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Research Article

ETHNOMEDICINAL PRACTICES BY THARU ETHNIC COMMUNITY IN RUPANDEHI AND NAWALPARASI DISTRICTS, WESTERN NEPAL

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ABSTRACT

Tharus are the marginalized indigenous people of Nepal. This study was carried out using Participatory Rural Appraisal (PRA), Rapid Rural Appraisal (RRA), and Focus Group Discussion (FGD) from 2019 to 2020. The ethnomedicinal data were collected using a semi-structured interview with 75 key informants, local healers, and *Guruwas*. A total of 74 plants, belonging to 39 families, for the treatment of 11 categories of ailments, were documented. The highest informant consensus factor (F_{IC}) value was for respiratory troubles (0.84), followed by the skeletomuscular disorder (0.83), and dermatological trouble (0.82). The highest frequency of citation (%) was found in *Azadirachta indica* (90 %), followed by *Calotropis gigantea* (67 %), *Euphorbia antiquorum* (67 %), and *Rauvolfia serpentina* (51 %). Fabaceae (6 spp.) was the most dominating family; herbs (47 %) the most frequently used life forms; leaves (32 %) the most frequently used plant part, and juice (30 %) being the most widely preferred mode of drug preparation. Different parts of the plant species were used for the treatment of more than one ailment using a different mode of drug preparation, and a single species was used to treat more than one ailments. The high average F_{IC} value (0.72) showed that there was a higher agreement among the informants for the use against certain categories of ailments. Some plants like *Rauvolfia serpentina*, *Piper longum*, and *Asparagus racemosus* need a proper conservation strategy, as their population is decreasing in this area.

Keywords: Ailments, Ethnomedicine, Ethnic community, Nepal, Tharu.

INTRODUCTION

The ecosystems of Nepal are significantly diversified (Chaudhary, 1998; Subedi, 2004), producing a wide range of unique and valuable medicinal plant resources. The country supports 6653 species of flowering plants, out of which over 701 species have medicinal uses (DPR, 2012), about 50 % are the rubrics "useful" and "ethnobotanical" (Uprety *et al*., 2010; Kunwar & Bussmann, 2008) and about 22-50 % are ethnomedicinal (Manandhar, 2002; Kunwar *et al.*, 2006). Nepal is considered an important place for a diverse medicinal plant and other non-timber forest products (NTFP) species. Among different plant resources, medicinal and aromatic plants play a vital role in the livelihood of rural people from local healthcare and socioeconomic prospects. They depend on traditional medicinal practices, mostly plant drugs, for their primary health care needs, using cheap and easily available plant products. About 80 % of the world's population depends on traditional medicine for their primary healthcare needs since ancient times (WHO, 1993). The use of herbal medicines in Nepal represents a long history of human interactions with the environment.

There is direct relation of ethnomedicine in the conservation of natural resources. Besides, it has relevance in the conservation of genetic resources. The knowledge of ethnobotany is at risk because of lack of written documents and a decrease in the practice of using wild resources (Shrestha, 1985). Modern medicine (allopathy) has limited the use of ethnomedicinal practices to a few groups of people, traditional healers, and ethnic peoples. Therefore, a documentation of useful plants and their ethnomedicinal information is urgently required for the conservation and proper utilization of these plant resources. Plants used for traditional medicine contain a wide range of substances that can be used to treat chronic as well as infectious diseases (Duraipandiyan *et al.*, 2006). On the other hand, systematic screening of folk medicine may result in the discovery of novel effective compounds (Tomoko *et al*., 2002).

Nepal is a multi-ethnic, multi-lingual, and multi-religious country with about 126 ethnic groups speaking about 123 languages (Bista, 2004; CBS, 2012). The Tharus are the inhabitants of the Tarai between the Mahabharata ranges and Indian plains, which used to be uninhabited dense forest due risk of malaria epidemic. The Tharus are one of the major ethnic groups, mostly inhabiting along entire Tarai and inner Tarai region, over the 20 different districts of Nepal. They are recognized as the marginalized indigenous people by the Government of Nepal. They represent 6.6 % (1.7 million) of Nepal's total population (CBS, 2011). Most of them are illiterate and are devoid of modern facilities of development. They have a distinct language, culture, folklore, rituals, customs, and lifestyles. *Guruwas* and healers are the best-known people for using plants to treat various diseases. Due to anthropogenic factors, both natural resources and Tharu culture are depleting at an alarming rate, therefore, there is an urgent need to explore and document this unique and indigenous knowledge before it is lost forever.

Some ethnobotanical studies of Tharus have been carried out in Nepal (Dangol & Gurung, 1991; Muller-Boker, 1993; Kumar *et al*., 2006; Acharya & Acharya, 2009; Ghimire & Bastakoti, 2009, Gachhadar, 2010; Joshi & Singh, 2010; Singh *et al*., 2011; Bhattarai & Acharya, 2013; Kumar *et al*., 2013; Singh & Hamal, 2013; Kumar & Bharati, 2014; Singh, 2017). This paper attempts to document an important ethnomedicinal indigenous knowledge for the pattern of utilization of medicinal plants to cure different types of ailments and diseases by an ethnic community dominated by the Tharus and to collect detailed information on the plant parts utilized, their uses, mode of preparation, and dosage. It also assesses the Frequency of citation (%) and informant consensus factor (F_{IC}) of valuable medicinal plants.

MATERIALS AND METHODS

Sampling technique and sample selection

Rupandehi and Nawalparasi (Bardaghat-Susta west) Districts lie in Lumbini province, in the southern part of Nepal. Rupandehi District includes one sub-metropolitan city, five municipalities, and ten rural municipalities. Similarly, the Nawalparasi District (Bardaghat-Susta west) includes three municipalities and four rural municipalities (Fig: 1). Various castes like Brahmin, Magar, Tharus, Musalman, Yadav, Chhetri live in these districts.

A stratified sampling technique was applied in this study. At first, the two municipalities (i.e. Tilottama and Devdaha) and one rural municipality (Rohini) of Rupandehi District, and the three rural municipalities (i.e. Sarawal, Pratappur, and Palhinandan) of Nawalparasi District (Bardaghat-Susta west) were selected based on the settlement of Tharu community, purposively. It was carried out with the help of census data (CBS, 2012) of the two districts. As a result, a total of 2 municipalities and 4 rural municipalities were selected. Most of the selected municipalities and rural municipalities lie in the southern part of Nepal at the border of Nepal and India.

A total of 58 strata (wards) were selected from 2 municipalities and 4 rural municipalities. From these strata (wards), a total of 15 samples (wards) were selected based on the settlement of Tharu community, viz. ward 17 in Tilottama Municipality; ward 11 in Devdaha Municipality; wards 2, 3, 5, 6, 7 in Rohini Rural Municipality, ward 1 in Sarawal Rural Municipality; wards 4, 5, 6 in Pratappur Rural Municipality; and wards 1, 2, 5, 6 in Palhinandan Rural Municipality. A total of 75 (40 male, 35 female) Tharu (key informants), who possess the knowledge of local medicinal plants, were selected by simple random sampling from the list of Tharus to collect detailed information on the medicinal plants. Though sampling areas lie in the two districts, they are adjoining continuous stretch of land in the Tarai region.

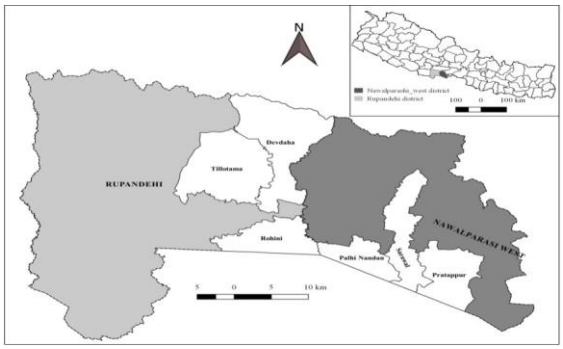

Fig. 1. Location map of the study area

Ethnomedicinal data collection

At the first stage, a field survey was conducted in the study area to identify and enumerate the commonly used ethnomedicinal plants by the Tharu community through transect forest walks, discussion with local healers, plant sample displaying method, and focus group discussions. Then, the ethnomedicinal data for plant parts used, mode of drug preparation, usage, application, dosage, etc. were collected using Participatory Rural Appraisal (PRA) (Martin, 1995) as well as Rapid Rural Appraisal (RRA) (Chaudhary, 1998) which includes a discussion with key informants, mainly local healers, *Guruwas*, and knowledgeable villagers through semi-structured interviews. The study was conducted by in three different seasons (spring, rainy, and winter) between the years 2019-2020 in the Rupandehi and Nawalparasi Districts (Bardaghat-Susta west). The uses of the plant species were verified in other villages by cross-checking the information with other respondents showing plant species in natural habitat or a collected sample. The data were considered valid if at least five informants provided similar uses about the medicinal plants.

Plant collection, herbarium preparation and identification

All the plant specimens were collected from the study area and used for voucher specimen preparation. The three sets of plant specimens for each species were collected from the natural habitats, tagged, dried, and mounted as voucher herbarium specimens following the standard techniques (Lawrence, 1967). Identification of specimens was confirmed with the help of experts and standard literature (Bhatt *et al.*, 2017; Grierson & Long, 1983; Hooker, 1875), website (www.Efloras.org, accessed on 3/15/2020), and tallyed with the herbarium specimens at the National Herbarium and Plant Laboratories, Godawari (KATH), and Tribhuvan University Central Herbarium (TUCH), Kirtipur. The voucher specimens were deposited at the Department of Botany, Butwal Multiple Campus, Butwal. The nomenclature and classification of plants were followed according to the website (www.theplantlist.org, accessed on 4/25/2020).

Data analysis

The collected data were analyzed using Microsoft Excel 2007 program for parts used, mode of preparation, types of ailments, and life forms of plants. The frequency of citation for each medicinal plant species was calculated using the following formula:

$$\text{Frequency of citation (\%)} = \frac{N}{T} \times 100 \quad (1)$$

Where, N is the number of informants who cited the particular species as medicine, and T is the total number of informants interviewed. The most popular or widely used species among the people will have the highest number for citation frequency. The informant consensus factor (F_{IC}) or the informant agreement ratio (IAR) was used to determine the consensus between informants for the treatment of a certain use category. The F_{IC} value indicates the relative degree of a culture-bound syndrome of the selection of a set of medicinal plants used in the treatment of a certain illness category. It was calculated as the number of use-reports in each category (N_{ur}) minus the number of species used (N_t) in each category, divided by the number of use-reports in each category minus 1, as given in equation (2) (Collins *et al.*, 2006; Trotter & Logan, 1986; Heinrich *et al*., 1998; Andrade-Cetto, 2009).

$$F_{IC} = \frac{N_{ur} - N_t}{N_{ur} - 1} \quad (2)$$

F_{IC} values range between 0 and 1, which was developed for identifying potentially effective medicinal plants. A high F_{IC} value (close to 1) indicates greater agreement among informants for uses of species for certain categories of ailments. In other words, a high value indicates that relatively few species are used by a large proportion of the people, while a low value indicates that the informants disagree on the species to be used in the treatment within a category of illness (Heinrich *et al*., 1998).

RESULTS AND DISCUSSION

Documentation of ethnomedicinal plant species

A total of 74 plant species, belonging to 39 families, used by the Tharu community as ethnomedicine for the treatment of various ailments was documented from the study area, detailing their family, voucher number, Tharu name(s), plant part(s) used, ailments treated, frequency of citation (%), life forms, mode of preparation, and dosage (Table 1). Among them, one species was pteridophyte, 15 spp. were cultivated, and 58 spp. were harvested from the wild. It showed that people depend on the natural environment to fulfill their primary healthcare and other basic requirements. *Allium sativum, Carica papaya, Curcuma longa, Momordica charentia, Musa paradisiaca, Trigonella foenum-graceum, Zingiber officinale, etc* were cultivated in their field for spices, fruits, or vegetable, but also used for medicinal purposes. They do not cultivate these plants for medicinal use on large scale. They use some high altitude medicinal plants viz. *Rhododendron arboreum*, *Rheum australe*, and *Swertia chirayita*, to cure ailments. Ghimire and Bastakoti (2009) reported the three plant species (*Santalum album*, *Dactylorhiza hatagirea*, and *Rhododendron arboretum*) used by the Tharus in Nawalparasi district. These valuable plants were collected from middle hills and high mountains or Himalayan region by small traders. Fabaceae was the most prominent family (6 spp.), followed by Asteraceae (4 spp.), Apocynaceae (4 spp.), Lamiaceae (4 spp.), Moraceae (4 spp.), Malvaceae (3 spp.), etc. Other researchers also reported that Fabaceae was the dominant family in their study area (Bhattarai & Acharya, 2013; Kumar *et al*., 2013).

It was found that the plant species used, parts used, method of drug preparation by the Tharus was more or less similar to the reports of an earlier study done in Chitwan, Dang-Deokhuri, Nawalparasi, Kanchanpur, Eastern Nepal, and Parroha/ Rupandehi in Nepal (Manandhar, 1985; Dangol & Gurung, 1991; Muller-Boker, 1993; Ghimire & Bastakoti, 2009; Acharya & Acharya, 2009; Gachhadar, 2010; Joshi & Singh, 2010). Some common plants (19 spp.) used by the Tharus in these parts of Nepal were *Achyranthes aspera*, *Artemisia dubia*, *Asparagus racemosus*, *Azadirachta indica*, *Calotropis gigantea*, *Cleome viscosa*, *Clerodendrum infortunatum*, *Cuscuta reflexa*, *Dalbergia sissoo*, *Eclipta prostrata*, *Ficus racemosa*, *Justicia adhatoda*, *Piper longum*, *Psidium guajava*, *Rauvolfia serpentina*, *Ricinus communis*, *Shorea robusta*, *Terminalia bellirica*, and *Terminalia chebula*. But the usage, method of drug preparation, method of drug administration & dosage, etc were not found to be exactly similar in the Tharus of Nepal.

Out of total documented plant species, the majority were herbs (47 %.), followed by trees (32 %), shrubs (16 %), & climbers (5 %) (Fig. 2). The Tharu community preferred to use herbs for medicinal purposes than other sources due to easy access and maybe the presence of more active compounds. Traditional healers preferred to use herbs than other sources, due to comparatively ease in collection from deep forest areas, and ease of cultivation for further use (Faruque *et al*., 2018). Several researchers (Gacchadar, 2010; Singh *et al*., 2012; Bhattarai & Acharya, 2013; Kumar & Bharati, 2014; Faruque *et al*., 2018; & Ambu *et al*., 2020) also reported that the most widely used form of plants for medicinal purposes was herbs. The Tharus use different parts of the plant for the treatment of ailments. Leaves were the most frequently used parts (32 %), followed by stems (16 %), barks (11 %), fruits (9 %), seeds (9 %), roots/rhizomes/tuberous roots (13 %), bulbs (2 %), young shoots (2 %), and whole

plants (2 %), (Fig. 3). According to other researchers, the most frequently used plant parts were leaves (Kumar & Bharati, 2014; Poudel & Singh, 2016; Faruque *et al.*, 2018); fruit and seeds (Acharya & Acharya, 2009); whole plant (Singh *et al*., 2012); root/rhizome/bulb (Ghimire & Bastakoti, 2009; Ambu *et al*., 2020) for medicinal purposes. Leaves may contain more active compounds and comparatively it is easy for phytochemical and pharmacological studies compared to other parts (Faruque *et al*. 2018). They use younger and fresher leaves than mature leaves to prepare drugs.

Table 1. Medicinal plants with their names, life forms, uses, parts used, mode of preparation and dosage

Species [Family]: Collection No.	Tharu /Local name	*Life form	Freq. citation (%)	Plant parts: uses	Preparation mode	Application & dosage
Abrus precatorius L. [Fabaceae]: CB0179	Tairi	C	28	Seeds & young shoots: Fever & typhoid	-Infusion	Oral: ½ glass × 2 × 5 days
Acacia arabica (Lam.) Willd. [Fabaceae]: CB0133	Babur	T	25	Small branch: tongue rashes	-Toothbrush	External: 1 piece × 2 × 15 days
				Leaves: Gastritis	-Juice	-Oral: ½ glass× 2 × 7 days
Achyranthes aspera L. [Amaranthaceae]: CB0145	Chidchira	H	37	Leaves: boils & sprain sacrum and backbone	-Paste	-External: 4-5 drops × 3 × 7 days
				Roots: gastritis & piles	-Infusion	-Oral: ½ glass × 2 ×15 days
Acmella calva (DC.) R.K. Jansen, [Asteraceae]: CB0124	Chunchun	H	25	Flower: mouth & throat sore, leucorrhea	-Infusion	-Oral: ½ glass× 3 × 14 days
				Leaves: human papilloma	-Paste	-External: 4-5 drops × 4 × 20 days
Acorus calamus L. [Acoraceae]: CB0134	Ghodbachh	H	44	Rhizome: cough, asthma & sore throat	- Chew raw	-Oral: 1 piece × 3× 7 days
Aegle marmelos (L.) Correa, [Rutaceae]: CB0159	Bel	T	44	Fruit pulp: reduce body heat, constipation, and diarrhea	-Juice	- Oral:1 glass× 2 × 7 days
Ageratum conyzoides (L.) L., [Asteraceae]: CB0135	Kukurawana	H	42	Leaves: stop bleeding at cut body parts	-Juice	-Oral: 1 teaspoonful × 3 × 5 days
Aloe vera (L.) Burm.f. [Xanthorrhoeaceae]: CB0123	Ghiukumari	H	53	Leaves: burnt body part & headache	-Juice	-External: 2 teaspoonfuls × 2× 7 days
				Leaves: indigestion & gastritis	-Juice	- Oral: 1 glass × 1×7 days
Allium sativum L., [Amaryllidaceae]: CB0178	Lasun	H	25	Bulb: ringworm infection, eczema, allergy	-Paste	- External: 4 drops × 2 × 15 days
Annona crassiflora Mart., [Annonaceae]: CB0165	Sarifa	T	21	Leaves: diabetes	-Infusion	-Oral: 1 glass × 2× 15 days
Argemone mexicana L., [Papaveraceae]: CB0113	Bharbanda Kanta	H	28	Stem: eye irritation/infection	-Latex	-External: 4 drops × 2 × 3 days
				Seeds: skin allergy,	-Paste	-External: 4 drop× 2

				eczema		× 7 days
Artemisia dubia L. ex B.D. Jacks, [Asteraceae]:CB0131	Dawana	H	32	Leaves: ringworms, skin allergy, nasal rashes, and headache	-Juice	-External: 4-5 drops × 2 × 5 days
Asparagus racemosus Willd., [Asparagaceae]: CB0166	Santawar	H	46	Tuberous root: fever & typhoid, a tonic for lactating mother	-Juice	-Oral: 1 glass× 2 × 15 days
Azadirachta indica A. Juss., [Meliaceae]: CB0164	Neem	T	90	Leaves: anthelmintic & fever	-Decoction	-Oral: ½ glass× 2 × 5 days
				Flower: Diarrhea & dysentery	-Decoction	- Oral: $^{1}/_{2}$ glass × 2 × 5 days
				Stem bark: cut, wound & burnt body parts	-Paste	-External: 4 drops × 3 × 7 days
Bambax ceiba L., [Malvaceae]: CB099	Semar	T	40	Stem bark: furuncles (pilo) and boils	-Paste	-External: 4-5 drops × 3 × 7 days
				Root: spermatorrhea (Dhatu rog) in man	-Juice	- Oral: 150 ml.× 1 × 15 days
Bryophyllum pinnatum (Lam.) Oken, [Crassulaceae]: CB067	Pattharchatti /Amarbel	H	44	Leaves: kidney stone, urinary bladder stone, dysentery & diarrhea	-Infusion	-Oral: 1 glass× 3 × 7 days
Calotropis gigantea (L.) Dry and, [Apocyanaceae]: CB098	Madar	H	67	Stem: toothache, ringworm infection, and boils	-Latex	-External: 4-5 drops × 2 × 7 days
				Leaf: Sprain & fractured body parts	-Bandage with oil	- External: Few leaves × 1 × 10 days
Carica papaya L., [Caricaceae]: CB065	Papita	T	28	Ripe fruit: jaundice	-Raw	- Oral: 1 fruit × 1 × 15 days
				Stem: ringworm infection	-Latex	-External: 4-5 drops × 2 × 15 days
				Root: kidney stone	-Infusion	- Oral: 1 glass × 2 × 15 days
Centella asiatica (L.) Urb., [Apiaceae]: CB080	Ghodtap	H	37	Leaf: reduce body heat, indigestion, gastritis, and leucorrhoea in females.	-Infusion	-Oral: ½ glass× 1 × 10 days
Cleome viscosa L., [Cleomaceae]: CB066	Hurhur	S	25	Leaf: ear infection	-Juice	-External: 3-4 drops × 3 × 5 days
Clerodendrum infortunatum L., [Lamiaceae]: CB005	Bhant	S	25	Leaf: wound	-Juice	-External: 4-5 drops × 3 × 7 days
				Stem: removes foul breath and kills germs	-Toothbrush	-External: 1 piece × 2 × 30 days
Curcuma longa L. [Zingiberaceae]: CB025	Haldi	H	28	Rhizome: common cold, cough, and fever	-Decoction	-Oral: 1 glass ×2 × 3 days
				Rhizome: wound	-Powder with oil	-External: 1 spoonful × 3× 7 days

Cuscuta reflexa Roxb., [Convolvulaceae]: CB069	Aakashbabar	C	35	Whole plant: jaundice	-Infusion - Bath	-Oral: 1 glass × 2 × 15 days -External: 1 bucket soaked water with plant × 1 × 7 days
Cynodon dactylon (L.) Pers., [Poaceae]: CB026	Dubo	H	28	Leaves: stop bleeding at cut body parts	-Juice	-External: 5 drops × 3 × 3 days
Cyperus rotundus L., [Cyperaceae]: CB081	Motha	H	25	Rhizome: boils & ringworm infection	-Decoction with mustard oil	-External: 1 teaspoonful × 3 × 15 days
Dalbergia sissoo DC., [Fabaceae]: CB070	Sisau	T	25	Leaves: reduce body heat	-Bath	-External: 1 bucket soaked water with leaves in clay pot × 2 × 3 days
Datura metel L., [Solanaceae]: CB0132	Dhaturo	H	25	Leaves/ seeds: rheumatism or gout	-Decoction with garlic & oil	-Oral: ½ glass × 2 × 10 days
Drimia indica (Roxb.) Jessop, [Asparagaceae]: CB0134	Banpiyaj	H	60	Bulb: rheumatism or gout	-Paste with oil	-External: 2 teaspoonfuls × 2 massage × 15 days
Eclipta prostrata (L.) L., [Asteraceae]: CB071	Bhangraiya	H	53	Leaves: fungal infection due to mud at sole and feet	-Juice	-External: 1 teaspoonful × 3 × 10 days
Equisetum arvense L., [Equisetaceae]: CB027	Hadjur	H	21	Whole plant: leucorrhea in women and spermatorrhea in man.	-Infusion	-Oral: 1 glass × 2 × 15 days
Euphorbia antiquorum L., [Euphorbiaceae]: CB078	Sihud	S	67	Leaf: cough and bronchitis.	-Juice	-Oral: ½ glass× 2 × 5 days
Ficus benghalensis L., [Moraceae]: CB077	Bargat	T	35	Stem: toothache, boils, mumps, and eye infection. Prop root: gastritis	-Latex -Powder	-External: 4-5 drops × 3 × 3 days -Oral: 10 gm. × 1 × 7 days
Ficus racemosa L., [Moraceae]: CB0198	Gular	T	25	Stem: toothache, boils, and mumps Stem bark: spermatorrhea	-Latex -Juice	-External: 4-5 drops × 3 × 7 days -Oral: ½ glass × 2 × 7 days
Ficus religiosa L., [Moraceae]: CB0100	Pipal	T	21	Stem bark: diarrhea and dysentery	-Infusion	-Oral: ½ glass × 2 × 5 days
Holarrhena pubescens Wall. ex G. Don, [Apocynaceae]: CB0105	Kachari	T	37	Stem bark: gastritis, diarrhea, and indigestion	-Powder	-Oral: 15 gm. × 2 × 5 days
Ipomoea carnea	Behaya	S	35	Stem: boils, mumps,	-Latex	-External: 4-5 drops

Jacq., [Convolvulaceae]: CB107				wounds, and at the sole to withdraw spines		× 3 × 5 days
Ipomoea aquatica Forssk., [Convolvulaceae]: CB0120	Kermuwa	H	23	Leaves: boils, wounds, allergy, and eczema	-Paste	- External: 4-5 drops × 3 × 7 days
Jatropha curcas L., [Euphorbiaceae]: CB0114	Bhakrend	S	58	Stem: boils appeared in tongue, mouth, and lips	-Latex	- External: 4-5 drops × 3 × 7 days
				Stem: teeth infection & toothache	-Toothbrush	- 1 piece × 2 × 7 days
Justicia adhatoda L., [Acanthaceae]: CB0102	Aarush	S	25	Leaves: cough, bronchitis, and asthma	-Decoction	-Oral: ½ glass × 2 × 10 days
Lawsonia inermis L., [Lythraceae]: CB075	Mehandi	S	32	Leaves: headache	-Infusion	-External: 1 glass × 1 × 2 days
				Seeds: dysentery, diarrhea, and diuretic	-Powder	-Oral: 1 spoonful × 2 × 5 days
Lagerstroemia parviflora Roxb., [Lythraceae]: CB051	Ashidhaha	T	23	Stem: leucorrhea in women	-Sap released from stem	-Oral: ½ glass × 2 × 7 days
Leucas aspera (Willd.) Link, [Lamiaceae]: CB0115	Gumma	H	46	Leaves: appetizer, gastritis, indigestion, asthma.	-Tablet	-Oral: 1 tablet × 2 × 7 days
Melia azedarach L., [Meliaceae]: 009	Bakain	T	32	Stem bark: gastritis, anthelmintic	-Juice	-Oral: ½ glass × 2 × 7 days
				Stem: toothache	-Toothbrush	-External: 1 piece × 2 × 10 days
Mentha spicata L. [Lamiaceae]: CB006	Pudina	H	25	Leaves: diarrhea and dysentery; reduces body heat	-Juice	-Oral: 3 teaspoonful × 2 × 7 days
Mimosa pudica L. [Fabaceae]: CB008	Lajainikhar	H	25	Root bark: piles	-Infusion with black pepper, & barley	-External: ½ glass × 2 × 15 days
Momordica charentia L., [Cucurbitaceae]: CB012	Karela	C	30	Leaves: ear infection	-Juice	-External: 5 drop × 4 × 5 days
				Root: piles	-Infusion with black pepper	-External: 3 teaspoonfuls × 2 × 15 days
Musa paradisiaca L., [Musaceae]: CB015	Kera	H	35	Unripe fruit: diarrhea	-Raw with salt	-Oral: 1 fruit × 3 × 3 days
Ocimum tenuiflorum L., [Lamiaceae]: CB033	Tulsi	H	53	Leaves: common cold, cough, and fever.	-Decoction with turmeric	-Oral: 1 glass× 2 × 5 days
				Leaves: ear infection	-Juice	-External: 4 drop × 3 × 3 days
Oxalis corniculata L., [Oxalidaceae]:	Amita/Amlol	H	21	Leaves: diarrhea and dysentery	-Infusion with salt	-Oral: 4 spoonfuls × 2 × 5 days

CB018						
Phyllanthus emblica L., [Phyllanthaceae]: CB042	Aawara	T	25	Fruits: gastritis and tonic	-Powder	-Oral: 10 gm. × 2 × 15 days
Piper longum L., [Piperaceae]: CB045	Pipari	C	39	Fruit: cough and bronchitis	-Powder	-Oral: 10 gm. × 2 × 10 days
Piper nigrum L., [Piparaceae]: CB035	Marich	C	25	Fruit: cough, and bronchitis	-Powder	-Oral: 10 gm.× 2 × 7 days
Psidium guajava L., [Myrtaceae]: CB050	Amrut	T	25	Young shoot: diarrhea and dysentery	-Juice	-Oral: 3-4 teaspoonful × 2 × 7 days
Pterocarpus marsupium Roxb., [Fabaceae]: CB034	Bijjiya	T	21	Stem/heartwood: diabetes	-Infusion made soaking stem in water overnight	-Oral: 1 glass × 1 × 15 days
Punica granatum L. [Lythraceae]: CB122	Anar	T	28	Flower and bark of fruits: diarrhea & dysentery	-Juice	-Oral: ½ glass × 2 × 7 days
Rauvolfia serpentina (L.) Benth. Ex Kurz, [Apocyanaceae]: CB143	Dhebarbaruwa	S	51	Root: fever and typhoid	-Infusion	-Oral: 1 glass × 2 × 7 days
Ricinus communis L., [Euphorbiaceae]: CB152	Rend	S	58	Leaves: sprain limbs, swelling joints, chest pain due to cough	-Bandage applying mustard oil on warmed leaves in the fire	-External: 2-3 warm leaves × 3 × 7 days
Rheum australe D.Don., [Polygonaceae]: CB054	Padamchal	H	25	Rhizome: cut, wound	-Paste with turmeric & oil	-External: 1 teaspoonful × 3 × 10 days
Rhododendron arboreum Sm., [Ericaceae]: CB0180	Laligurans	T	21	Flower: leucorrhea in women, piles	-Infusion	-Oral: ½ glass × 2 × 15 days
Saccharum officinarum L., [Poaceae]: CB056	Ukhu	S	25	Stem: jaundice	-Juice	-Oral: 1 glass × 2 × 15 days
Sesamum indicum L. [Pedaliaceae]: CB0181	Aalas	H	21	Seeds: burn	-Paste with mustard oil	-External: 5 drop × 3 × 7 days
Shorea robusta Gaertn, [Dipterocarpaceae]: CB0160	Shakhuwa	T	25	Stem bark: large boils and blisters	-A sticky paste made boiled with oil	-External: 5 drop × 2 × 8 days
Sida acuta Burm.f., [Malvaceae]:	Bariyar	S	53	Leaves: boils and wounds	-Juice	-External: 1 teaspoonful × 3 × 10

CB058						days
Solanum americanum Mill., [Solanaceae]: CB068	Bhumhuru	H	23	Leaves: cut and wound	-Juice	-External: 1 teaspoonful × 3 × 14 days
Solanum virginianum L., [Solanaceae]: CB076	Bhatkotaya	H	32	Seeds: toothache	-Decoction	-External: ½ glass × 3 gargles × 7 days
				Seeds: toothache	-Smoke from burnt seeds	-External: 2 times smoke × 7 days
Streblus asper Lour., [Moraceae]: CB082	Sihor	T	32	Stem: toothache	-Toothbrush	-External: 1 piece × 3 × 7 days
Swertia chirayita (Roxb.) Buch-Ham. ex. C.B. Clarke, [Gentianaceae]: CB095	Chirayito	H	25	Whole plant: fever & typhoid	-Decoction	-Oral: 1 glass × 2 × 7 days
Syzygium cumini (L.) Skeels, [Myrtaceae]: CB084	Jamun	T	32	Seeds: diabetes	-Powder	-Oral: 10 gm. × 2 × 30 days
				Stem bark: diarrhea, & dysentery	-Juice	-Oral: ½ glass × 2 × 5 days
Terminalia bellirica (Gaertn.) Roxb., [Cobretaceae]: CB0182	Bahera	T	23	Fruit: gastritis, colic pain & an appetizer	-Powder	Oral: 15 gm. × 2 × 15 days
Terminalia chebula Retz., [Cobretaceae]: CB096	Harad	T	44	Fruit: gastritis, appetizer, and cough	-Powder	-Oral: 15 gm. × 2 × 15 days
Thevetia nerrifolia Juss ex Steud., [Apocynaceae]: CB0184	Kanaili	S	35	Leaves: ear infection & conjunctivitis	-Juice	-External: 4-5 drops × 4 × 5 days
Trigonella foenum-graceum L., [Fabaceae]: CB005	Methi	H	25	Seeds: gastritis and indigestion	-Infusion	-Oral: 1 glass × 1 × 15 days
Triumfetta rhomboidea Jacq., [Malvaceae]: CB001	Bishkhopada	H	25	Leaves: allergy in fingers	-Juice	-External: 1 teaspoonful × 3 × 7 days
Zingiber officinale Roscoe, [Zingiberaceae]: CB0197	Aduwa	H	28	Rhizome: common cold, cough, and fever	-Decoction made with turmeric, basil, pepper	-Oral: 1 glass × 2 × 5 days

*Abbreviations: * H-Herb, S-Shrub, T-Tree, C- Climber, CS- Climbing shrub; All the quantities are approximate equivalent quantity in gm., ml. and liter; ½ glass=100 ml., 1 teaspoonful= 5 ml., 4-5 drops= 2 ml., 1 bucket=20 ltr.; 1×1 (once a day), 2×1 (twice a day), 3×1 (thrice a day), 4×1 (four times a day).*

The Tharus use different parts of the same plant in some cases for the treatment of different ailments, viz. leaves: anthelmintic & fever; flower: diarrhea & dysentery; stem bark: cut, wound & burnt body parts in *Azadirachta indica*; ripe fruit: jaundice; stem (latex): ringworm infection; root: kidney stone in *Carica papaya*, etc.People use different parts of the same plants for different ailments (Gachhadar, 2010; Rokaya, 2012). It shows that the healers of the Tharu community have knowledge that

different plant parts possess different components useful for the treatment of a particular problem/ailment.

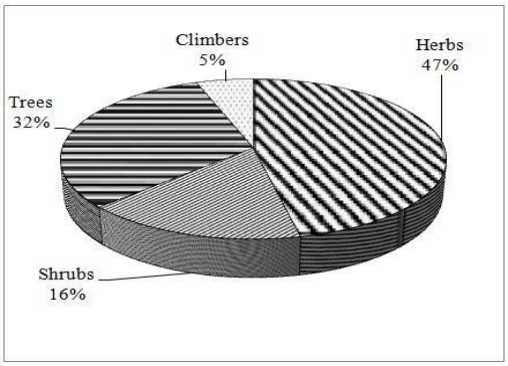

Fig. 2. Life forms of documented medicinal plants.

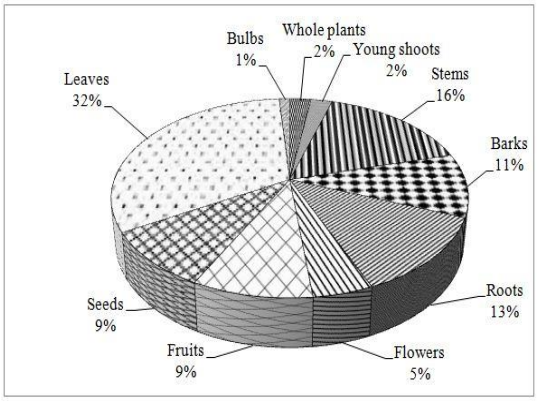

Fig. 3. Percentage of parts used in documented medicinal plants.

Mode of drug preparation

The Tharu community uses different methods of drug preparation such as infusion, decoction, juice, powder, tablet, etc. for the treatment of ailments. The most frequently used mode of drug preparation was juice (30 %), followed by infusion (16 %), powder (13 %), paste (11 %), decoction (8 %), tablet (1 %), and others (21 %) (Fig. 4). Other category of a mode of drug usage represented the latex, toothbrush, bandage, raw eating, sap, smoke, and massage. They also use a different mode of drug preparation for different parts of the same plant species in some cases viz. seeds: powder, bark: juice in *Syzygium cumini*; leaves: juice, root: infusion in *Momordica charentia*; leaves: paste, roots: infusion in *Achyranthes aspera*, based on the nature of the plant parts and ailments.

The juice is a natural fluid, which is extracted from a plant or one of its parts by crushing and squeezing. Most of the Tharus use juicing (30 %) as a method of drug preparation which is easier to prepare and more efficient than other methods. It can be prepared at high concentrations at any time by mixing with other ingredients and does not need sophisticated tools. This method of preparing local drug is effective in the small amount due to its high concentration, thus, helping in plant conservation. This method of drug preparation has been reported previously (Singh *et al*., 2012; Kumar & Bharati, 2014; Rai & Singh, 2015; Poudel & Singh, 2016; Singh, 2017; Ambu *et al*., 2020). Islam *et al.* (2014) reported that juice extraction is the second-highest mode of preparation in their study. Infusion is extracted from plant material in a solvent (water), by allowing the material to remain suspended in the solvent over time. A decoction is prepared by boiling the plant material with water. They do not store juice, infusion, and decoction using preservatives for further use. The main problem for the people to prepare and use infusion and decoction is it takes much time. The powder is prepared by grinding the dry plant materials or plant parts into a paste with the help of mortar and pestle. Tablet is prepared by first grinding the dry plant materials or plant parts into minute particles and then making it into small balls. Though the method for preparation of powder and tablet is more difficult than others, the Tharus store these forms of drug in airtight plastic/glass jars for a long period for further use.

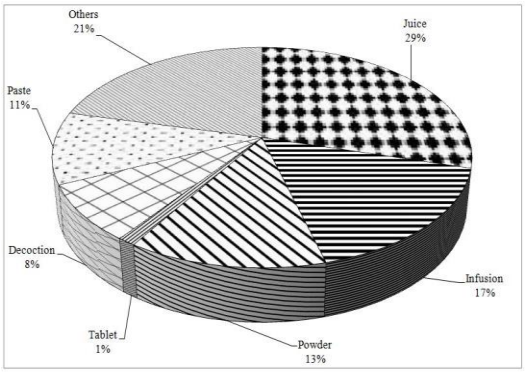

Fig. 4. Modes of drug preparation

Treatment of ailments

Out of the 75 informants (40 males, 35 females), the females were found to be more knowledgeable than the males about the medicinal use of plants, due to their daily involvement in household work for caring family members, cattle, and cultivation. The males were employed in other jobs. They treated 40 different types of ailments such as fever, typhoid, boils, gastritis, piles, mouth and throat sore, leucorrhea, papilloma, cough, asthma, ringworm, eye infection, allergy, anthelmintic, furuncles, spermatorrhea, kidney stone, jaundice, leucorrhea, gout or rheumatism, etc. These ailments were broadly categorized into 11 use categories (Table 2). It was found that a single species was used to treat more than one ailments and diseases, and the highest number of plants (26) were used for gastrointestinal disorders, that was followed by use for dermatological troubles (18), for respiratory troubles (8), for gynecological and

andrological problems (7), etc. The results are similar to Ambu *et al.* (2020) who has reported the use of 53 plant spp. to treat more than one ailments in Kavrepalanchok, Nepal. Reports of earlier researchers from Nepal and other countries showed that the number of plant species used for different categories of ailment differs with localities, viz. for a gastrointestinal disorder 26 spp. (Acharya & Acharya, 2009); 41 spp. (Singh *et al*, 2012); 24 spp. (Singh, 2017); & 24 spp. (Kumar and Bharati, 2014); for a dermatological disorder 4 spp. (Acharya & Acharya, 2009); 34 spp. (Singh *et al*, 2012); & 17 spp. (Kumar and Bharati, 2014); for a skeletomuscular problem 16 spp. (Singh *et al*, 2012); & 13 spp. (Kumar & Bharati, 2014). However, the modern medicine (allopathic) system of medication has directly affected the ethnomedicinal system of medication in the study area. It is limited to a few groups of people, who cannot afford modern expensive medical treatments, and to a few professional healers.

Frequency of citation (%) and Informant consensus factor (F_{IC})

The collected data on ethnomedicine was evaluated quantitatively by two ethnobotanical statistical tools, viz. Frequency of citation (%) and Informant consensus factor (F_{IC}) (Heinrich *et al*., 1998). The highest frequency of citations was found for the following plants: *Azadirachta indica* (90), *Calotropis gigantea* (67), *Euphorbia antiquorum* (67), *Drimia indica* (60), *Jatropha curcas* (58), *Ricinus communis* (58), *Eclipta prostrata* (53), *Ocimum tenuiflorum* (53), *Sida acuta* (53), and *Rauvolfia serpentina* (51) (Table 1). *Azadirachta indica* is a common tropical medicinal plant grown in the field, garden, roadside, etc. The Tharus used all the parts of this plant i.e. leaves, flowers, & stem bark, to treat intestinal worms, fever, diarrhea, cut, wounds, burnt body parts, etc. *Calotropis gigantea* is another common plant growing in a wasteland, field, roadside, forest, etc., which was used in toothache, dermatological and skeleton-muscular problems. *Rauvolfia serpentina* is an important medicinal plant, which is rare in its distribution, and it was used in fever and typhoid. The study area lies at the border of Nepal & India, so its roots are collected and transported illegally to India through an open border.

Table 2. Categories of different ailments documented in the study area and Informant consensus factor (F_{IC}) value

S.N.	Ailment category	*N_{ur}	*N_t	*F_{IC}
1	**Gastrointestinal disorder**: (diarrhea, dysentery, piles, indigestion, constipation, vomiting, stomachache, colic pain)	70	26	0.63
2	**Dermatological trouble:** (wound, boils, furuncles, blisters, ringworm infection, mumps, papilloma, pimples, allergy, skin rashes, eczema, etc.)	100	18	0.82
3	**Skeleto-muscular disorder:** (bone fracture, joint swellings, lumbar pain, rheumatism, gout, sprain, etc.)	25	05	0.83
4	**Respiratory troubles:** (asthma, cough, bronchitis, throat sore, etc.)	45	08	0.84
5	**Eye and ear trouble:** (eye irritation, redness in the eye, conjunctivitis, ear pain, etc.)	13	05	0.66
6	**Urinary problem:** (kidney stone, urinary bladder stone, urine retention, etc.)	07	03	0.66
7	**Gynaecological & andrological problem:** (leucorrhea in female, spermatorrhea in male, menstrual pain, etc.)	15	07	0.57
8	**Cut and burns**	23	05	0.81
9	**Teeth, tongue, & lip trouble:** (toothache, foul breath, rashes in the lip, rashes in a tongue, etc.)	33	07	0.81
10	**Cold, fever:** (headache, typhoid, malaria, running nose, etc.)	38	10	0.75
11	**Other/unclassified:** (diabetes, jaundice, reduce body heat, fungal infection at feet and sole, etc.)	12	05	0.63

*Abbreviations: *N_{ur} = number of use reports in a particular illness category, *N_t = number of taxa used to treat that particular category by informants, *F_{IC} = Informants consensus factor = $N_{ur} – N_t/(N_{ur}-1)$, F_{IC} value ranges from 0 to 1.*

The highest informant consensus factor (F_{IC}) was found for the respiratory trouble category (0.84), followed by skeletomuscular (0.83), dermatological troubles (0.82), cut, and burns (0.81), etc. (Table 2). The F_{IC} value ranged from 0.57 to 0.84 with an average value of 0.72 in this study. At first, 40 types of ailments treated by the Tharus were categorized into a broadly defined 11 ailment categories. It showed that a large population of Tharus depends on a few (8 spp.) plants for respiratory troubles. Similarly, a large population of the Tharus depends on only 18 plant species for dermatological troubles. The dermatological trouble was the major problem in the study area due to the prevailing hot climate throughout the year. Gastrointestinal was another important ailment category,

which showed a relatively smaller value (0.63) than others. Thus, a small population of the Tharus depends on a relatively higher number of plants (26 spp.) to cure gastrointestinal problems. According to other researchers, the highest informant consensus factor (F_{ic}) was 0.97 for the cardiovascular disorder (Singh *et al.,* 2012); 0.98 for wound & injury (Kumar & Bharati, 2014); 0.77 for digestive system disorder (Faruque *et al.,* 2018); & 0.49 for fever (Ambu *et al*., 2020). A high value of informant consensus factor for a use category was the culture-bound syndromes (Heinrich *et al.*, 1998). Thus, the F_{IC} value was used to identify plant species with particular importance in a culture and to select aliment categories where there was agreement on the use of plants among the informants (Andrade-Cetto & Heinrich, 2011). The above data shows that there is a higher agreement or consensus among the informants on the use of plants for most categories of ailments in the study area. On the other hand, a relatively high value of F_{IC} in many use categories showed that the sample for the ethnobotanical study was large enough to identify culturally important plants and it was also relevant for detailed phytochemicals as well as pharmacological studies (Bork *et al.,* 1996).

CONCLUSION

The Rupandehi and Nawalparasi (Bardaghat-Susta West) Districts lie at the tropical belt in the Tarai region, which are rich in terms of medicinal plant resources. But human activities like fast-growing urbanization, deforestation, infrastructure development, climate change, etc. are the major threats in the declination of the important medicinal plant resources & traditional knowledge from this region. On the other hand, very little information regarding the ethnomedicinal use of the local plant is available from this region. The Tharus are the major ethnic community of the Tarai region, who used to depend on forest resources to sustain their survival and livelihood. But, the rapid migration of people from the mid-hills and high mountains to Tarai has changed the socioeconomic status and cultural practices of the Tharu Community. Easy access to modern medicine for people is another cause of declining the use of plants for medicine. As a result, there is a great chance of disappearing valuable ethnoecological and ethnomedicinal knowledge in the younger generation. Therefore, there is an urgent need to document the ethnomedicinal knowledge of the Tharus before they disappear forever. It is essential to analyze the phytochemical properties of these medicinal plants for the confirmation of usage in particular ailments, as well.

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REFERENCES

Acharya, R., & Acharya, K. P. (2009). Ethnobotanical study of medicinal plants used by the Tharu community of Parroha VDC Rupandeshi district, Nepal. *Scientific World 7*(7), 80-84.

Ambu, G., Chaudhary, R. P., Mariotti, M., & Cornara, L. (2020). Traditional Uses of Medicinal Plants by Ethnic People in the Kavrepalanchok District, Central Nepal. *Plants*, *9*, 759. https://doi.org/10.3390/plants9060759

Andrade-Cetto, A. (2009). Ethnobotanical study of the medicinal plants from Tlanchinol, Hidalgo, Mexico. *Journal of Ethnopharmacology, 122*(1), 163-171.

Andrade-Cetto, A., & Heinrich, M. (2011). From the field into the lab: useful approaches to selecting species based on local knowledge. *Frontiers in Pharmacology*, *2*, 20. https://doi.org/10.3389/fphar.2011.00020

Bhatt, G. D., Khatri, S., Rai, S. K. & Rajbhandari, K. R. (2017). *Ramapithecus Banaspati Udyanka Banaspatiharu*. (Plants of Ramapithecus Botanical garden), Thapathali, Kathmandu Nepal: Department of Plant Resources.

Bhattarai, K. R., & Acharya, S. K. (2013). Documentation of ethnobotanical knowledge of Tharu people on the utilization of plant resources in Gadariya and Phulwari VDCs of Kailali district, west Nepal. *Bulletin of the Department of Plant Resources, 37*, 41-50.

Bista, D. B. (2004). *People of Nepal*. Kathmandu, Nepal: Ratna Pustak Bhandar.

Bork, P. M., Schmitz, M. L., Weimann, C., Kist, M., & Heinrich, M. (1996). Nahua Indian medicinal plants (Mexico): inhibitory activity on NF-kB as an anti-inflammatory model and antibacterial effects. *Phytomedicine*, 3, 263-269.

CBS (2012). *National Population and Housing Census 2011*, Volume 01, Central Bureau of Statistics, National Planning Commission Secretariat, Kathmandu, Nepal.

CBS, (2011). *Statistical Year Book of Nepal*. Central Bureau of Statistics, HMG Nepal National Planning Commission Secretariat, Kathmandu, Nepal.

Chaudhary, R. P. (1998). *Biodiversity in Nepal: Status and Conservation*. Bangkok, Thailand: Craftsman Press.

Collins, S., Martins, X. A., Mitchell, Teshome, A., & Arnason, J. T. (2006). Quantitative ethnobotany of two east Timorese cultures. *Economic Botany, 60*(4), 347–361.

Dangol, D.R., & S.B. Gurung (1991). Ethnobotany of the Tharu Tribe of Chitwan District, Nepal. *International Pharmacognosy*, *29*(3), 203-209.

DPR, (2012). *Plants of Nepal- fact sheet.* Ministry of Forest and Soil Conservation, Kathmandu, Nepal: Department of Plants Resource.

Duraipandiyan, V., Ayyanar, M., & Ignacimuthu, S. (2006). Antimicrobial activity of some ethnomedicinal plants used by the Paliyar tribe from Tamil Nadu, India. *BMC Complementary and Alternative Medicine, 6*, 35-41.

Faruque, M.O, Uddin, S.B, Barlow, J.W, Hu, S., Dong, S., Cai, Q., Li. X, & Hu, X. (2018). Quantitative ethnobotany of medicinal plants used by indigenous communities in the Bandarban District of Bangladesh. *Frontiers in Pharmacology, 9*, 40. https://doi.org/10.3389/fphar.2018.00040

Gachhadar, P. (2010). Indigenous knowledge and practices on medicinal plants among the Tharu community in Eastern Nepal. https://www.semanticscholar.org/paper/28fbf7123da826a1605baffe27f23a0f0f948b19

Ghimire, K., & Bastakoti, R. M. (2009). Ethnomedicinal knowledge and healthcare practices among the Tharus of Nawalparasi district in Central Nepal. *Journal Forest Ecology and Management*, *257*(10), 2066-2072.

Grierson, A.J., Long, D.G. (Eds.), (1983). *Flora of Bhutan*, vol. 1-3. Edinburgh, UK: Royal Botanic Garden Edinburgh.

Heinrich, M., Ankli, A., Frei, B., Weimann, C., & Sticher, O. (1998). Medicinal plants in Mexico: healers' consensus and cultural importance. *Social Science and Medicine, 47*, 1859-1871.

Hooker, J.D. (1875–1897). *Flora of British India*, vol. 1-8. London, UK: Reeve.

Islam, M. K., Saha, S., Mahmud, I., Mohamad, K., Awang, K., & Jamal Uddin, S. (2014). An ethnobotanical study of medicinal plants used by tribal and native people of Madhupur forest area, Bangladesh. *Journal of Ethnopharmacology, 151*, 921-930.

Joshi, N. R., & Singh, V. (2010). Non-timber forest products (NTFP's) used by the Tharu tribe Of Kanchanpur District of Far-Western Nepal. *New York Science Journal, 3*(11), 111-119.

Kumar, A., Pandey, V. C., Singh, A. G., & Tewari, D. D. (2013). Traditional uses of medicinal plants for dermatological healthcare management practices by the Tharu tribal community of Uttar Pradesh, India. *Genetic Resources and Crop Evolution, 60*, 203-224.

Kumar, A., Tewari, D.D. & Tewari, J.P. (2006). Ethnomedicinal knowledge among the Tharu tribe of Devipatan division. *Indian Journal of Tradition Knowledge, 5*(3), 310-313.

Kumar, R., & Bharati, K. A. (2014). Ethnomedicines of Tharu Tribes of Dudhwa National Park, India. *Ethnobotany Research & Applications, 12*, 01-13.

Kunwar, R. M., & Bussmann, R. W. (2008). Ethnobotany in the Nepal Himalaya. *Journal of Ethnobiology and Ethnomedicine*, *4*, 24. www.ethnobiomed.com/content/4/1/24.

Kunwar, R. M., Nepal, B. K., Kshhetri, H. B, Rai, S. K., & Bussmann, R. W. (2006). Ethnomedicine in the Himalaya: a case study from Dolpa, Humla, Jumla and Mustang district of Nepal. *Journal of Ethnobiology and Ethnomedicine*, *2*, 27. www.ethnobiomed.com/content/2/1/27.

Lawrence, G. H. M. (1967). *Taxonomy of vascular plants.* New Delhi, India: Oxford and IBH Publishing Co. Ltd.

Manandhar, N. P. (1985). Ethnobotanical notes on certain medicinal plants used by Tharus of Dang-Deukhuri district, Nepal. *International Journal of Crude Drug Research, 23*, 153-159.

Manandhar, N. P. (2002). *Plants and people of Nepal*. Oregon, USA: Timber Press Inc. Portland.

Martin, G. J. (1995). *Ethnobotany: A methods manual*. London, UK: Chapman and Halls.

Muller-Boker, U. (1993). Ethnobotanical study among Chitwan Tharus, *Journal of Nepal Research Centre*, *9*, 17-56.

Poudel, M., & Singh, N. B. (2016). Medical ethnobiology and indigenous knowledge system found in the Darai ethnic group of Chitwan, Nepal. *Journal of Institute of Science and Technology, 21(1), 103-111.*

Rai, R., & Singh, N. B. (2015). Medico-ethnobiology in Rai community: A case study from Baikunthe Village Development Committee, Bhojpur, Eastern Nepal. *Journal of Institute of Science and Technology, 20(1), 127-132.*

Rokaya, M., (2012). *Ethnoecology of medicinal plants in the Dho-Tarap area in the buffer zone of Shey Phoksundo national park, Dolpa, Nepal* (M.Sc. dissertation). Central Department of Botany, Tribhuvan University, Nepal.

Shrestha, P. (1985). Contribution to the ethnobotany of the Palpa area. *Contributions to Nepalese studies: Journal of the Institute of Nepal and Asian Studies, Tribhuvan University*, 12 (2), 63-74.

Singh, A. G., & Hamal, J. P. (2013). Traditional phytotherapy of some medicinal plants used by Tharu and Magar communities of Western Nepal, against dermatological disorders. *Scientific World*, *11*(11), 81-89.

Singh, A. G., Kumar, A., & Tewari, D. D. (2012). An ethnobotanical survey of medicinal plants used in the Terai forest of western Nepal. *Journal of Ethnobiology and Ethnomedicine*, *8*, 19. https://doi.org/10.1186/1746-4269-8-19

Singh, S. (2017). Ethnomedicines used by Kochila Tharu tribes living near the Bara district of Nepal. *World Journal of Pharmaceutical Research, 6*(14), 1267-1283.

Subedi, B. P. (2004). *Linking plant-based enterprises and local communities to biodiversity conservation in Nepal Himalaya* (Ph. D. thesis). Kumaun University, Nainital, India.

Tomoko, N., Takashi, A., Hiromu, T., Yuka, I., Hiroko, M., Munekazu, I., Totshiyuki, T., Tetsuro, I., Fujio, A., Iriya, I., Tsutomu N., & Kazuhito, W. (2002). Antibacterial activity of extract prepared from tropical and subtropical plants on methicillin-resistant *Staphylococcus aureus*. *Journal of Health Science*, *48*, 273-276.

Trotter, R. T., & Logan, M. H. (1986). Informant consensus: a new approach for identifying potentially effective medicinal plants. In N. L. Etkin (Ed.), *Plants in indigenous medicine and diet: Biobehavioral approaches* (p. 91-112), New York, USA: Redgrave Publishing Company.

Uprety, Y., Asselin, H., Boon, E. K., Yadav, S., & Shrestha, K. K. (2010). Indigenous use and bio-efficacy of medicinal plants in the Rasuwa District, Central Nepal. *Journal of Ethnobiology and Ethnomedicine*, *6*, 3. https://doi.org/10.1186/1746-4269-6-3

WHO. (1993). *Guidelines on conservation of medicinal plants*. Gland, Switzerland: IUCN, WHO and WWF.