	Kidney problem
63	<i>Salvia officinalis</i> , Linn.	Lamiaceae	Shrub	Flower	Flower paste is applied on skin	Snake and insect bite
64	<i>Solanum khasianum</i> , Clarke.	Solanaceae	Shrub	Fruit	Ripe fruit smoked and inhaled orally.	Toothache
65	<i>Solanum kurzii</i> , Brace ex prain.	Solanaceae	Shrub	Fruit	Decoction of the fruit is drunk	Hepatitis
66	<i>Solanum torvum</i> Sw.	Solanaceae	Shrub	Leaf	Pastes of leaves are applied	Cuts and wounds.
67	<i>Spondias mangifera</i> , Willd.	Anacardiaceae	Tree	Fruit	Juice extract consume as drink	Diarrhoea and dysentery
68	<i>Stereospermum chelonoides</i> (H.F) Dc.	Begoneaceae	Tree	Bark, root	Liquid extract of root and bark are consumed.	Cholera
69	<i>Terminalia chebula</i> , Retz.	Combretaceae	Tree	Fruit	Fruit is boiled and liquid extract drank.	Diarrhoea and dysentery
70	<i>Urena lobata</i> Linn.	Malvaceae	Shrub	Root and bark	Paste of root & bark is used as massage ointment.	Rheumatism
71	<i>Urtica dioica</i>	Urticaceae	Herb	Leaf	Leaves are soaked in water and massaged onto body swellings.	Body sores and swellings.

Among the different plant parts, the leaves were most frequently used for the treatment of diseases followed by fruit, root, flower, bark, whole plant, seed, stem, rhizome and tuber (figure 3). The methods of preparation fall into different categories such as plant parts applied as a paste, decoction, juice extracted from the fresh plant parts, boiled root, powder made from fresh or dried plant parts. Medicines are mostly taken orally and by topical or local applications also observed. Both the external (mostly for snake bites, wounds and skin diseases) and internal consumption of the preparations were involved in the treatment of diseases.

All the medicinal plants are generally found in each of the villages in this region. Local people used to collect plants from their surrounding plant communities in wild, semi-wild and some are cultivated as well. It was found that most of the plant parts used as medicines to cure diseases gathered from forest, but some rural people are devoted to raise certain plants with medicinal properties [1]. However, cultivation of medicinal plants in surroundings, home-gardens, agro-forestry systems is a very new and important from conservation point of view in north east India.

It was found that medicinal plants played a very important role in the health care system of these tribal communities. It is seen that rural community's health care seems to be the first and foremost line of defense. In spite of the advancement of science and technology, modern civilization and other activities, most of them are still holding on their traditional practices of medicinal systems. Regional indigenous knowledge is mainly confined to the traditional-healers and old-folks residing in villages. However, traditional healers think that the knowledge of the medicinal effectiveness of plants is being missing as they do not divulge the secret in fear. Even they also in tension that their professional supremacy may be at risk and the uses of medicinal potency of the plants would be destabilized. However, proper documentation of medicinal plants is very essential to know their potential for the improvement of health and hygiene through an eco-friendly system. Therefore, extra importance on ethno medicinal research would be helpful and effective strategy for the discovery of useful medicinally active identity. However, recent study has revealed that many of these valuable plants is under threat and depleting very fast deforestation, overexploitation of plant resources, practice of 'Jhum' or 'Shifting' cultivation, forest fire and other human socio-economic developmental activities in the area. Therefore, it is urgent need for protection and conservation of biodiversity including the valuable assets of medicinal plants. Different types of strategies are required to adopt, involving all the local people called community-based conservation systems.

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