Plants used in healthcare practices by Limboo tribe in South –West of Khangchendzonga Biosphere Reserve, Sikkim, India

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The study aimed in exploring indigenous knowledge of Limboo tribe on plant use practices for local healthcare in Khangchendzonga Biosphere Reserve, Sikkim. Use of 124 ethnomedicinal plants to cure 77 ailments, grouped into 13 broad categories, was recorded. Maximum number of species (31) was used to cure stomach related problems. Oral administration (71.77%) was the common practice. Artemesia vulgaris and Swertia chirayita (1.00 each) recorded the highest use value. Cut and wound problems recorded the highest Informant Consensus Factor (0.91). Paper also discussed the conservation aspects.

Keywords: Indigenous knowledge, Informant Consensus Factor, Khangchendzonga Biosphere Reserve, Limboo tribe, Sikkim

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Traditional medicine or ethnomedicine is a healthcare practice that has been transmitted orally from generation to generation through traditional healers and shamans with an aim to cure different ailments, and is strongly associated to religious beliefs and practices of the indigenous people. However, with the modernization, especially globalization in recent years, many cultures that possess a wealth of knowledge on the utilization of plants are vanishing. Indigenous knowledge of medicinal plants and their use by the community people are not only useful for the conservation of cultural traditions and biodiversity, but also for the community healthcare and drug development in present and in the future.

Documenting the plants and their ethnobiological values is essential to evaluate human plant relationships and in understanding the regional human ecology relations to their environment. Documenting indigenous knowledge is equally significant for the conservation and utilization of biological resources and that may have impacts from a bioeconomic point of view. Since, the Himalayan region has been experiencing tremendous decline in the indigenous knowledge on plant use in local healthcare, it is high time that we documents this traditional wisdom before such knowledge disappears for ever. This will not only help in preserving our ethnoculture but at the same time strengthening conservation strategies of those useful species.

This study has therefore targeted an indigenous tribe of Sikkim, i.e. Limboo tribe inhabiting the transition zone in South-western part of Khangchendzonga Biosphere Reserve (KBR), Sikkim. The major objectives of this study include, (i) valid documentation of the plants used in folk medicinal practices by the Limboo tribe in KBR; (ii) comprehensive accounting of the use parts, use pattern, nature of drug preparation, ailments cured, and other ethnocultural knowledge on the plant use among Limboos as folk medicine; (iii) determining the relative importance of the species surveyed; and (iv) calculating the informant consensus factor (ICF) in relation to use of medicinal plants. As per published literature, so far, no systematic studies targeting ethnomedicinal practice by the specific tribal community has been made in Sikkim, except by us on Lepcha tribe.

Methodology

Territory and the people

Khangchendzonga Biosphere Reserve (KBR) covering 41.31% of the total geographical area of the state of Sikkim, India was established in the year 2000. The Yuksam area (comprising of over 12 villages),
falling in the transition zone of KBR, is situated at an altitude of 1780 m asl and lies along 27°22′32″ N (Lat) and 88°13′29″ E (Long), known as the gateway to the Khangchendzonga National Park. The ‘Yuksam’ bears the historical significance which dates back to some 350 yrs. It was the first capital of Sikkim kingdom, until official merger of Sikkim as 22nd state to the Indian Union on 16th May 1975. In recent times, Yuksam has emerged as the base trekking point for the famous ‘Dzongri – Goeche La trek’ in KNP. Yuksam is mainly inhabited by Nepali, Bhutia and Limboo communities. The ethnomedicinal plant survey was conducted in Limboo dominated villages in Yuksam area, viz. Khyongtey, Mangsaboong, Mangtaboong, Topsing and Intang.

The Limboo or Tshong or Subba people are indigenous to hill or mountain regions. They have their own script “Shrijunga Script”, language “Limbu Kura” and religion “Yuma Samyo” or Yamaism”. Limboo community people have been living a simple and primitive life; they collect wild edibles, medicinal plants, and other nature based bio-resources. Being non-vegetarian, they mostly relish pork. The Limboos are very laborious; they practices mixed farming and rearing Goat, Cow, Sheep, Pig and Poultry form the important source of income to them. In Yuksam area, Limboo youngsters make huge income by working part time as guides and porters for the tourists and trekkers. With the passage of time, they have emerged as strong competitor to other communities and are holding high administrative and other posts in the state Government as well as in national and international level.

Data collection
Prior to field survey in the targeted villages in study area, available literatures were extensively reviewed including internet search to form a baseline. Checklist was prepared on ethnomedicinal plants available in the area for cross checking with the information obtained from the respondents. Information was obtained through, (i) random selection of informants (30 respondents in each village) during general conversation by keeping gender diversity, and (ii) informal interviews (semi-structure techniques) and small group discussion with the community people born or having lived most of their lives in the region. Since, the people are well versed in both Nepali and Hindi, either languages helped to conduct general conversation and personal interviews. During field survey, Limboo people were asked questions related to the use of plants with healthcare purpose. The study focused on folk medical knowledge of local plant based remedies which included the details of collection, ethnomedicinal notes on plants being used by them such as plant parts in use, mode of preparation, mode of administration and ailments cured. Direct questionnaire based formal survey was avoided which could otherwise have negative effect on their enthusiasm and confidence in conversation, as experienced in earlier studies in Dzongu valley2. Creating congenial atmosphere and friendly talks helped getting useful information. Special care was taken in collecting information to avoid any unauthentic details. Data were later cross-checked.

Field observations on the enlisted species in surrounding habitats (in wilderness) and semi-natural and agricultural landscapes in and around the villages were made during the survey as well as during several treks performed along altitudinal transect in KBR (1700 – 4500 m asl). Help of the elderly people in villages were taken in recognizing the ethnomedicinal plants used by them in the surrounding areas. Other local folks cooperated in recognizing the plants along higher altitudes, as they were hired as guides and porters during the field trekking. All the respondents belonged to age group between 20 and 80 yrs. Of the total 150 respondents, 30% were female and 70% were male. The men were mostly farmers who had acquired a broad knowledge on medicinal plants from their ancestors and through personal experiences in the wild, while the women were housewives who had acquired such knowledge by way of experimentations with their children, other family members, relatives and community members. The species were identified on the basis of our previous experiences and by consulting standard floras8,9. In order to establish originality of the present research, the recorded data were cross-checked with specific literatures2,10-13.

Data analysis
To determine the use variability and importance of the medicinal plants in terms of local use, the first step employed was the calculation of the informant consensus factor (ICF) following Heinrich et al.14. This factor indicates the differences and similarities in opinion amongst the people in the use of particular medicinal plant species in treating the illness in different categories. The value of this factor ranges from 0 to 1. The value nearing 0 indicates either, the
ethnomedicinal species were used in curing stomach related problems, followed by the cough and cold (23 species) and boil and skin related problems (20 species) (Table 2).

The recorded 124 medicinal plant species are used in curing stomach related problems, followed by the cough and cold (23 species) and boil and skin related problems (20 species) (Table 2).

The study explored 124 ethnomedicinal plant species belonging to 68 families and 114 genera used by Limboo tribe for medicinal and general healthcare purposes (Table 1). Except a few, which need extra time and cost for collection, the majority of these ethnomedicinal plants are well known and have widespread distribution in the area; and some (Allium cepa, A. sativum, Brassica campestris, Heracleum wallichii, etc.) are cultivated in their home gardens.

In terms of collection area, 64.52% of the medicinal plant species used was found to be collected from their farmlands, while 35.48% species collected from the forest. Further, in terms of species collected from the farmland, it was observed that 46.25% of the species used are cultivated one; while, native or weed species composed the non-cultivated category comprises 53.75% of the species use. Of 68 families, the predominating ones in terms of the species use were Asteraceae (8 spp.), Zingiberaceae and Rutaceae (6 spp. each) and Liliaceae (5 spp.). In terms of number of genera used, the predominant families included Asteraceae (8 genera) and Zingiberaceae (5 genera). The number of species and number of genera used as medicine by the Limboo tribe (Fig. 1A) was significantly correlated \((r = 0.92; p<0.001)\). As per habits, herbs (47.58%) were the most used ethnomedicinal species followed by the trees (32.26%), shrubs (10.48%) and climbers (9.68%).

The recorded 124 medicinal plant species are used to cure 77 ailments, which were grouped into 13 broad categories (Table 2). On individual disease category basis, the maximum number of species (31 species) was used in curing stomach related problems, followed by the cough and cold (23 species) and boil and skin related problems (20 species) (Table 2).
Table 1—Plant species used for curing different ailments by Limboo tribe in South-West Khangchendzonga Biosphere Reserve in West Sikkim, India

<table>
<thead>
<tr>
<th>Botanical name</th>
<th>Family</th>
<th>Common name</th>
<th>Ethnic uses</th>
<th>Use value</th>
<th>Collection locality</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abies densa Griffith</td>
<td>Pinaceae</td>
<td>Gobre salla</td>
<td>Leaf extract used in curing asthma, bronchitis and stomach pain</td>
<td>0.05</td>
<td>Forest</td>
<td>W</td>
</tr>
<tr>
<td>Abrus precatorius Linn.</td>
<td>Leguminosae</td>
<td>Lalgeri</td>
<td>Fruit is chewed or fresh root juice is administered orally during throat pain</td>
<td>0.07</td>
<td>Farmland</td>
<td>NC</td>
</tr>
<tr>
<td>Acacia pennata (Linn.) Wild.</td>
<td>Leguminosae</td>
<td>Arare</td>
<td>Leaf chewed with sugar and cumin during bleeding gums; leaf juice administered orally in indigestion in infants</td>
<td>0.05</td>
<td>Farmland</td>
<td>NC</td>
</tr>
<tr>
<td>Aconitum ferox Wall. ex Seringe</td>
<td>Rununculaceae</td>
<td>Kalo Bikh</td>
<td>After proper curing, the dried rhizome chewed during food poison, diarrhea, cough, cold</td>
<td>0.58</td>
<td>Forest</td>
<td>W</td>
</tr>
<tr>
<td>Aconitum spicatum Stapf.</td>
<td>Rununculaceae</td>
<td>Nilo Bikh</td>
<td>After proper curing, the dried rhizome chewed during food poison, diarrhea, cough, cold. Leaf paste applied on forehead during high fever and headache</td>
<td>0.35</td>
<td>Forest</td>
<td>W</td>
</tr>
<tr>
<td>Acorus calamus Linn.</td>
<td>Araceae</td>
<td>Bonjo</td>
<td>Small dried rhizome chewed to treat cough and cold, toothache, headache and throat pain. Also used as pesticide. The extract is taken to cure measles. Paste prepared from rhizome applied in skin diseases in humans as well as dogs. Powdered rhizome administered orally to expel intestinal worms in children.</td>
<td>0.90</td>
<td>Farmland</td>
<td>NC</td>
</tr>
<tr>
<td>Aegle marmelos Correa ex. Roxb.</td>
<td>Rutaceae</td>
<td>Bel</td>
<td>Fresh root chewed during diarrhea and dysentery; fruits eaten in constipation; fruit paste administered orally during stomach ache</td>
<td>0.08</td>
<td>Farmland</td>
<td>C</td>
</tr>
<tr>
<td>Ageratum conyzoides Linn.</td>
<td>Asteraceae</td>
<td>Elame jhar</td>
<td>Flower chewed during throat pain, the tender plant tip chewed during diarrhea and dysentery</td>
<td>0.93</td>
<td>Farmland</td>
<td>NC</td>
</tr>
<tr>
<td>Aesandra butyracea (Roxb.) Baehni</td>
<td>Sapitaceae</td>
<td>Chiwri</td>
<td>Oil extract of fruit applied all over the body during winter in place of petroleum jelly</td>
<td>0.18</td>
<td>Farmland</td>
<td>C</td>
</tr>
<tr>
<td>Allium cepa Linn.</td>
<td>Liliaceae</td>
<td>Piyaj</td>
<td>Bulb crushed and applied externally over sprained muscles and joints</td>
<td>0.63</td>
<td>Farmland</td>
<td>C</td>
</tr>
<tr>
<td>Allium sativum Linn.</td>
<td>Liliaceae</td>
<td>Lasun</td>
<td>Soup taken during altitude sickness, chewed raw brings down the blood pressure, relieves gas; crushed and mixed with water and sprinkled to drive away the snakes</td>
<td>0.89</td>
<td>Farmland</td>
<td>C</td>
</tr>
<tr>
<td>Albizzias procera (Roxb.) Benth.</td>
<td>Mimosaceae</td>
<td>Seti Siris</td>
<td>The bark crushed into paste and applied on the forehead during fever</td>
<td>0.09</td>
<td>Farmland</td>
<td>NC</td>
</tr>
<tr>
<td>Aloe vera (L.) Burm. f.</td>
<td>Liliaceae</td>
<td>Ghiw kumari</td>
<td>Leaf juice applied on the burnt wounds helps in cooling pain</td>
<td>0.79</td>
<td>Farmland</td>
<td>C</td>
</tr>
<tr>
<td>Anmora squamosa Linn.</td>
<td>Annonaceae</td>
<td>Sarifa</td>
<td>Root and seed paste applied externally on forehead during headache</td>
<td>0.13</td>
<td>Farmland</td>
<td>NC</td>
</tr>
<tr>
<td>Anomomum subulatum Roxb.</td>
<td>Zingeberaceae</td>
<td>Bada aalichi</td>
<td>Seeds boiled and the essence used to gargle during teeth and gum infection</td>
<td>0.24</td>
<td>Farmland</td>
<td>C</td>
</tr>
<tr>
<td>Ampelocissus barbata (Wall.) Planch.</td>
<td>Vitaceae</td>
<td>Jarila lahara</td>
<td>Plant juice used for sores in mouth and tongue of small milk sucking baby</td>
<td>0.05</td>
<td>Forest</td>
<td>W</td>
</tr>
<tr>
<td>Anthocephalus chinensis (Lam.) Rich. ex Walp.</td>
<td>Rubiaceae</td>
<td>Kadam</td>
<td>Fruits consumed during stomachache</td>
<td>0.13</td>
<td>Farmland</td>
<td>NC</td>
</tr>
</tbody>
</table>

(Contd.)
<table>
<thead>
<tr>
<th>Plant Species</th>
<th>Family</th>
<th>Common Name</th>
<th>Uses (Description)</th>
<th>Location</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Artemisia vulgaris</td>
<td>Asteraceae</td>
<td>Titeypati</td>
<td>Crushed leaves inserted in the nose stops bleeding; tender leaves chewed cures</td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>mouth ulcers; crushed leaves mixed with water and taken bath cures skin allergy;</td>
<td>1.00</td>
<td>Farmland NC</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Leaf juice work as anti-leech, besides it has religious use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Artocarpus heterophyllus</td>
<td>Moraceae</td>
<td>Rukh kathar</td>
<td>Latex applied on boils, bone fracture</td>
<td>0.09</td>
<td>Farmland C</td>
</tr>
<tr>
<td>Artocarpus lakoocha</td>
<td>Moraceae</td>
<td>Barar</td>
<td>Latex applied on boils, bone fracture</td>
<td>0.11</td>
<td>Farmland C</td>
</tr>
<tr>
<td>Asparagus racemosa</td>
<td>Liliaceae</td>
<td>Kurilo</td>
<td>Root paste administered orally in fever, cold and coughs. Fruits are eaten to</td>
<td>0.08</td>
<td>Farmland NC</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>treat pimples.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asitbe rivalarlis</td>
<td>Saxifragaceae</td>
<td>Budiokhati</td>
<td>Root boiled and the water taken during severe back pain. Leaf chewed raw in</td>
<td>0.97</td>
<td>Farmland NC</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>toothache</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Azadirachta indica</td>
<td>Meliaceae</td>
<td>Neempatta</td>
<td>Fresh/dried leaf chewed controls diabetes but overdose may cause hearing problem.</td>
<td>0.43</td>
<td>Farmland C</td>
</tr>
<tr>
<td></td>
<td>Juss. Linn.</td>
<td></td>
<td>Bark powder used as an insecticide</td>
<td></td>
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</tr>
<tr>
<td>Bauhinia purpuraea</td>
<td>Caesalpiniaceae</td>
<td>Tanki</td>
<td>Chewing dried bark cures diarrhea, bark paste applied on boils</td>
<td>0.14</td>
<td>Farmland NC</td>
</tr>
<tr>
<td>Berberis asiatica DC</td>
<td>Berberidaceae</td>
<td>Chutro</td>
<td>Fruit and leaf juice administered orally in diarrhea and dysentery. Bark and</td>
<td>0.17</td>
<td>Forest W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>root decoction administered orally in jaundice and fever.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bergenia ciliata (Haw.)</td>
<td>Saxifragaceae</td>
<td>Pakhanbed</td>
<td>Paste made out of root of Bergenia ciliata, Kaempferia rotunda, Viscum articulatum</td>
<td>0.97</td>
<td>Farmland C</td>
</tr>
<tr>
<td></td>
<td>Sternb.</td>
<td></td>
<td>applied and tied over the fractured bones. 6-7 follow ups set the fractured bones.</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Paste is also applied over the deep cut wounds. The decoction of root taken in</td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>the form of tea during diarrhea and dysentery, cough and cold</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bergenia purpurascens</td>
<td>Saxifragaceae</td>
<td>Lek pakhanbed</td>
<td>Dried roots use as substitute for tea by high altitude graziers and believe to</td>
<td>0.19</td>
<td>Forest W</td>
</tr>
<tr>
<td>(Hook. F. &amp; Thoms.)</td>
<td></td>
<td></td>
<td>give relief from body ache. Crushed roots tied on the fractured bones of the sheep</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Betula utilis</td>
<td>Betulaceae</td>
<td>Saur</td>
<td>Bark boiled and used for cleaning wounds act as an antiseptic</td>
<td>0.25</td>
<td>Forest W</td>
</tr>
<tr>
<td>D. Don</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biden pilosa Linn.</td>
<td>Asteraceae</td>
<td>Kuro</td>
<td>Leaf juice applied to eyes and ears helps in reducing the pain</td>
<td>0.09</td>
<td>Farmland NC</td>
</tr>
<tr>
<td>Bombax ceiba Linn.</td>
<td>Bombaceae</td>
<td>Simal</td>
<td>Gums taken during diarrhea and dysentery. Flower paste applied externally on</td>
<td>0.17</td>
<td>Farmland NC</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>small pox in children.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brassica campestris</td>
<td>Cruciferae</td>
<td>Tori</td>
<td>Massaging body with oil relieves muscular pain, joint pain. Oil applied on hair</td>
<td>0.26</td>
<td>Farmland C</td>
</tr>
<tr>
<td>Linn.</td>
<td></td>
<td></td>
<td>keeps the hair black and shiny and cleans dandruff. Oil applied in nostril in</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>new born and children to prevent the child from catching cold</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brissiopsis mitis CB</td>
<td>Araliaceae</td>
<td>Chuletro</td>
<td>Dried roots administered orally in case of dysentery</td>
<td>0.12</td>
<td>Forest W</td>
</tr>
<tr>
<td>Clarke</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bridelia retusa (Linn.)</td>
<td>Euphorbiaceae</td>
<td>Gayo</td>
<td>Paste prepared of bark of Bridelia retusa and Schima wallichii applied externally</td>
<td>0.06</td>
<td>Forest W</td>
</tr>
<tr>
<td>Spreng</td>
<td></td>
<td></td>
<td>on deep cut and wounds</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Contd.)
Table 1—Plant species used for curing different ailments by Limboo tribe in South-West Khangchendzonga Biosphere Reserve in West Sikkim, India (Contd.)

<table>
<thead>
<tr>
<th>Plant species</th>
<th>Family</th>
<th>Genus</th>
<th>Species</th>
<th>Habitat</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buddleja asiatica Lour.</td>
<td>Loganiaceae</td>
<td>Buddleja</td>
<td>Asiatica</td>
<td>Farmland</td>
<td>Leaves crushed and rubbed over body skin rashes and allergy</td>
</tr>
<tr>
<td>Callicarpa arborea Roxb. Verbenaceae</td>
<td>Callicarpa</td>
<td>Callicarpa</td>
<td>Arborea</td>
<td>Farmland</td>
<td>Fruit juice administered orally to cure fever</td>
</tr>
<tr>
<td>Cannabis sativa Linn.</td>
<td>Urticaceae</td>
<td>Cannabis</td>
<td>Sativa</td>
<td>Farmland</td>
<td>Decoction of leaves administered orally in small quantity during severe diarrhoea. Seeds pounded and mixed with water taken helps in relieving body pain but should be taken in very less quantity</td>
</tr>
<tr>
<td>Carica papaya Linn.</td>
<td>Caricaceae</td>
<td>Carica</td>
<td>Papaya</td>
<td>Farmland</td>
<td>Fruits eaten in jaundice</td>
</tr>
<tr>
<td>Celosia argentea Linn.</td>
<td>Amaranthaceae</td>
<td>Celosia</td>
<td>Argentea</td>
<td>Farmland</td>
<td>Leaf juice administered orally in diarrhea and dysentery.</td>
</tr>
<tr>
<td>Chenopodium album Linn.</td>
<td>Chenopodiaceae</td>
<td>Chenopodium</td>
<td>Album</td>
<td>Farmland</td>
<td>Cooked and eaten as vegetable reduces body pain especially back pain</td>
</tr>
<tr>
<td>Chrysanthemum indicum Linn.</td>
<td>Asteraceae</td>
<td>Chrysanthemum</td>
<td>Indicum</td>
<td>Farmland</td>
<td>Dried flowers chewed during stomach ache</td>
</tr>
<tr>
<td>Cinnamomum tamala (Buch.-Ham.)</td>
<td>Lauraceae</td>
<td>Cinnamomum</td>
<td>Tamala</td>
<td>Farmland</td>
<td>Bark extract used in treatment of intestinal disorder. Leaf used as spice, known to control diarrhea</td>
</tr>
<tr>
<td>Nees. &amp; Eberm.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Citrus medica Linn.</td>
<td>Rutaceae</td>
<td>Citrus</td>
<td>Medica</td>
<td>Farmland</td>
<td>Fruits are eaten during indigestion, vomiting, jaundice, typhoid. Dried fruit skin powder administered in dysentery in case of urinary disorder.</td>
</tr>
<tr>
<td>Citrus reticulate Blanco.</td>
<td>Rutaceae</td>
<td>Citrus</td>
<td>Reticulate</td>
<td>Farmland</td>
<td>Paste prepared from the dried fruit skin applied on the face softens and cleans the skin</td>
</tr>
<tr>
<td>Clematis buchananiana DC</td>
<td>Rununculaceae</td>
<td>Clematis</td>
<td>Buchanania</td>
<td>Forest</td>
<td>Fresh roots/leaves mashed and inhaled through nose cures sinusitis and nose blocks</td>
</tr>
<tr>
<td>Colebrookea oppositifolia Labiata</td>
<td>Labiatae</td>
<td>Colebrookea</td>
<td>Oppositifolia</td>
<td>Forest</td>
<td>Leaf juice administered orally in dysentery</td>
</tr>
<tr>
<td>Curcuma amada Roxb.</td>
<td>Zingiberaceae</td>
<td>Curcuma</td>
<td>Amada</td>
<td>Farmland</td>
<td>Powdered seeds taken with water act as vermifuge in children</td>
</tr>
<tr>
<td>Curcuma zeodoaria Rose.</td>
<td>Zingiberaceae</td>
<td>Curcuma</td>
<td>Zeodoaria</td>
<td>Farmland</td>
<td>Fresh rhizome cut and rubbed over the whole body cures skin allergy, body itching. Rhizome paste applied externally to sprained joints</td>
</tr>
<tr>
<td>Curcurbita pepo Linn.</td>
<td>Cucurbitaceae</td>
<td>Curcurbita</td>
<td>Pepo</td>
<td>Farmland</td>
<td>Dried rhizome chewed to cure bad breath</td>
</tr>
<tr>
<td>Dactylorhiza hatagirea (D Don) Soo.</td>
<td>Orchidaceae</td>
<td>Dactylorhiza</td>
<td>Hatagirea</td>
<td>Forest</td>
<td>Juice of plants applied over fresh cuts and wounds.</td>
</tr>
<tr>
<td>Daphne cannabina Wall.</td>
<td>Thymelaeaceae</td>
<td>Daphne</td>
<td>Cannabina</td>
<td>Forest</td>
<td>Rhizome paste applied on cuts and wounds. Rhizome powder sprayed on wounds to control bleeding.</td>
</tr>
<tr>
<td>Datura fastuosa Linn.</td>
<td>Solanaceae</td>
<td>Datura</td>
<td>Fastuosa</td>
<td>Farmland</td>
<td>Used as substitute to Aconitum sp. Root decoction causes severe diarrhoea and vomiting thus helps in removing the poison</td>
</tr>
</tbody>
</table>

(Contd.)
Table 1—Plant species used for curing different ailments by Limboo tribe in South-West Khangchendzonga Biosphere Reserve in West Sikkim, India (Contd.)

<table>
<thead>
<tr>
<th>Plant Name</th>
<th>Family</th>
<th>Village</th>
<th>W</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dicentra scandens (D. Don) Walp.</td>
<td>Fumariaceae</td>
<td>Jogi lahara</td>
<td>0.38 Forest W</td>
</tr>
<tr>
<td>Dichroa febrifuga Lour.</td>
<td>Hydrangeaceae</td>
<td>Basak</td>
<td>0.64 Farmland NC</td>
</tr>
<tr>
<td>Dolichus uniflorus Linn.</td>
<td>Fabaceae</td>
<td>Gahat</td>
<td>0.70 Farmland C</td>
</tr>
<tr>
<td>Drymaria cordata ex Roem &amp; Schult.</td>
<td>Caryophyllaceae</td>
<td>Abijalo</td>
<td>0.85 Farmland NC</td>
</tr>
<tr>
<td>Elaeocarpus spaeicus K. Schum</td>
<td>Eleocarpaceae</td>
<td>Rudrakshe</td>
<td>0.61 Farmland C</td>
</tr>
<tr>
<td>Elatostema platyphillum Wedd.</td>
<td>Urticaceae</td>
<td>Gaglet</td>
<td>0.31 Farmland NC</td>
</tr>
<tr>
<td>Entada pursaetha ssp. sinohimalensis</td>
<td>Mimosaceae</td>
<td>Pangra</td>
<td>0.42 Forest W</td>
</tr>
<tr>
<td>Grierson &amp; Long</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ephedra gererdiana Wall. Ex Stapf</td>
<td>Ephedraceae</td>
<td>Somlata, Sallefari</td>
<td>0.21 Forest W</td>
</tr>
<tr>
<td>Eupatorium adenophorum Asteraceae</td>
<td>Asteraceae</td>
<td>Kalijhar, Kalo banmara</td>
<td>0.99 Farmland NC</td>
</tr>
<tr>
<td>Evodia fraxinifolia Hook. f.</td>
<td>Rutaceae</td>
<td>Khanaka</td>
<td>0.81 Farmland NC</td>
</tr>
<tr>
<td>Fagopyrum esculantum Moenech</td>
<td>Polygonaceae</td>
<td>Phapar</td>
<td>0.58 Farmland C</td>
</tr>
<tr>
<td>Fragaria nubicola Lindl. ex Laca</td>
<td>Rosaceae</td>
<td>Bhuin aiselu</td>
<td>0.22 Farmland NC</td>
</tr>
<tr>
<td>Girardiana palmata (Forssk.) Gaudich</td>
<td>Urticaceae</td>
<td>Bhangrey sisnu</td>
<td>0.97 Forest W</td>
</tr>
<tr>
<td>Gynaephra heterophyllum</td>
<td>Scrophulariaceae</td>
<td>Kanakmala</td>
<td>0.06 Farmland NC</td>
</tr>
<tr>
<td>Himaphragma heterophyllum</td>
<td>Apiaceae</td>
<td>Chimping</td>
<td>0.93 Farmland C</td>
</tr>
<tr>
<td>Hydrocotyle asiatica Linn.</td>
<td>Apiaceae</td>
<td>Gol patta</td>
<td>0.69 Farmland NC</td>
</tr>
<tr>
<td>Imperata cylindrical Cyrill</td>
<td>Poaceae</td>
<td>Siru</td>
<td>0.19 Farmland NC</td>
</tr>
</tbody>
</table>

(Contd.)
Table 1—Plant species used for curing different ailments by Limboo tribe in South-West Khangchendzonga Biosphere Reserve in West Sikkim, India (Contd.)

<table>
<thead>
<tr>
<th>Plant species</th>
<th>Family</th>
<th>Common names</th>
<th>Uses</th>
<th>Geographical position</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Juglans regia</em> Linn.</td>
<td>Juglandaceae</td>
<td>Okhar</td>
<td>Stem bark decoction taken to cure arthritis, rheumatism, skin diseases and toothache. Dried young shoot bark taken as anthelmintic.</td>
<td>Farmland C</td>
</tr>
<tr>
<td><em>Juniperus indica</em> Bertol.</td>
<td>Cupressaceae</td>
<td>Dhupi</td>
<td>Fruit powder is put on the glowing red fire coal and the scent is smelt which reduces headache and blood pressure; The graziers mixes the dried fruit powder with tea or milk and drinks to get relief from cough and cold in high altitude. It has religious significance.</td>
<td>Forest W</td>
</tr>
<tr>
<td><em>Kaempferia sikkimensis</em> (King ex Baker) K. Larsen</td>
<td>Zingeberaceae</td>
<td>Bhuin champa</td>
<td>Paste prepared of rhizome mixed with other such as <em>Bergenia ciliata</em> (rhizome), <em>Viscum articulatum</em> etc., applied and the extract tied over the fractured bones, bone dislocation helps in curing the problem; rhizome paste applied externally to sprained joints, on burns.</td>
<td>Farmland C</td>
</tr>
<tr>
<td><em>Lantana camara</em> Linn.</td>
<td>Verbinaceae</td>
<td>Banmara</td>
<td>Leaves crushed and the juice applied over the fresh cuts immediately stops bleeding and the extract placed over the wound as an antiseptic agent</td>
<td>Farmland NC</td>
</tr>
<tr>
<td><em>Litsea citrata</em> Blume</td>
<td>Lauraceae</td>
<td>Silitimmar</td>
<td>Dried fruits chewed during nausea and giddiness. Taken in chutney form increases appetite</td>
<td>Forest W</td>
</tr>
<tr>
<td><em>Lycopodium clavatum</em> Linn.</td>
<td>Lycopodiaceae</td>
<td>Nagbeli</td>
<td>Spores applied externally on wounds</td>
<td>Farmland NC</td>
</tr>
<tr>
<td><em>Mahonia nepalensis</em> DC</td>
<td>Berberidaceae</td>
<td>Kesari</td>
<td>Bark juice applied in the eyes during eye inflammation</td>
<td>Forest W</td>
</tr>
<tr>
<td><em>Mangifera indica</em> Linn.</td>
<td>Anacardiaceae</td>
<td>Aanp</td>
<td>Tender shoots chewed during cough, sore throat</td>
<td>Farmland C</td>
</tr>
<tr>
<td><em>Mentha arvensis</em> Linn.</td>
<td>Lamiaceae</td>
<td>Padina</td>
<td>Fresh leaves chewed during gastritis and acidity</td>
<td>Farmland C</td>
</tr>
<tr>
<td><em>Momordica charantia</em> Linn.</td>
<td>Cucurbitaceae</td>
<td>Tite karela</td>
<td>Fruit juice taken for blood purification, helps control diabetes</td>
<td>Farmland C</td>
</tr>
<tr>
<td><em>Morus indica</em> Linn.</td>
<td>Moraceae</td>
<td>Kimbu</td>
<td>Tender leaves chewed helps in curing inflammation of vocal cord, hoarse voice.</td>
<td>Farmland C</td>
</tr>
<tr>
<td><em>Mucuna monosperma</em> Wall.</td>
<td>Papilionaceae</td>
<td>Baldengra</td>
<td>Seeds act as expectorant in cough</td>
<td>Forest W</td>
</tr>
<tr>
<td><em>Nasturtium officinale</em> R. Br.</td>
<td>Cruciferae</td>
<td>Simrayo</td>
<td>Eaten in the form of vegetable relieves back pain, considered important source of iron and prescribed for pregnant women</td>
<td>Forest W</td>
</tr>
<tr>
<td><em>Nyctanthes arbortristis</em> Linn.</td>
<td>Oleaceae</td>
<td>Parijaat</td>
<td>Leaf juice taken orally during fever</td>
<td>Farmland C</td>
</tr>
<tr>
<td><em>Ocimum sanctum</em> Linn.</td>
<td>Labiatae</td>
<td>Talasi</td>
<td>Leaves chewed cures mouth ulcers</td>
<td>Farmland C</td>
</tr>
<tr>
<td><em>Oroxylum indicum</em> (L.) Kurz</td>
<td>Bignoniaceae</td>
<td>Totola</td>
<td>Root bark boiled and the juice taken during loss of appetite, cures vomiting sensation; seed burnt and powdered and mixed with lime and applied externally to relieve throat pain; fresh seed chewed to relieve menstrual pain in women</td>
<td>Farmland NC</td>
</tr>
<tr>
<td><em>Osyris arborea</em> Salz. ex Dacne.</td>
<td>Santalaceae</td>
<td>Nundhiki</td>
<td>Stem bark paste applied externally on fracture and sprain bone</td>
<td>Forest W</td>
</tr>
<tr>
<td><em>Oxalis corniculata</em> Linn.</td>
<td>Geraniaceae</td>
<td>Chari amilo</td>
<td>The aerial part chewed during cough, diarrhoea, dysentery; it also increases appetite</td>
<td>Farmland NC</td>
</tr>
</tbody>
</table>

(Contd.)
<table>
<thead>
<tr>
<th>Plant species</th>
<th>Family</th>
<th>Common name</th>
<th>Uses</th>
<th>Similarities</th>
<th>Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panax pseudo ginseng Wall.</td>
<td>Araliaceae</td>
<td>Mangan</td>
<td>Dried roots chewed act as aphrodisiac</td>
<td></td>
<td>Forest W</td>
</tr>
<tr>
<td>Perilla frutescens Britt.</td>
<td>Labiatae</td>
<td>Silam</td>
<td>Dried seeds if chewed cures cough and nausea</td>
<td></td>
<td>Farmland C</td>
</tr>
<tr>
<td>Phyllanthus emblica Linn.</td>
<td>Euphorbiaceae</td>
<td>Rukh amala</td>
<td>Fruit edible, increases appetite, cures cough and dysentery. Fruit juice applied on scalp blackens and strengthens the hair</td>
<td></td>
<td>Forest W</td>
</tr>
<tr>
<td>Phytolacca acinosa Roxb.</td>
<td>Phytolaeaceae</td>
<td>Jaringo</td>
<td>Eaten in the form of vegetable relieves body pain. Root juice dropped in the nose to cure sinusitis</td>
<td></td>
<td>Farmland C</td>
</tr>
<tr>
<td>Picrorhiza kurrooa Royle ex Benth.</td>
<td>Scrophulariaceae</td>
<td>Kutki</td>
<td>Dried rhizome soaked overnight in water and water taken during cough, cold, fever, stomach ache, throat pain, diarrhea, dysentery, headache</td>
<td></td>
<td>Forest W</td>
</tr>
<tr>
<td>Piper longum Linn.</td>
<td>Piperaceae</td>
<td>Pipla</td>
<td>Powdered dried roots taken with water serve as vermifuge in children, relieves from stomach ache. Fruits taken during diarrhea and dysentery</td>
<td></td>
<td>Forest W</td>
</tr>
<tr>
<td>Plantago eroasa Wallich</td>
<td>Plantaginaceae</td>
<td>Isabgol</td>
<td>Flower and fruits used to cure cough and cold, indigestion, diarrhea and dysentery. Root paste applied externally on boils, joints, during fever and headache.</td>
<td></td>
<td>Forest W</td>
</tr>
<tr>
<td>Psidium guajava Linn.</td>
<td>Myrtaceae</td>
<td>Ambak</td>
<td>Tender shoots chewed during cough, sore throat</td>
<td></td>
<td>Farmland C</td>
</tr>
<tr>
<td>Rheum acuminatum Hook. f. &amp; Thomson</td>
<td>Polygonaceae</td>
<td>Khokim</td>
<td>Root paste applied on forehead during severe headache. Juice from shoot portion is taken in dysentery and intestinal problems. Petiole is eaten as an appetizer.</td>
<td></td>
<td>Forest W</td>
</tr>
<tr>
<td>Rhododendron arboreum Smith</td>
<td>Ericaceae</td>
<td>Gurans</td>
<td>Fresh or dried petal chewed in diarrhea, blood dysentery and throat pain. Young leaf chewed to get relief from headache</td>
<td></td>
<td>Forest W</td>
</tr>
<tr>
<td>Rosa sericea Lindl.</td>
<td>Rosaceae</td>
<td>Banko galab</td>
<td>Decoction of leaf used to wash wounds. Flower paste taken to cure headache</td>
<td></td>
<td>Forest W</td>
</tr>
<tr>
<td>Rhus semialata Murray.</td>
<td>Anacardiaceae</td>
<td>Bhakimlo</td>
<td>Fruit juice administered orally during blood dysentery</td>
<td></td>
<td>Farmland C</td>
</tr>
<tr>
<td>Rubia cordifolia Roxb. ex Fleming</td>
<td>Rubiaceae</td>
<td>Manjito</td>
<td>Leaf and root juice are taken during fever, stomachache and dysentery. Fruit is taken to lower the body temperature; decoction of leaves and stems used as a vermifuge. Root mashed and the juice obtained applied on cuts and wounds.</td>
<td></td>
<td>Forest W</td>
</tr>
<tr>
<td>Rumex nepalensis Sreng.</td>
<td>Polygonaceae</td>
<td>Halhaley</td>
<td>Massaging with root paste relieves body pain, cures skin disease and if applied on scalp reduces hair loss. Leaf extract used in cuts and wounds.</td>
<td></td>
<td>Farmland NC</td>
</tr>
<tr>
<td>Sapindus mukorossi Gaertn.</td>
<td>Sapindaceae</td>
<td>Rittha</td>
<td>Fruit used to wash wounds and wash scalps cures dandruff</td>
<td></td>
<td>Forest W</td>
</tr>
<tr>
<td>Schima wallichii (D.C) Korth.</td>
<td>Theaceae</td>
<td>Chilauney</td>
<td>Bark paste with bark of Bridelia retusa applied externally on deep cut and wounds</td>
<td></td>
<td>Farmland NC</td>
</tr>
<tr>
<td>Seijesbeckia orientalis Linn.</td>
<td>Asteraceae</td>
<td>Kuro</td>
<td>Leaves applied externally as poultice on sores</td>
<td></td>
<td>Farmland NC</td>
</tr>
</tbody>
</table>

(Contd.)
Table 1—Plant species used for curing different ailments by Limboo tribe in South-West Khangchendzonga Biosphere Reserve in West Sikkim, India (Contd.)

<table>
<thead>
<tr>
<th>Plant Species</th>
<th>Family</th>
<th>Common Name</th>
<th>Uses</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solanum khasianum</td>
<td>Solanaceae</td>
<td>Boksi kanra</td>
<td>Burnt fruit administered orally to check tooth decay</td>
<td>0.25</td>
</tr>
<tr>
<td>(C.B. Clarke)</td>
<td></td>
<td></td>
<td></td>
<td>Farmland</td>
</tr>
<tr>
<td>Swertia chirayita</td>
<td>Gentianaceae</td>
<td>Chirowo</td>
<td>Whole plant soaked in water overnight and water is taken during fever, cough, cold, stomach pain, gastritis, throat pain, diarrhea, dysentery, headache, back ache, diabetes</td>
<td>1.00</td>
</tr>
<tr>
<td>(Roxb. Ex Flem.) H. Karst.</td>
<td></td>
<td></td>
<td></td>
<td>Forest W</td>
</tr>
<tr>
<td>Swertia paniculata Wall</td>
<td>Gentianaceae</td>
<td>Chirowo</td>
<td>Used as substitute to Swertia chirayita and bears the same properties to some extent</td>
<td>0.09</td>
</tr>
<tr>
<td>Symlocos theifolia D. Don</td>
<td>Symlocaceae</td>
<td>Kharaney</td>
<td>Fruit juice in diluted form administered orally incase of diarrhea</td>
<td>0.13</td>
</tr>
<tr>
<td>Tagetes patula Linn.</td>
<td>Asteraceae</td>
<td>Sayapatri</td>
<td>Chewing dried flowers cures sore throat, cough, and mouth ulcers</td>
<td>0.37</td>
</tr>
<tr>
<td>Terminalia chebula Retz.</td>
<td>Combretaceae</td>
<td>Harra</td>
<td>Fruit consumed during cough and sore throat, vomiting sensation, hiccups.</td>
<td>0.89</td>
</tr>
<tr>
<td>Terminalia myriocarpa Hauck &amp; Muell – Agr.</td>
<td>Combretaceae</td>
<td>Pani saaj</td>
<td>Bark juice applied externally on cuts and wounds</td>
<td>0.13</td>
</tr>
<tr>
<td>Thysanlaena maxima (Roxb.) O. Kutze.</td>
<td>Poaceae</td>
<td>Amliso</td>
<td>Root paste applied externally as a poultice on sores and boils</td>
<td>0.18</td>
</tr>
<tr>
<td>Toona ciliata M. Roem.</td>
<td>Meliaceae</td>
<td>Tooni</td>
<td>Stem bark taken to cure toothache. Fruit used for chest pain, fever and measles</td>
<td>0.13</td>
</tr>
<tr>
<td>Tricosanthes lepiniana (Naudin.) Cogn.</td>
<td>Cucurbitaceae</td>
<td>Indreni</td>
<td>Oleous extract of seed applied externally to cure skin diseases</td>
<td>0.59</td>
</tr>
<tr>
<td>Tupistra nutans Wall.</td>
<td>Liliaceae</td>
<td>Nakima</td>
<td>Cooked and eaten as vegetable increases appetite</td>
<td>0.56</td>
</tr>
<tr>
<td>Urtica parviflora Roxb.</td>
<td>Urticaceae</td>
<td>Patley sisnu</td>
<td>Root juice taken in skin diseases and kidney problems. Root extract used in toothache. The tender shoot part eaten in the form of vegetable controls high blood pressure</td>
<td>0.81</td>
</tr>
<tr>
<td>Viscum articulatum Burm. f.</td>
<td>Loranthaceae</td>
<td>Harchur</td>
<td>Root paste prepared along with others (Bergenia ciliata, Kaempferia sikkimensis, etc) applied over the fractured/dislocated bone cures the problem. Paste applied externally on wounds and boils</td>
<td>0.77</td>
</tr>
<tr>
<td>Zanthoxylum acanthopodium DC</td>
<td>Rutaceae</td>
<td>Bokey timmur</td>
<td>Fruit used as appetizer and cures bad breath. Fruit and stem barks taken in indigestion and tooth decay. Decoction of fruits used in cold and stomachache and as anthelmintic. Crushed leaves rubbed over the body act as anti leech agent</td>
<td>0.93</td>
</tr>
<tr>
<td>Zanthoxylum alatum Roxb.</td>
<td>Rutaceae</td>
<td>Bhaley timmur</td>
<td>Bears same properties as Z. acanthopodium</td>
<td>0.85</td>
</tr>
<tr>
<td>Zingiber officinale Rose.</td>
<td>Zingeberaceae</td>
<td>Aduwa</td>
<td>Rhizome crushed and boiled with sugar, turmeric powder and milk and is taken hot during severe cough. Roasted rhizome chewed with salt during severe dry cough</td>
<td>0.90</td>
</tr>
</tbody>
</table>

*W = wild, NC = not cultivated, C = cultivated

The highest informant consensus factor (ICF) was linked to the problems of cut and wound (0.91) followed by diarrhoea and dysentery (0.87) and children related problems (0.85) (Table 2). By reporting only 12 species, there were 138 citations for cut and wounds. Similarly, for diarrhoea and dysentery, with 79 citations, there were 11 species in use. Others category included diseases such as pneumonia, altitude sickness, blood pressure, nose bleeding, diabetes, typhoid, jaundice, pain reliever, ear problems, etc., for which the ICF value was 0.66.
Table 2—Informant consensus factor (ICF) by disease categories for Limboo tribe in South-West part of Khangchendzonga Biosphere Reserve (west Sikkim, India)

<table>
<thead>
<tr>
<th>Ailments</th>
<th>Species use</th>
<th>(%) All species</th>
<th>Use citations</th>
<th>(%) All use citations</th>
<th>ICF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body ache and backache</td>
<td>7</td>
<td>5.65</td>
<td>19</td>
<td>12.67</td>
<td>0.67</td>
</tr>
<tr>
<td>Boil and skin related problems</td>
<td>20</td>
<td>16.13</td>
<td>23</td>
<td>15.33</td>
<td>0.14</td>
</tr>
<tr>
<td>Children related problems</td>
<td>13</td>
<td>10.48</td>
<td>81</td>
<td>54.00</td>
<td>0.85</td>
</tr>
<tr>
<td>Cough and cold</td>
<td>23</td>
<td>18.55</td>
<td>97</td>
<td>64.67</td>
<td>0.77</td>
</tr>
<tr>
<td>Cut and wound</td>
<td>12</td>
<td>9.68</td>
<td>138</td>
<td>92.00</td>
<td>0.91</td>
</tr>
<tr>
<td>Diarrhoea and dysentery</td>
<td>11</td>
<td>8.87</td>
<td>79</td>
<td>52.67</td>
<td>0.87</td>
</tr>
<tr>
<td>Fever and headache</td>
<td>16</td>
<td>12.90</td>
<td>67</td>
<td>44.67</td>
<td>0.77</td>
</tr>
<tr>
<td>Mouth and throat related problems</td>
<td>14</td>
<td>11.29</td>
<td>47</td>
<td>31.33</td>
<td>0.72</td>
</tr>
<tr>
<td>Muscle and bone related problems</td>
<td>10</td>
<td>8.06</td>
<td>27</td>
<td>18.00</td>
<td>0.65</td>
</tr>
<tr>
<td>Nose and eye related problems</td>
<td>6</td>
<td>4.84</td>
<td>11</td>
<td>7.33</td>
<td>0.50</td>
</tr>
<tr>
<td>Stomach related problems</td>
<td>31</td>
<td>25.00</td>
<td>75</td>
<td>50.00</td>
<td>0.59</td>
</tr>
<tr>
<td>Teeth and gum related problems</td>
<td>10</td>
<td>8.06</td>
<td>33</td>
<td>22.00</td>
<td>0.72</td>
</tr>
<tr>
<td>Others</td>
<td>32</td>
<td>25.81</td>
<td>91</td>
<td>60.67</td>
<td>0.66</td>
</tr>
</tbody>
</table>

Discussion

The present study explored widely accepted traditional system of medicine for the primary healthcare, practiced by the Limboo tribe in KBR. In spite of prevailing dominance of allopathic system of medicine everywhere these days, the Limboo community still use, both, ethnomedicinal plants along with present day pharmaceuticals. Although, the Limboo tribe has maintained their ethnomedicinal knowledge till date, the present experience suggests that the folk phytotherapy today has considerably reduced and plunging towards abandonment and is limited to minor ailments like skin diseases, stomach problems, fevers, headache, cold, cough, etc. This is due to the wide scale prevalence of pharmaceutical technology in addition to the death of a person or practitioner having traditional knowledge. Simultaneously, it was encouraging to note that the youths in the study area uphold good knowledge on the use of plants as medicine. As, majority of them are involved in agriculture, farming, etc. and many works as part time porters and guides which gives them ample opportunity to learn about plants, through experimentation, during their trips to forest and high altitude landscapes in KBR.

Irrespective of the on-going depletion in ethnomedicinal practices worldwide, it is worth mentioning that there are many herbs like A. vulgaris, C. dactylon, E. adenophorum, G. palmata, H. wallichii, S. chirayita, U. parviflora, etc. which appears to have been in use persistently at local level by the Limboo community, either for their multiple
medicinal properties or religious or cultural values or due to their considerable availability in the area. However, of the total species recorded, only 47.58% had persistent use (frequency of citation: over 50), which indicates that the popularity of the plant use is diminishing and likely to be lost in near future and the collection of data on the folk plant use may soon be highly difficult\textsuperscript{2,17}. These circumstances strongly advocate for the immediate documentation of the folk medicinal knowledge to restrain further loss of knowledge that can be precious to the development of new useful phyto-products. The maximum number of species use belonging to family Asteraceae in the present study area is similar to that of the Apatani tribe of eastern Himalaya\textsuperscript{18} and local communities of Bumdeling wildlife sanctuary, Bhutan\textsuperscript{19}, indicating Asteraceae as the most dominant family of ethnomedicinal plants in North-eastern states of India\textsuperscript{20} as well as in Bhutan.

An important observation in the present study was the high use of herbs as medicine by the Limboo tribe, similar high use of herbs as ethnomedicine have been reported to be used by Irula tribe from Tamil Nadu, India\textsuperscript{21}. The Limboos believes that the underground parts contain more healing power than other parts in general, which was reflected in the data we procured, viz. 31% species’ harvesting for roots/rhizomes/bulb, followed by leaves (28%) and fruits/fruit skin (21%). Our previous study\textsuperscript{7} supports present results, where we explored the root/rhizome being the most harvested part used by the Lepcha tribe followed by leaves and fruits.

The oral remedies are taken with water, skimmed milk, honey, sugar and sometimes as such in the raw form. Medicine is taken in both ways, as a single or in mixed ingredients. The mixture is not changed depending on the person, but at the same time, the dosages of plant medicine are not specific, which could be dangerous sometimes, however, the children are suggested to take small dosage compared to the elders\textsuperscript{7}. The plants are used mostly in raw form depending on the availability in the vicinity. For example, A. vulgaris, E. adenophorum, G. palmata, R. nepalensis, U. parviflora, etc. are weed species and are available in plenty; these species can be acquired whenever needed. However, species such as, Aconitum ferox, A. spicatum, Dactylorhiza hатегорia, Juniperus indica, Panax pseudo ginseng (Fig. 3), Picrorhiza kurrooa, Rheum acuminatum (Fig. 4), etc. are available at the higher altitudes, so, these need to be stored in advance and used in dried form. Similarly, the species, viz. V. articulatum, parasitic in nature, is available on the trees and often not very easy to spot, so they collect this species on sighting, in huge quantity. The study revealed that a wide variety of medicinal plants from higher elevations are collected by the Limboos; however, in small quantities for their personal use only. From conservation point of view, such small quantity collection is considered sustainable.

The highest ICF value for ailments, such as, cut and wound, diarrhoea and dysentery, children related problems, cough and cold, and fever and headache may be related to the common nature of ailments existing in the village life in every part of the world, and is the result of great agreement on the use of same species by Limboos in the study area. For example, 100% respondents agreed on the use of Swertia chirayita in treating diarrhoea and dysentery, cough and cold, and fever and headache. For the back pain, 97.33% Limboos responded on the use of Astilbe rivularis, a common weed. However, difference in use pattern was reported for A. rivularis; some respondents mentioned that the crushed root (raw) is boiled and the decoction is taken, while some shared that the root is dried, cut into small pieces, stored and is chewed during backache. Similarly 92.67% and 90% of the respondents agreed on the use of Ageratum conyzoides and Acorus calamus for treating diarrhoea and dysentery and cold and cough. It was observed that the Limboo women keep good knowledge on the diseases associated with the children especially, stomachache, diarrhoea, dysentery, intestinal worms, cold and cough, and fever, etc. because the rate of exchange of information is high amongst the women. Nevertheless, in respect to the knowledge on ethnomedicinal plants, the female were found lagging behind the male, which might be either because the traditional knowledge in the family or community is passed from the male to his first-born son\textsuperscript{22} or due to their greater involvement in works away from home and family.

The use of species for treating different ailments depends on its availability on the surroundings as well as time and space needed for plant collection. The widespread availability of species, viz. A. vulgaris, S. chirayita, E. adenophorum, A. rivularis, B. ciliata and G. palmata, either in the farmlands or forest fringe relates to their high use value. B. ciliata is exception to above relationship, which is
also a garden plant in Sikkim, offers capability to cure multiple problems and choice for limited extra efforts in the collection. Species such as *A. cepa*, *A. sativum*, *H. wallichii*, etc. grown in the kitchen garden and frequently used in adding flavour to the food, cure the problem before appearing. Similarly, the use value of *Juniperus indica*, a high altitude species, was comparatively high (0.85) because it is very helpful in treating headache and blood pressure, as this is the common problem after reaching the high altitude areas. Further, *Juniperus indica* (common name: *Dhupi*) along with *Rhododendron anthropogon* (popular name: *Sunpati*; a threatened taxa) is used as incense especially by the Buddhists (*Bhutias*, *Lepcha* and the *Sherpas*; authors’ personal observation); so they are collected in huge quantity when the people are on their trip to high altitude areas. Some of them make their way to high altitude areas particularly for collecting these species as the incense bears high market price; however, in recent years, such large quantity extraction has significantly being checked and reduced due to several restrictions by KBR management. Also, people have reported its use in curing indigestion, stomachache, vomiting sensation and other problems associated with the attack from some so-called evil forces. It would be important to note here that, either species bear high value in the international market and are under immense pressure which called for immediate conservation attention.

Some of the ethnomedicinal plants, documented, like *Rubia cordifolia*, *Swertia chirayita*, *Piper longum* and *Picrorhiza kurrooa* have very high demand in the Indian pharmaceutical markets and are largely imported from Nepal in order to fulfill the increasing demand. Along with those, the species, viz. *Aconitum ferox*, *A. spicatum*, *Aloe vera*, *Dactylorhiza hatagirea*, *B. ciliata*, *Acorus calamus*, etc. have high potential for commercialization in Sikkim due to their high pharmaceutical value. These species can be considered for the large scale cultivation to fulfill the ever increasing need of the Indian pharmaceutical companies. Hitherto, this can be used as an encouraging tool for in-situ conservation as well as to improve socio-economic status of the local inhabitants, as the monetary output/input ratio for the medicinal plant cultivation is higher compared to cash crops and horticultural crops, comparatively.

**Significant observation related to Limboo tribe in KBR**

It was assessed that the use pattern of several plant species differs within the state of Sikkim as well as other regions in India and neighbouring country Nepal. For example, in the present study area, the leaf extract of *Abies densa* is used to cure asthma, bronchitis and stomachache by the *Limboo* tribe; which is used to cure fever and stomachache by *Lepcha* tribe; such use of the species is not reported from other regions. Similarly, *Rubia cordifolia* is used by the *Limboo* tribe in treating fever, stomachache, dysentery etc.; however, the use pattern for the same species is different in southern India, viz., it is used to cure scorpion sting and dizziness. There were species viz., *Abras precatorius*, *Aegle marmelos*, *Aloe vera*, *Astilbe rivularis*, *Bidens pilosa*, *Ocimum sanctum*, *Panax pseudo ginseng*, etc., which were observed to be used only by the Limboo tribe when compared with other Himalayans tribes of India. Different groups use many herbs like *Acorus calamus* to cure broad range of ailments; the
species is used to cure 8 ailments by the Limboo tribe (present study) and 5 ailments by the Lepcha tribe\(^2\) in KBR (Sikkim), 6 ailments by the residents of Dolpa, Nepal\(^27\), and 4 ailments by Apatani tribe of NE India\(^18\). The 100% response on the use of *Swertia chirayita* by Liboos is unique and suggestive of high presence of species.

**Conclusion**

The present investigation on 124 ethnomedicinal plant species used alone by the Limboo tribe in Yuksam area of South-West part of Khangchendzonga Biosphere Reserve and previous assessment of 118 ethnomedicinal plant species used by the Lepcha tribe\(^2\), over a previous reporting of 31 medicinal plant species used in Yuksam area\(^19\), indicates that the Sikkim Himalaya is still under-explored in terms of ethnomedicinal knowledge. Therefore, it is highly recommended to take up the detailed investigation on persisting ethnomedicinal knowledge among different ethno-cultural groups in Sikkim, before such valuable knowledge entirely vanishes. The present investigation on the ethnomedicinal plants used by the Limboo tribe fills up the existing lacunae and should help in identifying species having potential of developing herbal medicine, which can be supportive in curing different diseases around the globe along with the conservation of traditional ethnomedicinal knowledge\(^2\). At the same time, biochemical analysis, pharmacological evaluation and isolation of active ingredients of the ethnomedicinal plants used by the different ethno-cultural groups in Sikkim may throw some light on unexplored scientific information and towards discoveries of noble molecules. The KBR management may play an important role in encouraging the local folk in maintaining and carrying forward the indigenous knowledge on the use of medicinal plants by motivating them to develop herbal gardens in transition zone; however, the scientific guidance from locally established research organizations would be immensely useful for the same.

**Acknowledgement**

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**References**