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

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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 Nongkhyllem Wildlife Sanctuary located in the Ri-Bhoi district of Meghalaya to investigate the uses of medicinal plants and their conservation. The Nongkhyllem wildlife sanctuary was carved out of Nongkhyllem 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 resided in around the Nongkhyllum Wildlife Sanctuary, Meghalaya.

2. Materials and Methods

2.1. Study Site

The study was conducted in and around the Nongkhyllum 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 Nongkhyllum wildlife sanctuary and Nongkhyllum reserve forest are continuous. The Nongkhyllum reserve forest was constituted in the year 1910 with 96.91 km area. The Nongkhyllum wildlife sanctuary was carved out of Nongkhyllum 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-Behal.

3. Results and Discussion

Ethno-botanical survey on traditional practices of medicinal plants was carried out in and around the Nongkhyllum 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, Arecaeae, 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

| Sl No. | Botanical Name               | Family              | Habit     | Parts Used | Mode of Use                                      | Disease Classification                        |
|--------|------------------------------|---------------------|-----------|------------|-------------------------------------------------|-----------------------------------------------|
| 1      | Achyranthes aspera Linn.     | Amaranthaceae       | Herb      | entire plant | Plant is boiled, water extract is used as a drink | Pneumonia, Blood pressure, diabetes           |
| 2      | Agave americana, Linn.       | Asparagaceae        | Shrub     | Leaf       | Water extract and boiled leaves is drunk once a day. | T.B, Jaundice.                                |
| 3      | Albizia chinensis (Osbeck.) Merr. | Fabaceae      | Shrub     | Leaf       | Bark paste applied as antidote.                   | Insects, snake bite                           |
| 4      | Alcea rosea Linn.            | Malvaceae           | Tree      | Bark       | Mild purgative of the flower is consumed.         | Stomach ache and gastric problem              |
| 5      | Alnus nepalensis D.Don.      | Betulaceae          | Tree      | Root       | Juice extract of root is drunk.                   | Diarrhoea                                     |
| 6      | Aloe vera (L.) Burm.f.       | Xanthorrhoeaceae    | Shrub     | Leaf       | Fleshy leaves paste applied on skin.              | Wounds, cuts                                  |
| 7      | Antirrhinum majus Linn.      | Scrophulariceae     | Herb      | Leaf       | Leaves paste applied as poultice.                 | Tumours and ulcers                            |
| 8      | Arctium lappa, Linn.         | Asteraceae          | Shrub     | Leaf       | Leaves are boiled and liquid extract is drunk.    | Fever                                         |
| 9      | Argemone mexicana Linn.      | Papaveraceae        | Herb      | Leaf       | Leaves paste is applied on affected area          | Wounds and ulcers                             |
| 10     | Artemisia vulgaris, Linn.    | Asteraceae          | Herb      | Leaf       | Leaves paste is applied on skin                   | Rashes and ringworms                          |
| 11     | Baccaraea ranniflora, Lore.  | Phyllanthaceae      | Tree      | Seed       | Paste of seed is consumed with water              | Diarrhoea and dysentery.                     |
| 12     | Begonia palmataD. Don.       | Begoniaceae         | Herb      | Entire plant | Whole plant is crushed, liquid extracted is taken orally after food | Fever, stomach ache                           |
| 13     | Begonia sp                   | Begoniaceae         | Herb      | Stem       | Stem is eaten in raw form                         | Food poisoning                                |
| 14     | Borassus aethiopum, Mart.    | Arecaceae           | Tree      | Root       | Water extract of boiled root is consumed          | Indigestion, stomach problem                  |
| 15     | Butea buteiformis (Voigt) Grierson, syn. | Fabaceae   | Shrub     | Seed       | Paste of seeds consumed with water                | Parasitic worm infections                     |
| 16     | Butea monosperma, Roxb.ex.Willd. | Fabaceae    | Tree      | Bark       | Bark is soaked in water, liquid is drunk          | Piles, skin problems                          |
| 17     | Cajanus cajan (Linn.) Mill.  | Fabaceae            | Shrub     | Seed       | Boiled seeds are consumed as anthelmintic.        | Parasitic worm infections                     |
| 18     | Canarium resiiferum, Bruce.ex.King. | Burseraceae | Tree      | Fruit      | Fruits are consumed                               | Indigestion                                   |
| 19     | Carica papaya, Linn.         | Caricaceae          | Tree      | Fruit      | Unripe fruit is consumed in raw form              | Abortion                                      |
| 20     | Catharanthus roseus (L.) G.Don. | Apocynaceae | Herb      | Leaf       | Leaves are consumed in raw form.                  | Diarrhoea and dysentery.                     |
| 21     | Centella asiatica (L.) Urban. | Apiaceae           | Herb      | Entire plant | Whole plant is taken in raw form.                 | Blood pressure and diabetes                   |
| 22     | Cephalotaxus griffithii      | Cephalotaxaceae     | Shrub     | Leaf       | Leaves paste is consumed                          | Tumour                                        |
| 23     | Chenopodium album, Linn.     | Chenopodiaceae      | Herb      | Entire plant | Paste is consumed as laxative.                    | Constipation                                  |
| 24     | Citrus maxima, Burn.         | Rutaceae            | Tree      | Fruit      | Juice extract is drunk.                           | Indigestion                                   |
| 25     | Clerodendrum serratum, Linn. | Verbenaceae         | Shrub     | Stem       | Juice extract is drunk.                           | Menstruation problem                          |
| 26     | Colacasia sp                 | Araceae             | Herb      | Stem       | Juice extract is used                             | Insect bite                                   |
| 27     | Colchicum autumnale, Linn.   | Colchicaceae        | Herb      | Flower     | Paste of the flower used as massaging agent.     | Rheumatism and Arthritis                      |
| No. | Species                                      | Family       | Part Used   | Description                                                                 | Disease                          |
|-----|---------------------------------------------|--------------|-------------|----------------------------------------------------------------------------|----------------------------------|
| 28  | Costus Speciosus, Sm.                       | Costaceae    | Herb        | Entire plant Paste is applied on the decayed tooth                          | Toothache                        |
| 29  | Curcuma angustifolia 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  | Curcuma caesia Roxb.                        | Zingiberaceae| Herb        | Rhizome Rhizome paste is applied locally                                     | Rheumatism and bruises           |
| 31  | Curcuma domestica, Val.                     | Zingiberaceae| Herb        | Rhizome Paste of the rhizome is applied on wounds for quick healing.         | Wounds and cuts                  |
| 32  | Datura innoxia, Mill.                       | Solanaceae   | Shrub       | Leaf, Flower Both Leaves and flower are crushed together, and used as massaging agent. | Rheumatism                       |
| 33  | Debregeasia longfolia Wedd.                 | Urticaceae   | Tree        | Fruit Fruits are taken                                                       | Constipation                     |
| 34  | Euphorbia antiquorum, Linn.                 | Euphorbiaceae| Tree        | Bark Liquid extract from boiled bark and drank                               | Constipation                     |
| 35  | Euphorbia pulcherrima, Willd.ex.Klotz.      | Euphorbiaceae| Shrub       | Stem Milky latex of the stem applied                                         | Skin rashes and ringworms         |
| 36  | Feronia limonia, Linn.                      | Rutaceae     | Tree        | Leaf Leaves boiled, liquid extract is drank.                                 | Fever                            |
| 37  | Ficus Racemosa, Linn.                       | Moraceae     | Tree        | Fruit Fruit is eaten                                                         | Intestinal worms                 |
| 38  | Helianthus annuus, Linn.                    | Asteraceae   | Herb        | Flower Young flowers are crushed and applied as massage ointment.            | Rheumatism                       |
| 39  | Hibiscus mutabilis, Linn.                   | Malvaceae    | Shrub       | Leaf Leaves chewed and consumed                                              | Gastric pain                     |
| 40  | Hibiscus rosa-sinensis, Linn.               | Malvaceae    | Shrub       | Flower Flower is crushed, consumed with water.                               | Menstruation problem             |
| 41  | Hibiscus sabdariffa, Linn.                  | Malvaceae    | Shrub       | Fruit Fruits are sliced, dried and consumed                                 | Constipation                     |
| 42  | Iris versicolor, Linn.                      | Iridaceae    | Herb        | Root Dried roots are crushed and consumed                                   | Liver infection                  |
| 43  | Lasia spinosa, Thwaites.                    | Araceae      | Herb        | Immature Shoot shoots are boiled and consumed                                | Intestinal worms                 |
| 44  | Leucas aspera, Spreng.                      | Lamiaceae    | Herb        | Leaf Crushed leaves used for inhale                                           | Sinus                            |
| 45  | Litsea citrata, Blume.                      | Rutaceae     | Tree        | Leaf Boiled leaves consumed                                                  | Blood Pressure                   |
| 46  | Manihot esculenta, Crantz.                  | Euphorbiaceae| Shrub       | Leaf Decoctions of the leaves are applied locally                            | Skin disease                     |
| 47  | Manihot sp.                                 | Euphorbiaceae| Shrub       | Tuber Decoctions of the leaves are applied locally                            | Skin disease                     |
| 48  | Mentha spicata, Linn.                       | Lamiaceae    | Herb        | Leaf Juice extract of leaves are consumed.                                  | Diarrhoea and constipation        |
| 49  | Mimosida pudaica, Linn.                     | Mimosaceae   | Herb        | Leaf Leaves paste is applied on cuts                                         | Wounds and cuts                  |
| 50  | Murraya koenigii, Linn.                     | Rutaceae     | Tree        | Leaf Leaves paste is consumed with water and salt                            | Diarrhoea and dysentery          |
| 51  | Musa paradisiaca, Linn.                     | Musaceae     | Herb        | Fruit Ripe fruit is taken                                                    | Constipation                     |
| 52  | Mussaenda roxburghii, Hook.F.              | Rubiaceae    | Shrub       | Root Roots soaked in water for whole night, liquid extract is drunk.         | Gastric pain                     |
| 53  | Ocimum basilicum, Linn.                     | Lamiaceae    | Herb        | Leaf Leaves are chewed                                                       | Stomach pain                     |
| 54  | Oxalis acetosella, Linn.                    | Oxalidaceae  | Herb        | Leaf Consumption of boiled leaves                                            | Kidney and urinary infection.    |
| 55  | Panax quinqufolius, Linn.                   | Araliaceae   | Herb        | Tuber Dried and crushed powder of the tuber is mixed with water and drunk regularly for a few days | Diabetes                         |
| 56  | Papaver somniferum, Linn.                   | Papaveraceae | Herb        | Seed Seed paste is consumed with water.                                      | Stomach pain                     |
Table 1 Continued

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