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ETHNOBOTANY OF THARUS OF DUDHWA NATIONAL PARK, INDIA

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ABSTRACT

Tharus are inhabited on southern foothills of the Himalayas along Indo-Nepal border. They have been using many plant species to meet their day-to-day needs. The aim of this study was to collect information on the traditional uses of different plants and to document the potential economic use of these plants. Fieldwork was conducted over a period of two years in Dudhwa National Park, utilizing the "transect walk" method of Participatory Rural Appraisal (PRA). The data was analyzed using the following techniques: frequency of citation and informant consensus factor (Fic). The present communication gives information on 86 species belonging to 38 families of plants used by Tharu tribes of Dudhwa National Park, Uttar Pradesh. The frequency of citation was very high for *Alstonia scholaris* (fire-wood), *Antidesma acidum*, *Artocarpus lakoocha* (edible), *Bauhinia vahlii*, *Butea monosperma* (food plate), *Dendrocalamus strictus* (hut preparation), *Hibiscus cannabinus* (rope), *Oryza rufipogon* (food), *Phoenix acaulis* (edible) and *Tamarix dioica* (broom).

Keywords: Ethnobotany; Tharu tribe; Dudhwa National Park; Traditional knowledge.

INTRODUCTION

Man was dependent on plants for survival even before the beginning of civilization[1]. Primitive people were very close to nature and acquired immense knowledge about useful and harmful plants. This knowledge was time tested, grew into an integrated part of culture and passed on orally from generation to generation. Some of it is still exists with indigenous people [2]. The botany of primitive people has given number of economically important plants: *Bixa orellana, Manihot esculanta, Lonchocarpus utilis, Hevea brasiliensis, Erythroxylum coca,* etc.[3]

The southern foothills of the Himalayas along Indo-Nepal border is the home-land of the Tharu tribe. They are a predominantly Mongoloid people having certain non-Mongoloids features as well[4]. Tharus have successfully adopted themselves to an unhealthy and inhospitable environment of the Terai region. They are also known for their ability to survive in the most malarial dominated area of the Terai region that is deadly to outsiders. This is due to their unique genetic composition, which provides resistance against *Plasmodium falciparum*[5]. More than 90% of the Tharu population is engaged in agriculture[4,6]. The aboriginal people still prefer to live in forest areas to meet their day to day needs. Rice is staple food of Tharus and *Daru* (local liquor) is their favourite drink, which is prepared from the flowers of *Madhuca longifolia* and jaggery. The Tharu villages are situated inside the border areas or in the buffer zone of the National Park. The Dudhwa National Park lies in between 28°31.8'N-28°42'N latitudes and 80°28'E-80°57'E longitudes, with an area of 680 km^2 (Fig. 1). The climate is humid subtropical with dry winter and the vegetation is Himalayan subtropical broadleaf forest[7]. Summers are hot with temperature rising up to 42°C and winter temperatures average 5°C. The tigers and swamp deer are the major attractions of the National Park.

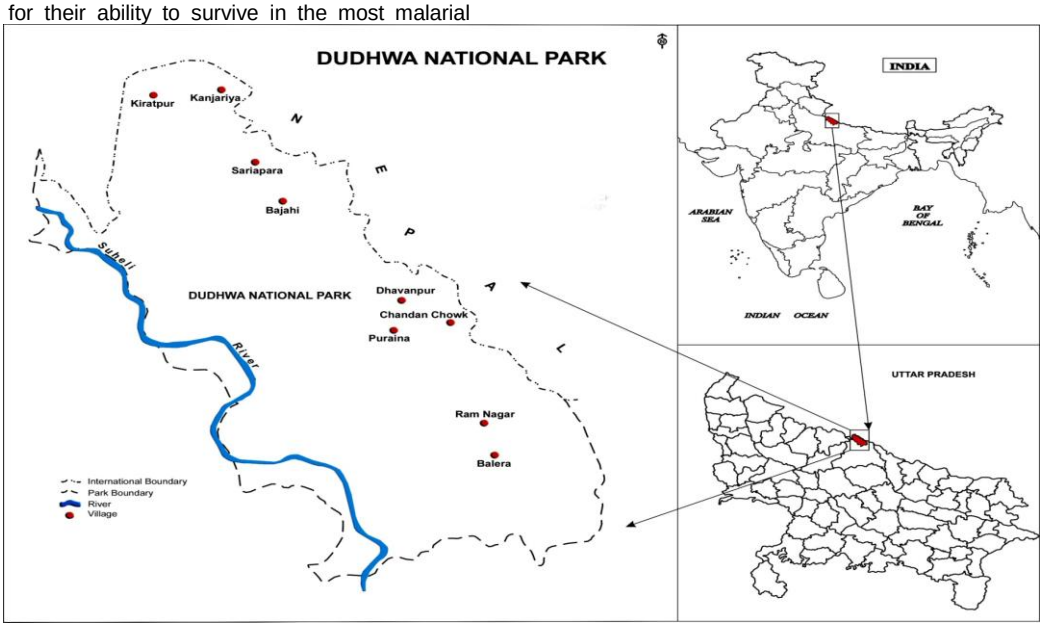

Fig.1 : Geographical position of Dudhwa national park and the villages where ethnobotany was documented.

A perusal of literature revealed that the ethnobotany of Tharu tribes of India and Nepal have been studied by number of researchers.[8-28] There has been no ethnobotanical study within Dudhwa National Park that uses statistical analysis of consensus data. Keeping this in mind, we set out to investigate the ethnobotany of Tharu tribes using quantitative statistical techniques. The aim of this study was: (1) to document the indigenous use of plants by Tharus of Dudhwa National Park, (2) to uncover new plants of potential economic use or new uses of known plants.

Methodology

Field survey and data collection

An ethnobotanical survey was conducted from June 2010 to August 2012 in 9 villages of Dhudhwa National Park inhabited by Tharu tribes (Fig. 1). After consultation with local people the sample villages were identified and prior informed consent was obtained from the respondents before interviewing them. Sixty-seven people (43 men & 24 women) were interviewed during the field survey. A Transect Walk method of a Participatory Rural Appraisal (PRA) was adopted[29]. This method involves semi-structured interviews and discussion with key-research participants such as, community elders, farmers and house-wives.

Common use of plants and their raw materials, were recorded. Plant voucher specimens were collected with key informants in the areas where they normally collect the plants, as part of the Transect Walk process. Plants were identified using Duthie, Raizada and Singh[30-32]. Additional identification was carried out by matching voucher specimens with previously identified specimens held in herbaria of Botanical Survey of India (BSA) and Forest Research Institute (DD). Voucher specimens of this study have been deposited at the Department of Botany, Bareilly College, Bareilly, India. The botanical names of the plant specimens were updated according to the Plant List (www.theplantlist.org). The nomenclatures of families are updated according to APG III system of classification[33]. A comparative assessment in the form of a literature review was also conducted to differentiate between new findings and similarities with past research.

Analysis of Quantitative Data

Quantitative ethnobotanical techniques have great scientific interest as they reflect cultural value systems and may also aid in the conservation of biodiversity. These techniques compare the uses and cultural importance of different plant species[34, 35]. The frequency of citation for each use was calculated. Logically, the most popular use among community member will get the high number of the citation-frequency; this is calculated by following formula:

$$\text{Frequency of citation}(n\%) = \frac{N}{T} \times 100$$

Where, N, number of informants who cited the use; T, total number of informants. The informant agreement ratio (IAR) or informant consensus factor (Fic) technique was used to figure out the consensus between informants for the treatment of a certain use category. The IAR or Fic value illustrates the cultural coherence of the selection of a set of plants deployed for certain category of uses. It is calculated as the number of mentions in each usage category (n_{ur}) minus the number of taxa used in each category (n_t), divided by number of mentions in each usage category minus one [36-39]. A high Fic value indicates the use of relatively few species in a certain use category. The Fic values range between 0 and 1.

$$\text{Fic} = \frac{n_{ur} - n_t}{n_{ur} - 1}$$

RESULTS

A total of 86 plant species has been documented; they are used by Tharu people for various purposes. The economically useful species are enumerated in Table 1:

Table 1: Enumeration of plant species used by Tharu tribes of Dudhwa national park, India.

	Species, family in brackets and specimen number	Local name	Frequency of citation	Use
1.	*Acacia catechu* (L.f.) Willd. [Leguminosae] KAB 27	*Khair*	47.76	The wood is used in making agricultural instruments.
2.	*Acacia nilotica* (L.) Delile [Leguminosae] KAB 54	*Babul*	71.64	The wood is used in making agricultural instruments.
3.	*Albizia lebbeck* (L.) Benth. [Leguminosae] RK 87	*Siris*	89.55	The branches are used as fire-wood for cooking.
4.	*Alstonia scholaris* (L.) R. Br. [Apocynaceae] KAB 52	*Chitwan*	92.53	The branches are used as fire-wood for cooking.
5.	*Ampelocissus latifolia* (Roxb.) Planch. [Vitaceae] RK18	*Panibel*	17.91	Green colour dye is extracted from leaves to colour the ropes.
6.	*Anagallis arvensis* L. [Primulaceae] RK 89	*Jaighani*	64.17	The plant is used as fodder.
7.	*Antidesma acidum* Retz. [Phyllanthaceae] RK 98	*Amlola*	95.52	The ripen fruits are edible.
8.	*Antidesma ghaesembilla* Gaertn. [Phyllanthaceae] RK 109	*Ban musari*	80.59	The ripen fruits are edible.
9.	*Apluda mutica* L. [Poaceae] RK 114	*Ghosni, Mujura*	47.76	The leaves are used for construction of hut.
10.	*Ardisia solanacea* (Poir.) Roxb. [Primulaceae] KAB 29	*Patpata*	77.61	The ripen fruits are edible.
11.	*Arisaema tortuosum* (Wall.) Schott [Araceae] KAB 15	*Jhag papri*	70.14	The rhizome is cooked and eaten as vegetable.
12.	*Artocarpus lakoocha* Roxb. [Moraceae] KAB 49	*Barhal*	94.02	The ripen fruits are edible.
13.	*Asparagus adscendens* Roxb. [Asparagaceae] RK 118	*Satawari*	50.74	The root are used as one of the ingredient in preparation of rice beer named “Jand”.
14.	*Asparagus racemosus* Willd. [Asparagaceae] KAB 8	*Satawari*	83.58	The root are used as one of the ingredient in preparation of rice beer named “Jand”.
15.	*Avena fatua* L. [Poaceae] KAB 28	*Jaraee*	86.56	The plant is used as fodder.
16.	*Barringtonia acutangula* (L.) Gaertn. [Lecythidaceae] RK 138	*Naura*	58.20	The stem bark is used for fishing (fish poison) as stuperfier.
17.	*Basella alba* L. [Basellaceae] RK 110	*Poi*	77.61	The leaves & aerial parts are boiled and eaten as vegetable.
18.	*Bauhinia malabarica* Roxb. [Leguminosae] RK 123	*Amlosa*	53.73	The wood is used in making agricultural instruments.
19.	*Bauhinia racemosa* Lam. [Leguminosae] KAB 38	*Mahuli*	62.68	The stem bark fiber are used for making

				ropes.
20.	*Bauhinia vahlii* Wight & Arn. [Leguminosae] RK 108	*Mahulain bel*	56.71	The seeds are roasted and used as food.
			97.01	The leaves are used as plates.
21.	*Bauhinia variegata* L. [Leguminosae] RK 145	*Koiler*	35.82	The flowers are cooked and eaten as vegetable.
22.	*Benincasa hispida* (Thunb.) Cogn. [Cucurbitaceae] KAB 41	*Petha*	55.22	The fruits are cut in small pieces, sun- dried and used as vegetable.
23.	*Bombax ceiba* L. [Malvaceae] KAB 32	*Semar*	41.79	The flower buds are cooked and eaten as vegetable.
			28.35	The roots are boiled and eaten as vegetable.
			23.88	The wooden frame of musical instrument named "*Dhol*/*Mirdang*" is constructed from timber.
24.	*Bothriochloa bladhii* (Retz.) S.T.Blake syn. *Bothriochloa intermedia* (R.Br.) A.Camus [Poaceae] RK 81	*Sandhaur*	59.70	The plant is used as fodder.
			55.22	The leaves are used in the construction of hut.
25.	*Bothriochloa pertusa* (L.) A.Camus [Poaceae] RK 124	*Sandhaur*	50.74	The whole plant is used as fodder.
			76.11	The leaves are used in hut preparation.
26.	*Bridelia retusa (L.) A.Juss.* syn. *Bridelia squamosa* (Lam.) Gehrm. [Phyllanthaceae] RK 160	*Khaja*	73.13	The fruits are edible.
			20.88	The wooden frame of musical instrument named "*Dhol*/*Mirdang*" is constructed from timber.
27.	*Buchanania cochinchinensis* (Lour.) M.R.Almeida syn. *Buchanania lanzan* Spreng. [Anacardiaceae] KAB 31	*Piyal*	23.88	The ripen fruits are edible.
28.	*Butea monosperma* (Lam.) Taub. [Leguminosae] KAB 68	*Paras*	97.01	The leaves are used as food plates.
			64.17	Flowers gives are boiled for red colour dye. It is used for colouring of cloths.
29.	*Cajanus cajan* (L.) Millsp. [Leguminosae] KAB 76	*Rahar*	32.83	The stem without leaves is used as broom.
30.	*Calamus pseudotenuis* Becc. [Arecaceae] RK 129	*Bent*	86.56	The stem is used for making basket.
			43.28	Fish trapping instrument is prepared from stem.
31.	*Callicarpa macrophylla* Vahl [Lamiaceae] RK 162	*Daya*	88.05	The ripen fruits are edible.
32.	*Calotropis gigantea* (L.) Dryand. [Apocynaceae] KAB 192	*Akua*	17.91	The stem fiber is used for making fishing net.
33.	*Cannabis sativa* L. [Cannabaceae] KAB 115	*Bhang*	73.13	The stem fiber is used for making ropes.
34.	*Catunaregam spinosa* (Thunb.) Tirveng. [Rubiaceae] RK 169	*Mani*	50.74	The fruits are used during fishing (fish poison) as stuperfier.
35.	*Celtis australis* subsp. *caucasica* (Willd.) C.C.Towns. syn. *Celtis caucasica* Willd. [Cannabaceae] RK 143	*Karga*	80.59	The leaves are used as fodder.
36.	*Chionachne gigantea* (J.Koenig) Veldkamp syn. *Chionachne koenigii* (Spreng.) Thwaites [Poaceae] RK 166	*Lachara*	56.71	The leaves are used for hut preparation.
37.	*Chrysopogon zizanioides* (L.) Roberty syn. *Vetiveria zizanioides* (L.) Nash [Poaceae] KAB 186	*Seenk*	35.82	The inflorescence is used for making of broom.
38.	*Crotalaria juncea* L. [Leguminosae] KAB 50	*Sanai*	20.89	The stem fiber is used for making ropes.
39.	*Dalbergia sissoo* DC. [Leguminosae] KAB 4	*Shisham*	28.35	The leaves are used as fodder.
40.	*Dendrocalamus strictus* (Roxb.) Nees [Poaceae] KAB 16	*Bans*	98.50	The stem is used in hut preparation.
			43.28	The leaves are used as fodder.
41.	*Desmostachya bipinnata* (L.) Stapf [Poaceae] RK 167	*Dabh*	23.88	The leaves are used in making ropes
42.	*Digera muricata* (L.) Mart. [Amaranthaceae] RK 194	*Lehesua*	71.64	The leaves are used as vegetable.
43.	*Dillenia pentagyna* Roxb. [Dilleniaceae] RK 120	*Aggai*	46.26	The leaves are used in hut preparation.
44.	*Dioscorea bulbifera* L. [Dioscoreaceae] KAB 33	*Ratalu*	86.56	The rhizome is cooked and used as vegetable.
45.	*Diospyros malabarica* (Desr.) Kostel. syn. *Diospyros peregrina* (Gaertn.) Gürke [Ebenaceae] RK 165	*Paisi*	32.83	The fruits are used for making adornment.
46.	*Dioscorea pentaphylla* L. [Dioscoreaceae] RK 172	*Suarkand*	77.61	The rhizomes are cooked and used as vegetable.
47.	*Diplazium esculentum* (Retz.) Sw. [Woodsiaceae] RK 189	*Dhuskia*	74.62	The leaves are cooked and eaten as vegetable.
48.	*Echinochloa crus-galli* (L.) P.Beauv. [Poaceae] RK 172	*Sanwa*	58.20	The leaves used as fodder.
49.	*Ehretia laevis* Roxb. [Boraginaceae] KAB 30	*Chamror*	68.65	The branches are used as fire-wood for cooking.
50.	*Erioglossum rubiginosum* (Roxb.) Blume [Sapindaceae] KAB 56	*Anga-banga*	55.22	The ripen fruits are edible.
51.	*Eulaliopsis binata* (Retz.) C.E.Hubb. [Poaceae] KAB 164	*Bankus*	64.17	The leaves are used in making ropes.
52.	*Flemingia chappar* Benth. syn. *Flemingia chapper* Benth. [Leguminosae] RK 128	*Kusraut*	52.23	The stem is used as broom.
53.	*Glycosmis mauritiana* (Lam.) Tanaka [Rutaceae] KAB 11	*Ban nibu*	83.58	The ripen fruits are edible.

54.	*Gmelina arborea* Roxb. [Lamiaceae] RK 127	*Gamhar*	37.31	The wooden frame of musical instrument named "*Dhol/Mirdang*" is constructed from timber.
55.	*Grewia hirsuta* Vahl. [Malvaceae] KAB 55	*Gursakari*	86.56	The ripen fruits are edible.
56.	*Grewia sclerophylla* Roxb. ex G.Don [Malvaceae] KAB 53	*Dapher*	80.59	The ripen fruits are edible.
57.	*Helicteres isora* L. [Malvaceae] RK 125	*Murra*	56.71	The stem fibers are used in making ropes.
58.	*Helminthostachys zeylanica* (L.) Hook. syn. *Tectaria zeylanica* (Houtt.) Sledge [Dryopteridaceae] RK 183	*Kamraj*	74.62	The tender leaves are cooked and eaten as vegetable.
59.	*Hibiscus cannabinus* L. [Malvaceae] RK 121	*Patua*	92.53	The stem fibers are used in making ropes.
60.	*Hibiscus sabdariffa* L. [Malvaceae] KAB 20	*Patua*	88.05	The sepals are cooked and used as vegetable.
61.	*Holoptelea integrifolia* Planch. [Ulmaceae] RK 111	*Chillbil*	52.23 68.65	The leaves are used fodder. The seeds are edible.
62.	*Ichnocarpus frutescens* (L.) W.T.Aiton [Apocynaceae] RK 116	*Kalidudhi*	50.74	The vine is used in making basket.
63.	*Indigofera cassioides* DC. [Leguminosae] RK 154	*Jirhul*	88.05	The flowers are cooked and eaten as vegetable.
64.	*Ipomoea aquatica* Forssk. [Convolvulaceae] RK 159	*Karemua*	77.61	The leaves are cooked and eaten as vegetable.
65.	*Jasminum grandiflorum* L. [Oleaceae] RK 136	*Chameli*	64.17	The leaves are cooked and eaten as vegetable.
66.	*Madhuca longifolia* (J.König ex L.) J.F.Macbr. [Sapotaceae] KAB 2	*Mahua*	95.52	The dried flowers are mixed with Jaggery and fermented to prepare local whiskey named "*Daru*".
67.	*Miliusa tomentosa* (Roxb.) J.Sinclair [Annonaceae] KAB 36	*Bari kari*	38.80	The branches are used in hut preparation.
68.	*Millettia extensa* (Benth.) Baker [Leguminosae] KAB 48	*Gouj*	65.67	The root is used during fishing (fish poison) as stuperfier.
69.	*Nelsonia canescens* (Lam.) Spreng. [Acanthaceae] RK 157	*Prithvipal*	79.10	The roots are edible.
70.	*Nymphaea nouchali* Burm.f. [Nymphaeaceae] KAB 67	*Kumodhini*	73.13	The root are cooked and eaten as vegetable.
71.	*Ophioglossum reticulatum* L. [Ophioglossaceae] RK 112	*Jhibiya*	47.76	The tender leaves are cooked and eaten as vegetable.
72.	*Oryza rufipogon* Griff. [Poaceae] RK 163	*Pasi*	100	The seeds are edible.
73.	*Phalaris minor* Retz. [Poaceae] KAB 57	*Senhu*	83.58	The whole plant is used as fodder.
74.	*Phoenix acaulis* Roxb. [Arecaceae] KAB 71	*Chindi*	95.52	The root is edible.
75.	*Persicaria serrulata* (Lag.) Webb & Moq. syn. *Polygonum serrulatum* Lag. [Polygonaceae] RK 179	*Miriya*	47.76	The whole plant is used for fishing (fish poison) as stuperfier.
76.	*Rumex dentatus* L. [Polygonaceae] RK 119	*Ambavati*	35.82	The plant is used as fodder.
77.	*Saccharum officinarum* L. [Poaceae] KAB 64	*Kans*	23.88	The leaves are used for making basket.
78.	*Senna tora* (L.) Roxb. syn. *Cassia tora* L. [Leguminosae] KAB 6	*Chakwad*	16.41 55.22	The leaves are cooked and eaten as vegetable. The leaves are used as fodder.
79.	*Tamarix dioica* Roxb. [Tamaricaceae] RK 151	*Jhau*	92.53	The branches are used as broom.
80.	*Tamilnadia uliginosa* (Retz.) Tirveng. & Sastre [Rubiaceae] RK 7	*Pedar*	79.10	The unripe fruits are cooked and eaten as vegetable.
81.	*Themeda arundinacea* (Roxb.) A.Camus [Poaceae] RK 182	*Ulla*	64.17	The culms are used in hut preparation.
82.	*Trifolium alexandrinum* L. [Leguminosae] RK 178	*Bursem*	89.55	The aerial parts are used as fodder.
83.	*Typha angustifolia* L. [Typhaceae] KAB 193	*Pater*	55.22	The leaves are used for making mat.
84.	*Urena lobata* L. [Malvaceae] KAB 188	*Lapetua*	41.79	The stem fiber are used in making ropes.
85.	*Vallaris solanacea* (Roth) Kuntze [Apocynaceae] KAB190	*Bakarthana*	50.74	The vines are used in making basket.
86.	*Ziziphus oenopolia* (L.) Mill. [Rhamnaceae] RK 187	*Makoi*	83.58	The ripen fruits are edible.

DISCUSSION

During the present study 86 plant species have been found to be used by tharus as food, 13 species for fodder, 8 species for hut construction, 8 species for rope making, 4 species for broom making, 3 species for agricultural instruments, 3 species as fire-wood, 2 species for making musical instrument, 2 species for making plates, and 2 species as dye yielding (Table 1). Within 86 species of plants studied, leaves were the most commonly used plant part. Nineteen species of plants have been harvested for leaves, followed by fruits of 16 species, the root or rhizome of 9 species, the flower of 8 species, the whole plants of 7 species, the wood of 6 species, the seed of 2 species, and for aerial parts 2 species. The leaves, stem and fruits are among frequently harvested plant parts, representing about 73% of all the plant part used (Fig. 2). Herbs were the commonly used plants types (35.55%), followed by trees (Fig. 3). The plants in this study represent 38 families with prominent family being Leguminosae (16 species), followed by Poaceae (13 species), Malvaceae (7 species), Phyllanthaceae (3 species) and rest of the families are represented by two or one species. The Leguminosae and Poaceae are prominent may be due to frequent use in food and fodder. Weediness and large food reserve in members of these families is also a major factor for selection of food and fodder by indigenous people[39-40].

Informant consensus factor (Fic) and Frequency of citation

The data were evaluated by two quantitative statistical tools of ethnobotany: informant consensus factor (Fic) and frequency of citation. The major aim of the statistical analysis was to identify the popular plants among Tharu tribes. The frequency of citation was very high for *Alstonia scholaris* (fire-wood), *Antidesma acidum, Artocarpus lakoocha* (edible), *Bauhinia vahlii,*

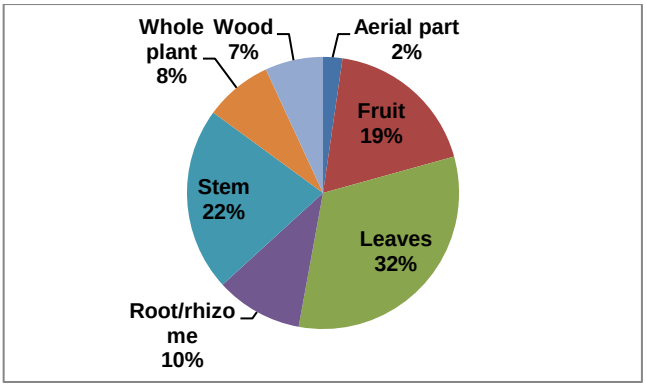

Fig. 2: Percentage of the plant part(s) used by Tharus in day-to-day activities.

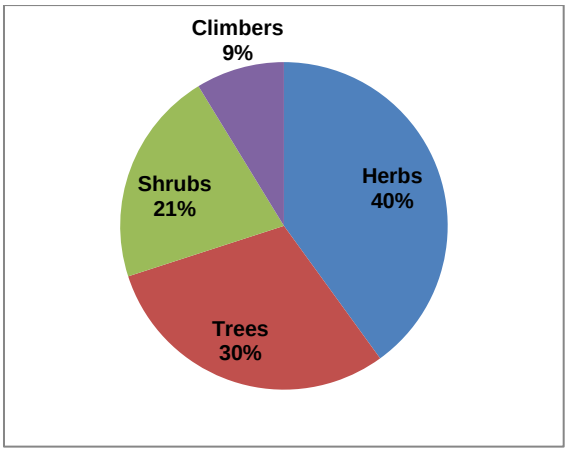

Fig. 3: Percentage distribution of life form of useful plants of Tharus

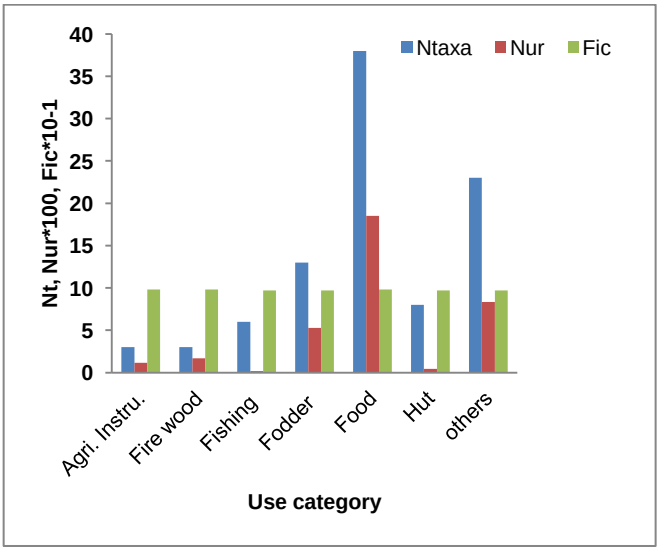

Fig. 4: Use category of plants, number of taxa (Ntaxa/Nt), number of usage category (Nur) and their informant consensus factor (Fic).

Butea monosperma (food plate), *Dendrocalamus strictus* (hut preparation), *Hibiscus cannabinus* (rope), *Oryza rufipogon* (food), *Phoenix acaulis* (edible) and *Tamarix dioica* (broom). It has been observed that most of the edible plants have relatively high frequency of citation. (table 1). The conservation related aspects are not included in present study because the species recorded during the investigation are not mentioned in red-data book of plants[41, 42].

The Fic technique was applied to calculate the consensus of informants for the treatment of a certain use category[37]. In our study, the Fic value ranges from 0.97 to 0.98, with a high value for Fic indicating greater agreement among informants for use of species for certain use category (Fig. 4). The frequency of citation technique was used to figure out the level of consensus among informants for a particular species for particular use (Table 2). The species having high informant's citation and informant agreement value are economically significant. Such species have potential to serve mankind in near future.

CONCLUSIONS

In this study, 86 species of plants have been identified and documented. Informants used these plants for food, fodder, fire-wood, fishing, hut preparation, basket & ropes making, food serving plates, preparation of agricultural and musical instruments. Quantitative data analysis revealed that there is a great agreement among informants for *Alstonia scholaris* (fire-wood), *Antidesma acidum, Artocarpus lakoocha* (edible), *Bauhinia vahlii, Butea monosperma* (food plate), *Dendrocalamus strictus* (hut preparation), *Hibiscus cannabinus* (rope), *Oryza rufipogon* (food), *Phoenix acaulis* (edible), *Tamarix dioica* (broom). Since uses of these species are time-tested, they may play role as major economic plants in future.

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