Ethnobotanical Study of Magar Ethnic Community of Palpa District of Nepal

Bimala Pangeni, Shandesh Bhattarai, Hari Paudyal and Ram Prasad Chaudhary

Research

Abstract

Background: This study was aimed to document the important medicinal plants and their herbal preparation method. The investigation and documentation of medicinal plants and their associated indigenous knowledge are crucial to raise the socio-economic status of the indigenous Magar ethnic community, and for the conservation of biological resources.

Methods: Participatory Rural Appraisal (PRA) that involved direct interaction with local people and observations was used to collect data. Informant Consensus Factor (Fic) and Relative Frequency Citation (RFCs) were applied to explore the cultural importance of ethnomedicinal plants.

Results: Forty medicinal plants, out of 58 ethnobotanically useful plant species were reported. Fic value was found to be high (1) for treatment of maternal ailment, followed by eye irritation (0.95), rheumatism and urinary ailments (0.92). Similarly, cancer (0.90), skin diseases (0.87), asthma (0.83), nervous system disorders (0.73), fever (0.67), gastrointestinal (0.53), and least value was recorded for respiratory problems (0.48). Based on the RFCs values, the most important ethnomedicinal species were *Cissampelos pariera* (0.86), *Centella asiatica* (0.78), *Bergenia ciliata* (0.54), *Delphinium vestitum* (0.48), *Clematis buchananiana* (0.44), *Oxalis corniculata* (0.42), *Cassia fistula* (0.32), *Cuscuta reflexa* and *Asparagus racemosus* (0.26), *Corchorus aestuans* (0.24), and *Nicotiana tabacum* (0.22).

Conclusions: Further research on high valued plants for investigation of particular chemical components and their commercialization into national level is recommended. Results on such aspects would help local communities to conserve and disseminate their ethnomedicinal knowledge, and also to transfer their unique healthcare practices to young generations.

Keywords: Indigenous knowledge, Magar ethnic community, Medicinal practices, Palpa District

Correspondence

Bimala Pangeni[1]*, Shandesh Bhattarai[2], Hari Paudyal[3], Ram Prasad Chaudhary[4]

[1]Department of Botany, Trichandra Multiple Campus, Ghantaghar, Kathmandu, Nepal
[2]Nepal Academy of Science and Technology, Khumaltar, Lalitpur, Nepal
[3]Central Department of Chemistry, Tribhuvan University, Kirtipur, Kathmandu, Nepal
[4]Research Centre for Applied Science and Technology, Tribhuvan University, Kirtipur, Kathmandu, Nepal
*Corresponding Author: bpangeni2049@gmail.com

Ethnobotany Research & Applications
20:44 (2020)

Background

Traditional medicine occupies a vital place in health care in the world. Even today, the rural people trust on the use of herbal medicine. Many rural communities in Nepal still have some areas where traditional herbal medicine is the major, and in some cases, the only source of primary healthcare (Lama *et al*. 2001, Manandhar 2002, Bhattarai *et al*. 2006, Pangeni 2009, Kunwar *et al*. 2010, Ambu *et al*. 2020). More than 80% of people in developing countries cannot afford the most basic medical procedures, drugs, and vaccines. In both developed and developing countries, even among richer populations' complementary and alternative practices of medical treatment are gaining popularity, and the demand for herbal medicine is rising (Pandey *et al*. 2013).

Manuscript received: 09/09/2020 - Revised manuscript received: 18/11/2020 - Published: 19/11/2020

http://dx.doi.org/10.32859/era.20.44.1-17

About 31128 species of flowering plants have been documented as useful plant resources of the world, of which 17810 species have been documented as medicinal plants, 5538 species as human food, and 3649 species as fodder and forage plants (RBG 2016, Shrestha *et al*. 2018). About 52885 plant species are believed to be used in traditional medicine, but the exact number of medicinally useful bioactive metabolites in these plants is still unknown (Schippmann *et al*. 2002, Gewali 2008). Out of 52885 plant species, about 15000 are threatened due to habitat fragmentation, over exploitation, climate change and illegal trade in medicinal plants (Schippmann *et al.* 2006).

Traditional systems of medicine are important health care practice spread all over the world, especially in developing countries (WHO 2019), and the people are extremely knowledgeable and dependent on plants and other natural resources that are found around their habitat. Increasingly, medicinal species that exist in natural regions have received scientific and commercial attention, but we still know little about the treasure trove living our wild places (Roberson 2008). However, changes in lifestyle carried out by globalization have led to the reversal of traditional ethnobotanical knowledge in ongoing efforts to ensure sustainable management of resources with a parallel loss of related knowledge (Brosi *et al*. 2007). Especially, transmission of this knowledge between the older and younger generations is no longer adequately associated (Kargioglu *et al*. 2008). Hence, it is crucial to preserve the communication between indigenous peoples' and local communities (IPLCs) and their environment to conserve such important knowledge for many generations (Ambu *et al*. 2020).

An ethnobotanical study helps to rescue disappearing indigenous knowledge and uses this information to develop a sustainable resource use program that benefits the local communities. Many rural communities in developing countries still rely on wild plant collection for medicines, food, construction materials, fuel, and many other purposes. About 80% of the population in developing countries rely on herbal plants as plant-based medicines for primary healthcare needs (WHO 2013). The IPLCs residing in different geographical regions of Nepal depend upon wild plants to fulfill their fundamental needs and have their art of ethnomedicinal knowledge about the plant resources available in and around their landscape (Bhattarai & Ghimire 2006, Ghimire & Bastakoti 2009, Bhattarai *et al*. 2010, Rokaya *et al*. 2010, Uprety *et al*. 2010).

Nepal is the country with the most diverse and superb landscape with diversity of plants, animals and fungi. One of the principal charms of Nepal is a great variety of climate and vegetation within a comparatively small country (Stainton 1972, Miehe *et al*. 2015). Due to its significant variations in altitude, topography and climate, Nepal has an important floral biodiversity comprising nearly 6500 species of flowering plants (Hara *et al*. 1978, Hara & Williams 1979, Hara *et al*. 1982, WCMC 1992, Press *et al*. 2000, Frodin 2001, Groombridge & Jenkins 2002, MoFSC 2014, Shrestha *et al*. 2018) of which about 2000 species are commonly used in traditional healing practices (Gaire & Subedi 2011). So, Nepal is a land of topographic contrast, floristic diversity, and ethnic variation. Due to wide altitudinal variation and diverse climatic conditions within a small country, it has a unique position in the world both in its biological and cultural diversity. In Nepal, there exist more than 102 caste groups, and more than 92 different languages are spoken (CBS 2005). Due to various socio-environmental factors, the populations living in the rural areas are considered to adopt traditional knowledge about medicinal plants which is available easily and cheaply.

The present study is an exhaustive documentation of useful plant species used by Magar ethnic community living in several villages of Ringneraha and Siluwa VDCs (now Purbakhola Rural Municipality) of Palpa District. Our results integrate earlier related ethnobotanical studies (Rajbhandari 2001, Bhattarai & Ghimire 2006, Dutta 2007, Ghimire & Pyakurel 2008, Rokaya *et al*. 2010), focusing on medicinal plants. We mainly focus our study to answer the following questions: i) why IPLCs are dependent on local plant resources; and ii) how they use medicinal plants for primary healthcare including treatment of various diseases. The hypothesis of the study was whether the Magar ethnic community are equally knowledgeable in using medicinal plants as compared to other local community or not ? Based on above research questions and hypothesis, the major objectives of the present research work were to document the indigenous knowledge of Magar ethnic community about the use of medicinal plants with the focus of parts used, method of preparing medicine, their mode of administration and dose.

Materials and Methods

Study Area and Ethnic People

Palpa District is situated in Lumbini Province of Nepal. The total land area of the district is about 1366 km^2. The altitude varies from about 300 to 1900 m asl (meter above sea level). It is bounded by Nawalparasi District from east, Arghakhanchi and Gulmi from west, Syangja, Gulmi, and Tanahu from north; Rupandehi and Nawalparasi from south (Mahato 2006).

The present research was conducted in the Ringneraha and Siluwa wards. The villages surveyed were Arkhaldanda, Koranga, Nandedanda, Dhakrebash, Tarepahad, Arghichaur, Hattilek, and Gundanda (Figure 1). All the surveyed villages are included in Purbakhola Rural Municipality, since 12 March 2017 by Government of Nepal under new local administrative structure. Purbakhola Rural Municipality is one of the 753 local units.

The study areas are inhabited by many ethnic groups, of which the majority is comprised of Magars and rest by Brahman, Chhetri, Damai, Kami, Sarki, etc. According to CBS (2011), Purbhakhola Rural Municipality had a population of 19590 (men-8563; women-11027). Siluwa is comprised of 1035 houses, having total population of 4988 (men-2210; women-2778) and Ringneraha of 543 houses, having total population of 2,498 (men-1381; women-1117). Our research focused on three villages in Ringneraha ward no. 3 (Arkhaldanda, Koranga, and Nandedanda), and five villages in Siluwa ward no. 1 (Dhakrebash, Arghichaur, Gundanda, Hattilek, and Tarepahad).

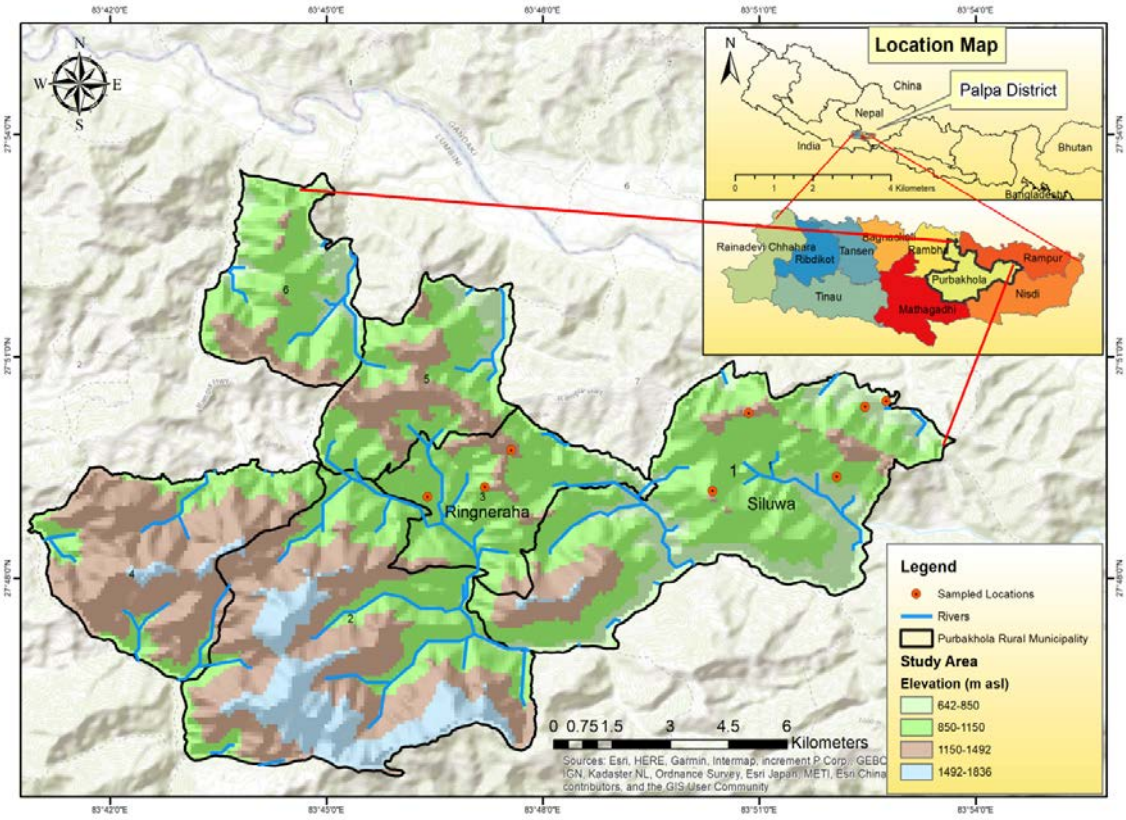

Figure 1. Map of Purbakhola Rural Municipality, Palpa District, Nepal.

Field Survey and Data Collection

A total of three field visits were conducted in eight villages of Purbakhola Rural Municipality between September 2008 to March 2009. Ten days of each field visit was made during survey of research work. Preliminary work was initiated by conducting small meeting with local council of Ringneraha-3 and Siluwa-1 of Purbakhola Rural Municipality, including chairman, vice-chairman, secretary and village captains, teachers, elderly people, traditional faith healers, women, herders, etc. They agreed to extend their help and support to the study. After obtaining the necessary permission (verbal informal consents), we conducted ethnobotanical surveys and documented their traditional knowledge of medicinal practice. The IPLCs (including Magar ethnic community) key informants (elderly people, Dhami, Jhakri, Baidya) were interviewed individually to generate the data on diseases treating, medicinal plants used, mode of preparation of medicines, usage and dosage.

The Participatory Rural Appraisal method was followed. During the interviews, information was noted using data documentation sheet of open-ended and semi-structured questionnaire for collecting ethnobotanical information. A total of 50 informants were interviewed (counted only for those who can respond about the knowledge of ethnomedicinal practice, pre-selected as informants from small meeting with local council) between the group of age 28-82 years including both males and females. These informants were the representatives of whole community. During trans-sect walk, different

cross-checking(asking about the same species to at least three informants) was done at different places to confirm their identity in terms of vernacular names, uses for the reliability and validity of the information as for ethnomedicinal values.

The voucher plant specimens were collected from the studied areas with the help of local peoples concentrating on Magar ethnic community. The photographs of the specimens, GPS (Global Positioning System) locations of the respective plants along with many other botanical field notes were recorded (Pangeni 2009). The specimens were identified and described with the help of standardbotanical literature (Hooker 1872-1897, Balley 1969, Polunin & Stainton 1987, Stainton 1988, Grierson & Long 1983-2001) and with experts' help at the Central Department of Botany, Tribhuvan University, Nepal. Each specimen was mounted on the standard herbarium sheet.The nomenclature of the identified species follows (www.tropicos.org, www.plantlist.org, www.gbif.org) and also crossed checked with Nepalese publications (Hara *et al*.1978, Hara & Williams 1979, Hara *et al*. 1982, Press *et al*. 2000, and Rajbhandari 2001). The collected plant specimens were deposited at Tribhuvan University Central Herbarium, Kirtipur, Kathmandu (TUCH).

Quantitative Analysis

The ethnobotanically used plant species are quantitatively listed showing their high value of priority as medicine which include plant species botanical name, family, local name, altitude, location, voucher specimen number, parts used and ethnomedicinal uses as described in (Pangeni 2009), and this research work to treat the various diseases / ailments. These diseases / ailments were grouped into 11 different categories (Maheshwari 1995, Jain & Mudgal 1999, Shrestha *et al*., 2016, Adhikari *et al*., 2019, Ambu *et al*., 2020). The use of plant resources as medicine was quantitatively assessed using the informant consensus factor (Fic) and relative frequency of citation (RFCs) according to the following mentioned equations (Trotter & Logan 1986).

Informants Consensus Factor (Fic)

This Fic is the mathematical expression in ethnobotanical research work which was used to calculate the homogeneity in the information of informants. This is calculated for each ailment category with the following formula:

$$Fic = (N_{ur}-N_t)/(N_{ur}-1) \quad (1)$$

where,N_{ur} is the number of use reports in each ailment category, and N_t is the total number of taxa or species used in that particular category. A high value of Fic indicates the support of the informants in the use of taxa for a certain disease category.

Relative Frequency of Citation (RFCs)

This index is used to determine the local importance of each species in the study area. The formula is used, according to the following equation:

$$RFCs = FCs/N \quad (2)$$

where, FCs is the number of informants that cites the use of a plant species, and N the total number of informants.

Results and Discussion

Demographics of the informants

Among 50 informants (based on reports of one or more ethnomedicinal uses of species), 34 of whom were general informants and 16 of them were key informants, from eight villages of the study areas. The distribution of informants by age, gender, and education level is shown in Table 1. Among them, 20% of informants were over 40 years old, 48% of informants had only a primary education, and 18% were illiterate. There were more male informants (68 %) than female informants (32%).

Table 1. Demographic profile of informants (Numbers 50)

Indicators	Description	General informants	Key informants	Total	Frequency %
Age	28-39	4	2	6	12
	40-49	7	3	10	20
	50-59	6	4	10	20
	60-69	7	3	10	20
	70-79	6	2	8	16
	>=80	4	2	6	12
Gender	Male	23	11	34	68
	Female	11	5	16	32
Education	Illiteracy	6	3	9	18
	Primary	16	8	24	48
	Secondary	10	4	14	28
	Degree	2	1	3	6

Plant Diversity

In the present findings, a total of 58 plant species belonging to 42 families, and 57 genera used by the Magars of the study areas have been documented. The diversity of the total ethnobotanically useful plant species found in the study areas is 54 species of Angiosperms (93.65%), 3 species (*Adiantum philippense*, *Lycopodium cernuum*, and *Equisetum diffusum*) of Pteridophytes (4.76%) and 1 species *(Pinus roxburghii)* of Gymnosperm (1.58%). The documented plants have been used for multipurpose and categorized into four different groups. They are medicinal (40 species), fodder (10 species), wild edible (4 species), and miscellaneous (4 species) such as spices, agricultural equipment, ornamental, household equipment, etc. (Figure 2). The ethnomedicinal details of 40 plant species from the study areas are presented in Table 2.

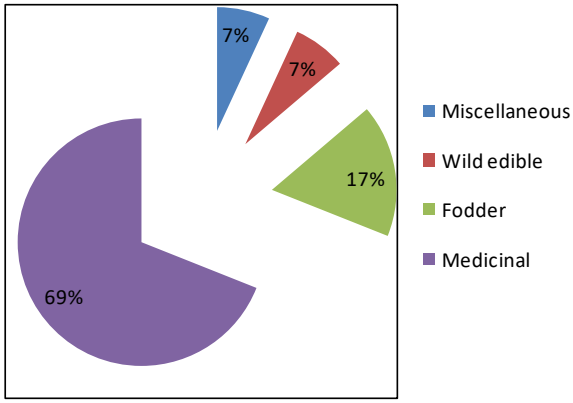

Figure 2. Ethnobotanical use categories of plant species

The taxonomic diversity percentage was calculated. The most representative species belonged to Asteraceae with 4 species (6.90%); then Lamiaceae, Ranunculaceae and Zingiberaceae have 3 species each (5.17%); Apiaceae, Berberidaceae, Euphorbiaceae, Liliaceae, Oleaceae, Rosaceae, Solanaceae have 2 species each (3.45%), and remaining 31 families have 1 species (1.72%) in each genus as enumerated in Table 3.

Among them the most representative were herbs (37%), followed by trees (31%), shrubs (23%), and climbers (9%) as shown in Figure 3. Herbs are naturally available in the study areas, which were mostly hilly and covered by a forest canopy, creating favorable conditions for their growth. The herbs were easily available as diverse sources of ethnomedicinal plants. These data are the key sources of the richness of the local flora and help to collect the botanical knowledge of the informants, in accordance with the previous studies conducted in western Nepal (Mahato & Chaudhary 2005, Ale *et al*. 2009, Acharya 2012, Singh *et al*. 2012, Panthi & Singh 2013, Malla *et al*. 2015).

Ethnomedicinal uses of plants

About 69% (40) of the 58 species was reported for medicinal purposes, with 241 citations of uses. Out of total species reported, *Diploknema butyracea*, *Aegle marmelos* (religious), *Colebrookea oppositifolia*, *Ziziphus mauritiana*, *Cissampelos pareira* (domestic), *Asparagus racemosus*, *Morus serrata*, *Phyllanthus emblica* (food) as shown in Table 2 together with medicinal values, and the species presented in Supplementary Table 1 as agricultural values, considered in the present work as miscellaneous uses. Thus, about 17% (10 species) was reported for fodder, 7% (4 species) for wild edible and 7% (4 species) for miscellaneous uses as shown in Figure 3. The Ethnomedicinal valuable plants mostly gathered from wild by Magar ethnic community as they are easy to find, particularly, herbs, trees and shrubs growing in and around the studied villages.The IPLCs (including Magar ethnic community) residing in the research areas sometimes used the cultivated plant species for medicinal purposes such as *Amaranthus spinosus*, *Eryngium foetidum*, *Acorus calamus*, *Swertia nervosa*, etc. (Table 2). The medicinal plants were used by the informants to treat 11 categories of human diseases / ailments. Many of the reported medicinal plants were used to treat more than one disease (e.g. *Ocimum bacilicum*, *Mentha arvensis*, *Asparagus racemosus*, see Table 2).

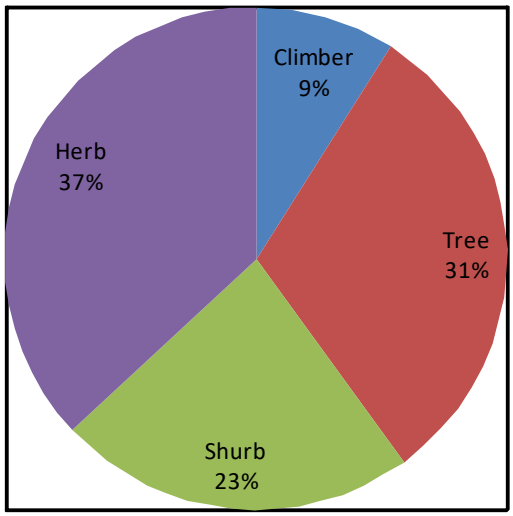

Figure 3. Growth habits of the plant species in the study areas

Table 2. Plants used by Magar ethnic community of Palpa District, Western Nepal

Family Scientific name (Voucher number)	**Vernacular name[a]**	**Life forms[b] & Origin**	**Parts Used[c]**	**Ethnobotanical Uses[d]**	**Use Description**	**Similar Uses References**	**Other Uses References**
ASTERACEAE *Artemisia dubia* Wall. ex Bess. (B. Pangeni-317, TUCH)	Titepati-N Paati-M	(H) W	L & R	Med / derm med / fev	Fresh juice of leaves is applied to treat cut and wounds. Root is crushed and boiled with water and the extract is taken to cure fever and asthma.	Budha- Magar *et al*. 2020; Shrestha *et al*. 2016	
AMARANTHACEAE *Amaranthus spinosus* L. (B. Pangeni-24,TUCH)	Lunde-N SetoLunde-M	(H) Cul	L & S	Food /med / resp / med / fev	The soft stem and leaves are cooked as vegetable. Stem is pounded with water and filtrate is drunk once a day for curing cough and common cold. This is also useful in dizziness.	Manandhar 1995; Bhattarai *et al*. 2009	
APIACEAE *Centella asiatica* (L.) Urb. (B. Pangeni-06, TUCH)	Ghodtapre-N	(H) W	L	Med / musc / gast / resp	Two-three teaspoonful leaves juice is used before meal once a day for cooling of body. It is also used for curing stomachache, indigestion, asthma and gastric.		
APIACEAE *Eryngium foetidum* L. (B. Pangeni-320, TUCH)	Kandedhaniya-N	(H) Cul	Wp	Food / med / nerv	Leaves paste is used to relief from headache problems. Leaves are also used to make pickle.		
ARACEAE *Acorus calamus* L. (B. Pangeni- 23,TUCH)	Bojho-N Malabaru-M	(H) Cul	Rh &Wp	Med / resp / med / fev	Piece of rhizome is taken and chewed orally and swallowed two-three times a day (morning, day and evening) for five days to common cold, cough and sore throat.	Risal (1994); Panthi & Chaudhary (2003)	Chaudhary *et al*. 2002; Aryal *et al*. 2018; Kunwar *et al*.2010; Ambu *et al*. 2020
ASCLEPIADACEAE *Calotropis gigantea* (L.) Dryand. (B. Pangeni-351, TUCH)	Aank-N / M	(S) W	Lx & S	Med / musc / resp	Latex is used for curing fracture and swelling part of body. Smoking of 2 cm long dry stem every day in the evening cures the sinusitis.	Shrestha1985	Bhattarai1993
ASTERACEAE *Eclipta prostrata* (L.) L. (B. Pangeni-09, TUCH)	Bhringraj-N	(H) W	Wp	Med / gast	The paste of aerial part of this plant is used to treat dysentery.		Ambu *et al*. 2020

ASTERACEAE *Elephantopus scaber* L. (B. Pangeni-01, TUCH)	Butijhar-N	(H) W	R	Med / ENT	Root juice is applied to cure the infection of ear.		Ambu *et al*.2020
CAMPANULACEAE *Lobelia pyramidalis* Wall. (B. Pangeni-338, TUCH)	Eklebir-N	(H) W	L & In	Med / resp / nerv / fev	Leaf and inflorescence decoction used to cure bronchitis, asthma and syphilis.		
CONVOLVULACEAE *Cuscuta reflexa* Roxb. (B. Pangeni-344, TUCH)	Aakasbeli-N	(C) W	S	Med / met	The paste of stem is given to cure jaundice.		Sharma *et al*.2014
EQUISETACEAE *Equisetum diffusum* D. Don. (B. Pangeni-14 a, TUCH)	Kurkurejhar-N	(H) W	Wp	Med / fev	The paste of aerial part except root with *Ocimum basilicum* is used to cure typhoid.		
ERICACEAE *Rhododendron arboreum* Sm. (B. Pangeni-345, TUCH)	Laligurans-N	(T) W	Fl	Food / med / gast	The juice of flower is prepared and used to cure dysentery. Flowers are also used in the preparation of pickle.	Coburn 1984; Karna 1997; Shrestha and Dhillion2003	Manandhar 1995; Chaudhary *et al*. 2002
EUPHORBIACEAE *Mallotus philippensis* (Lam.) Müll.-Arg. (B. Pangeni-301, TUCH)	Sindure- M Rohini-N	(T) W	Wp	Med / gast	The paste and juice of bark is made to treat diarrhea and dysentery.		Sharma *et al*.2014
EUPHORBIACEAE *Phyllanthus emblica* L. (B. Pangeni-316, TUCH)	Amala-N	(T) W	F	Food /med / gast / fev	Fruits are taken orally to cure stomach problems, gastric and indigestion. Powder of dried fruit is used to cure diarrhea and dysentery. Dry fruit is used in the preparation of "Triphala", an Ayurvedic medicine used for liver and gastrointestinal troubles.	Bhattarai 1993; Panthi & Chaudhary 2003	Ambu *et al*.2020
FABACEAE *Cassia fistula* L. (B.Pangeni-306, TUCH)	Rajbrikshya-N	(T) W	F (pulp +sd) & R	Med / fev / nerv / met	Root filtrate juice is used to cure fever. Pulp is taken orally for tonic. Powder of seed is taken to cure diabetes.		Sharma *et al*.2014
GENTIANACEAE *Swertia nervosa* (Wall. ex G. Don) C.B. Clarke (B. Pangeni-14b, TUCH)	Nakali Chirayito-N	(H) Cul	Wp	Med / gast / genh	The paste of entire plant is taken after meal for curing diarrhea and stomach problems until recovery. The juice (filtrate from paste) is also used as tonic.	Shrestha *et al*.2016	
LAMIACEAE *Colebrookea oppositifolia* Sm. (B. Pangeni-312, TUCH)	Dhusure-N Dhursi-M	(S) W	L	Domes med / derm / fev	Leaves paste is used locally twice a day for three-four days to cure cut & wounds. Plant is used as fodder.	Ambu *et al*. 2020	

LAMIACEAE *Mentha arvensis* L. (B. Pangeni-329, TUCH)	Pudina-N	(H) Cul	L	Med / resp / gast	Leaves decoction is made to cure throat infection, indigestion and stomach problems.		
LAMIACEAE *Ocimum basilicum* L. (B. Pangeni-11, TUCH)	Babariphul-N	(H) Cul	L, Fl&Sd	Med / resp / nerv / gast	The juice of leaves is taken for curing cough and bronchitis. Flowers are smelled to cure headache caused by Sinusitis. The infusion of seed was given for dysentery.		
LILIACEAE *Asparagus racemosus* Willd. (B. Pangeni-360, TUCH)	Kurilo-N Bhikh-M	(C) Cul	Sh& Rh	Food / med / urinogen / fev	Tender shoots are used to make vegetable curry during summer to rainy season. One-two tuberous roots are burned and taken twice a day after meal for curing fever, two-four teaspoonful powder of dry rhizome was taken to cure urinary troubles.		Budha-Magar *et al*. 2020
LYTHRACEAE *Woodfordia fruticosa* (L.) Kurz (B. Pangeni-300, TUCH)	Dhayaro-N	(S) W	Fl	Med / gast	The powder of dried flower is taken to cure dysentery. Fresh flowers were eaten orally to cure stomach problems.	Siwakoti &Varma 1996; Bhattarai 1993; Mahato & Chaudhary 2005	
MENISPERMACEAE *Cissampelos pareira* L. (B. Pangeni-328, TUCH)	Batulpate, Gurgigano-N	(C) W	Rh & L	Domes / med / fev	One to two teaspoonful rhizome juices used for curing malarial fever. Leaves and aerial parts of the plant are used as fodder.		Sharma *et al.*2014
MORACEAE *Morus serrata* Roxb. (B. Pangeni-322, TUCH)	Kimbu-N	(T) Cul	R & F	Food / med / gast	Fruits are edible. Fresh root paste is used to treat diarrhea.		
OXALIDACEAE *Oxalis corniculata* L.	Chariamilo-N Jhyamruk-M	(H) W	L	Med / ENT	The leave juice is used curing eye infection.	Coburn 1984; Shrestha & Pradhan (1986),	Manandhar 1994; Parajuli 2001
RANUNCULACEAE *Anemone vitifolia* Buch.-Ham. ex DC. (B. Pangeni-12, TUCH)	MaureJhar-N Mauremulo- M	(H) W	L &R	Med / gast	Root paste is taken twice a day for curing dysentery		Budha-Magar *et al*. 2020
RANUNCULACEAE *Clematis buchananiana* DC.	Bagjunge-N	(C) W	L	Med / resp	Two handfuls of leaves are taken and rubbed between the palms and smelled to treat sinusitis.	Ambu *et al*. 2020	

RANUNCULACEAE *Delphinium vestitum* Wall. ex Royle (B. Pangeni-18, TUCH)	Maurejhar-N	(H) W	R	Med / derm	Root paste is applied for curing cut and wounds until drying of infected part.	Budha-Magar *et al*. 2020	
RHAMNACEAE *Ziziphus mauritiana* Lam.	Bayar-N	S) W	F & R	Domes / Food / med / fev	Leaves are used as forage. Fruits were edible. The paste of root was used to treat fever.		
ROSACEAE *Rubus ellipticus* Sm. (B. Pangeni-309, TUCH)	Ainselu-N, Chinag-M	(S) W	F &R	Food / med / gast / met	The ripen fruits are consumed raw. The juice of root is taken for curing dysentery, pneumonia, gastric problems.	Ambu *et al*.2020	
ROSACEAE *Fragaria nubicola* (Lindl. ex Hook.f.) Lacaita (B. Pangeni-308, TUCH)	Bhuikaphal-N	(H) W	F & R	Food / med / gast	Fruits are edible. The rootstocks paste is made and used to treat diarrhea, dysentery and stomach problems.		
RUBIACEAE *Rubia charifolia* Wall ex. G.Don (B. Pangeni-13, TUCH)	Sano kharsite-N	(C) W	R	Med / gast / urogen	The juice of root is filtered through cotton cloth. The extract juice is taken to cure constipation, urinary problem and astringent.		
RUTACEAE *Aegle marmelos* (L.) Correa (observed only)	Bel-N / M	(T) W	F, L & R	Rel / med / fev / gast	Leaves are used as religious purposes. Root juice is taken two times a day for one week to cure fever. About half part of ripen fruit is eaten once a day for 5 days to cure constipation & dyspepsia. Three teaspoonful unripe fruit is taken orally for curing diarrhea.	Panthi & Chaudhary 2003; Siwakoti & Varma 1996; Bhattarai 1993	Joshi & Joshi 2000; Choudhary 2000; Malla1994
SAPOTACEAE *Diploknema butyracea* (Roxb.) H.J. Lam (B. Pangeni-12,TUCH)	Chuiri-N	(T) W	B &F	Rel / med / resp / gast	Leaves are used to make plate in ceremony. Bark paste (one teaspoonful) is taken daily for curing sinusitis. Unripe fruits (two-three) taken orally to cure stomachache for two-three days.		
SAXIFRAGACEAE *Bergenia ciliata* (Haw.) Sternb. (B. Pangeni-355, TUCH)	Pakhanved-N,M	(H) W	R &Rh	Med / musc / gast	Powder of rootstocks is used for treating rheumatism and post-delivery and also to cure diarrhea and dysentery.	Shrestha *et al.* 2016	Budha- Magar *et al*. 2020

SOLANACEAE *Nicotiana tabacum* L. (B. Pangeni-307, TUCH)	Surti, Tamakhu-N	(H) W	L	Med / resp / genh	Powder of leaves is taken orally and with hot water to cure bronchitis. This is also helpful in tonic.		
SOLANACEAE *Solanum torvum* Sw. (B. Pangeni-305, TUCH)	Bihi-N	(S) W	F	Med / nerv / fev	Raw and mature fruits are taken for curing headache and fever.		
TILIACEAE *Corchorus aestuans* L. (B. Pangeni-05, TUCH)	Mungrilo-N	(H) W	R &Sd	Med / fev / mat	Filtrate root juice is used to cure malarial fever. Mixed seed with hot water or milk is given to women after post-delivery of child to increase lactation.		
VERBENACEAE *Clerodendrum infortunatum* L., (B. Pangeni-348, TUCH)	Bhait- N Chitu-M	(S) W	L &Sd	Med / gast	Two –three sun dried leaves are crushed to make powder. This powder is taken with hot water to treat stomachache and gastric.		
ZINGIBERACEAE *Curcuma amada* Roxb.	Haldi-N	(H)Cul	Rh	Med / derm	The paste of rhizome is applied in the infected part of body for skin allergy.		
ZINGIBERACEAE *Zingiber officinale* Roscoe.	Aduwa-N	(H)Cul	Rh	Med / resp / fev	The rhizome juice is used to treat diarrhea, common cold and cough, fever also.	Risal1994; Manandhar 1995;Panthi & Chaudhary 2003; Mahato & Chaudhary (2005)	

[a]N- Nepali, M- Magar; [b]H-Herb. S- Shrub, C-Climber, T-Tree, W- Wild. Cul- cultivated; [c]Fl-Flower, F-fruit, Wp-whole plant, Rh- Rhizome, R- Root / rootstock, L- Leaves, In-Inflorescence, Lx- Latex, S-Stem; Sd-seed; [d]Med- medicinal, Rel- religious, Domes-domestication, gast- gastrointestinal, nerv-nervous system, resp- respiratory problems, urogen-urinary disorders, derm- dermatological, met- metabolic, fev- fever, musc- musculoskeletal, ENT- ear, nose, throat infection, genh- general health

Table 3. Taxonomic diversity of recorded plant species

Family	Number of Genera	Genera Percent Value	Number of species	Species Percent Value
Acanthaceae	1	1.75	1	1.72
Adiantaceae	1	1.75	1	1.72
Amaranthaceae	1	1.75	1	1.72
Apiaceae	2	3.51	2	3.45
Araceae	1	1.75	1	1.72
Asclepiadaceae	1	1.75	1	1.72
Asteraceae	**4**	**7.02**	**4**	**6.90**
Berberidaceae	2	3.51	2	3.45
Campanulaceae	1	1.75	1	1.72
Convolvulaceae	1	1.75	1	1.72
Ebenaceae	1	1.75	1	1.72
Equisetaceae	1	1.75	1	1.72
Ericaceae	1	1.75	1	1.72
Euphorbiaceae	2	3.51	2	3.45
Fagaceae	1	1.75	1	1.72
Gentianaceae	1	1.75	1	1.72
Lamiaceae	**3**	**5.26**	**3**	**5.17**
Lauraceae	1	1.75	1	1.72
Liliaceae	2	3.51	2	3.45
Loganiacae	1	1.75	1	1.72
Lycopodiaceae	1	1.75	1	1.72
Lythraceae	1	1.75	1	1.72
Melastomataceae	1	1.75	1	1.72
Menispermaceae	1	1.75	1	1.72
Moraceae	1	1.75	1	1.72
Myrsinaceae	1	1.75	1	1.72
Oleaceae	2	3.51	2	3.45
Oxalidaceae	1	1.75	1	1.72
Pinaceae	1	1.75	1	1.72
Poaceae	1	1.75	1	1.72
Ranunculaceae	**3**	**5.26**	**3**	**5.17**
Rosaceae	2	3.51	2	3.45
Rubiaceae	1	1.75	1	1.72
Rutaceae	1	1.75	1	1.72
Sapotaceae	1	1.75	1	1.72
Saurauiaceae	1	1.75	1	1.72
Saxifragaceae	1	1.75	1	1.72
Solanaceae	2	3.51	2	3.45
Theaceae	1	1.75	1	1.72
Tiliaceae	1	1.75	1	1.72
Verbenaceae	1	1.75	1	1.72
Zingiberaceae	2	3.51	3	5.17
Total 42	**57**	**100**	**58**	**100**

The most frequent disease categories treated with the reported medicinal plant species and showing the highest citations, were gastrointestinal, fever, musculoskeletal, dermatological, respiratory diseases with the citations of 39, 43, 27, 24, and 22 respectively (Table 4). The IPLCs practice their traditional primary healthcare system based on the availability of medicinal plant resources and external appearances of diseases such as swelling of body parts, colors of sense organs and tongue, body temperature noticed by their hands, colors of urine, stools, etc.

Although, the influences of modern medicine are extremely high in our society (because of the migration of villages' people to city, development of easily handling and facilitated allopathic medicine), Magar ethnic community still continue to depend on traditional medicinal plants found in their locality. This adds the confirmation of therapeutic efficacy of local plants for the treatment of the most common and widespread pathologies.

Herbal Remedies

The plant parts used for the preparation of herbal remedies are presented in Table 5. The underground parts (i.e. root/rhizome/tuber) (27.78%) with maximum citations (30 citations), was found to be the most frequently used plant parts in the preparation of medicine followed by leaves (12.96%), fruits

(12.04%), whole plants (10.18%), flower (8.33%), seed (6.48%), stem (8.33%), bark (5.56%), young shoot parts of plants (3.70%), and latex (4.63%) used by the informants. The high use of underground part in this work was found to be similar with the ethnobotanical study carried out by Bhattarai (2018), Kunwar *et al*. (2013), Ambu *et al*., (2020). The selection of plant parts could be related to their availability during the year and to the higher content of active ingredients.

Table 4. Ailments included in each illness category

Illness category	Ailments	Number of Citations
Gastrointestinal	Gastritis, indigestion, stomach problems, constipation, diarrhea, dysentery, abdominal pain, loss of appetite, liver stones, vomiting	39
Fever	Fever, malarial fever, typhoid fever	43
Musculoskeletal	Body pain, Rheumatism, joint pain, joint swelling, bone fracture	27
Dermatological	Skin allergy, cut, wounds, pimples, boils, itching, burns, pustules, skin infection	24
Respiratory diseases	Common cold, cough, sinusitis, throat problems, breathing problems, rhinitis	22
ENT (ear, nose and throat)	Ear infections, nose swelling, toothache, gums problems, tongue problems, eye diseases, mouth swelling	21
Nervous system	Headache, migraine, insomnia, anxiety	16
Urinogenital	Urinary problems, bladder swelling, blood in the urine, kidney stones	13
Metabolic	Jaundice, diabetes, goiter, blood purification	13
Maternal ailments	Infertility, menstrual disorders, postpartum bleeding, difficulty in childbirth	12
General health	Weakness, fatigue, cancer	11
Total (**11**)		**241**

Table 5. Plant parts used in the preparation of medicine

Plant parts	Use citation	% Citation
Root / Rhizome / Tuber	30	27.78
Leaves	14	12.96
Fruits	13	12.04
Whole plant	11	10.19
Flowers	9	8.33
Stem	9	8.33
Bark	6	5.56
Seed	7	6.48
Young shoot	4	3.70
Latex	5	4.63
Total	**108**	**100**

Focusing only on the 40 plant species used to treat human ailments, the informants reported various ways of medicine preparation. The methods of preparation fall into four categories, *viz*.; plant parts applied as a paste, juice extracted from the fresh parts of the plant, plants used to prepare decoction in combination with water, and powder made from fresh or dried material. Thus, prepared herbal medicine to treat human ailments was administered through different routes as internal and external uses.

Quantitative analysis towards ethnomedicine

The informant consensus factor (Fic) was used to correlate the medicinal plants of particular use by ethnic groups and the degree of agreement of informants about each category of ailments. The different diseases/ailments were classified into 11 categories following the classical book such as Maheshwari (1995), Jain & Mudgal (1999); comparing the available literature (Shrestha *et al*. 2016, Adhikari *et al*. 2019, Ambu *et al*. 2020) as well as based on the verbal information noted on data sheet from the informants. The similar or related diseases were kept in one group, after converting from their native languages (Nepali, Magar) and made equivalent translation into English (Table 4) and a Fic value for each category was calculated. The outcomes showed that the Fic value ranged between 0.48 to 1. The maternal disorder such as milk production had highest values (Fic 1) followed by ENT (ear, nose and throat) problems (Fic 0.95),

musculoskeletal and urinogenital problems (Fic 0.92). Similarly, breast pain problems, syphilis, gonorrhea, and the diseases due to lack of awareness mainly to women (general health- like cancer) (Fic 0.90), dermatological (Fic 0.87), metabolic (Fic 0.83), nervous system (Fic 0.73), fever (Fic 0.67), gastrointestinal (Fic 0.53), and the informants with the lowest (Fic 0.48) agreements were for respiratory diseases (Table 6). High Fic values for a majority of ailments in the present study show the homogeneity of the informants' knowledge in the study areas. A large number of taxa were used for the treatment of gastrointestinal disorder, followed by fever, respiratory disease, nervous system problems and then dermatological problems. The result is almost similar to most of the rural communities of Nepal (Rokaya *et al*. 2010).

Plant species with highest relative frequency of citation (RFCs) were *Cissampelos pariera* (0.86), *Centella asiatica* (0.78), *Bergenia ciliata* (0.54) followed by *Delphinium vestitum* (0.48) and the lowest relative frequency citation was for *Nicotiana tabacum* (0.22) for general health ailment category as can be seen in Table 7. It is also supported by the dependency of local people on the plant resources for their daily life.

Table 6. Informants consensus factor (Fic) by ailment categories, calculated only for multiple use reports

Disease category	Use reports (Nur)	Number of taxa (Nt)	Fic
Gastrointestinal	39	19	0.53
Fever	43	15	0.67
Musculoskeletal	27	3	0.92
Dermatological	24	4	0.87
Respiratory diseases	22	12	0.48
ENT (ear, nose and throat)	21	2	0.95
Nervous system	16	5	0.73
Urinogenital problems	13	2	0.92
Metabolic	13	3	0.83
Maternal ailments	12	1	1.00
General health	11	2	0.90

Table 7. Relative frequency of citation (RFCs) (representing one species for each ailments category)

Ailment category	Plant species	RFCs
Gastrointestinal	*Centella asiatica*	0.78
Fever	*Cissampelos pariera*	0.86
Musculoskeletal	*Bergenia ciliata*	0.54
Dermatological problem	*Delphinium vestitum*	0.48
Respiratory disorders	*Clematis buchananiana*	0.44
ENT (ear, nose and throat problems)	*Oxalis corniculata*	0.42
Nervous system problems	*Cassia fistula*	0.32
Urinogenital disorders	*Asparagus racemosus*	0.26
Metabolic problems	*Cuscuta reflexa*	0.26
Maternal problems	*Corchorus aestuans*	0.24
General Health problems	*Nicotiana tabacum*	0.22

Treatment practices and associated knowledge

Thus, the IPLCs (including Magar ethnic community) have rich traditional knowledge on the utilization of plant resources for their subsistence and livelihood. Majority of the species are being utilized by them for medicinal values followed by food supplements, fodder, fuel wood, and many other miscellaneous uses (Supplementary File 1). Due to poor economic status and poor access to transportation, they have to depend highly on plants and their products for their primary healthcare.

The average numbers of plant utilization reported by informants of 28-39 years of age group was lower compared to that reported by informants of ≥40 years. These findings might suggest that there was a potential loss of indigenous knowledge in the younger generation. Compared to female gender, male informants showed more knowledge in the study area which was because of shyness of female, not frequently going outside for collecting herbal medicine, due to far of jungle area. Another reason of showing low ethnobotanical knowledge of female respondents than male respondents, because the women were not practicing as faith healers (only three out of 16 key informants) as well. As a result, in our research work, it was investigated that key informants showed more potential uses of medicinal practices than the general informants. On the other hand, higher number of plants reported by the

indigenous Magars corroborated the long-standing local belief than that of non-indigenous people in the study area. The highly used medicinal plant species *Cissampelos pareira*, *Centella asiatica*, *Bergenia ciliata*, and *Delphinium vestitum* were found to treat fever, gastric problem, rheumatism, and cut and wound, respectively.

The Informant consensus factor (Fic) shows the homogeneity in the information provides by the informants. The relative frequency citation (RFCs) was found highest to the fever ailments category in which the local people use *Cissampelos pariera* for treating different kinds of fever disease and other species were also used by them. *Centella asiatica* was used to treat the gastric problem is reported in second position of RFCs value. *Bergenia ciliata* for cut and wound along with other species reported was used in the study areas. The high values of RFCs mean higher use of particular plant species for different diseases and low RFCs values indicates the lower use of plant species for treating human ailments and disease which confirms for less preference to use in the study areas for further utilization.

These facts justified the dependency of local people on plant resources for the fulfilment of their daily needs. The interviewed informants showed that the Magar ethnic community found to be more knowledgeable than other IPLCs in the study areas which were in positive answers to the hypothesis. The dissimilarity of results for the same plant species is due to different ethnic groups in different locality and its use by them in their style and system of management.

Conclusions

The present investigation revealed that the ethnobotanical explorations in these study areas is the first attempt to document the indigenous knowledge of local people among the Magars. The Magar community used the different growth habits of plants as a tree, shrub, herb, and climber; among them, herbs are most frequently used and climbers the least.

The traditional healers and knowledgeable persons had given a high degree of level regarding the use of plant species. These facts support that the Magar ethnic community are dependent on plants and their products for their primary healthcare and other purposes in their daily routine. However, traditional medicinal knowledge and medicinal plants are greatly threatened by rapid economic development for various reasons. Thus, policies and practices for the conservation of medicinal plants and their associated traditional knowledge are necessary to be considered.

Based on the present study, following recommendations are made for consideration to sustainably use and manage plant resources for conservation of the traditional ethnobotanical knowledge of local people: i) A fundamental task related to the medicinal plants is to protect the knowledge of local people and to encourage young generations to use medicinal plants in primary healthcare; and ii) Local people should also be trained for sustainable utilization of medicinal plants.

Declarations

List of abbreviations: PRA: Participatory Rural Appraisal, Fic: Informant Consensus Factor asl: above sea level, RFC: Relative Frequency of Citation, IPLC: Indigenous Peoples' and the Local Community, m asl: meter above sea level, GPS: Global Positioning System, TUCH: Tribhuvan University Central Herbarium, and ENT: Ear, Nose, and Throat.

Ethics approval and consent to participate: Permission letter was taken from Department of National Park and Wildlife Conservation, Babarmahal, Kathmandu prior to data collections. Oral agreements were obtained from the local informants and all field data were collected through their oral consents.

Consent for publication: Not applicable.

Availability of data and materials: The Voucher specimens were deposited at TUCH (Tribhuvan University Central Herbarium, Kirtipur, Kathmandu, Nepal). Data will be available from corresponding authors on request.

Competing interest: Authors declared there is not any interest of conflicts between them.

Funding: Not applicable.

Author's contribution: BP performed fieldwork, collected data. SB and RPC analyzed the data and helped to identify the collected specimens. SB and HP helped to prepare the draft for the manuscript. BP conceptualized and wrote the manuscript, SB provided necessary feedback on the manuscript, HP edited the manuscript. RPC supervised the research work.

Acknowledgements

The authors would like to thank traditional healers and local people of Purbakhola Rural Municipality for sharing their knowledge and kind cooperation and hospitality during field visits. Furthermore, the authors would like to thank Mr. Purna B. Ale, Wildlife Biologist at Third Pole Conservancy, Nepal for drawing the map of the study area.

Supplementary Table S1. Plant species used for making Agricultural Equipment

Nepali Name	English Name	Species used
Bancharo	Axe	*Castanopsis indica, Pyrus pashia, Schima wallichi*
Halo	Plough	*Shorea robusta*
Harish	Beam of plough	*Schima wallichi*
Hasiya	Sickle	*Schima wallichi*
Juwa		*Fraxinus floribunda*
Kodalo	Spade	*Castanopsis indica*, *Pyrus pashia*, *Schima wallichi*
Kutte	Mattock	*Castanopsis indica*
Segu	Leaf umbrella	*Arundanaria falcata, Bahunia variegata*

Literature Cited

Acharya R. 2012. Ethnobotanical study of medicinal plants of Resunga Hill used by Magar community of Badagaun VDC, Gulmi district, Nepal. Scientific World 10(10): 54-65.

Adhikari M, Thapa R, Kunwar RM, Devkota HP, Poudel P. 2019. Ethnomedicinal uses of plant resources in the Machhapuchchhre Rural Municipality of Kaski District, Nepal. Medicines 6:69.

Ale R, Raskoti BB, Shrestha K. 2009. Ethnobotanical knowledge of Magar community in SiluwaVDC, Palpa district, Nepal. Journal of Natural History Museum 24(1): 58-71.

Ambu G, Chaudhary RP, Mariotti M, Cornara L. 2020. Traditional use of Medicinal plants by Ethnic people in the Kavrepalanchok District, Central Nepal. Plants 9:759.

Aryal KP, Poudel S, Chaudhary RP, Chettri N, Chaudhary P, Ning W, Kotru R. 2018. Diversity and use of wild and non-cultivated edible plants in the western Himalaya. Journal of Ethnobiology and Ethnomedicine 14(1):1.

Balley LH. 1969. Manual of cultivated plants most commonly grown in the continental United States and Canada, Cornell University, The Machillan Company.

Bhattarai KR, Ghimire M. 2006. Commercially important medicinal and aromatic plants of Nepal and their distribution pattern and conservation measure along the elevation gradient of the Himalayas. Banko Janakari 16(1):3-13.

Bhattarai NK. 1993. Folk herbal remedies for diarrhea and dysentery in central Nepal. Fitoterapia 64(3):243-250.

Bhattarai S, Chaudhary RP, Quave CL, Taylor RS. 2010. The use of medicinal plants in the trans-himalayan arid zone of Mustang District, Nepal. Journal of Ethnobiology and Ethnomedicine 6(1):14.

Bhattarai S, Chaudhary RP, Taylor RS. 2009. Ethnomedicinal plants used by the people of Nawalparasi District, Central Nepal.Our Nature 7(1): 82-99.

Bhattarai S, Chaudhary RP, Taylor RSL. 2006. Ethnomedicinal plants used by the people of Manang District, central Nepal. Journal of Ethnobiology and Ethnomedicine 2:41.

Bhattari KR. 2018. Ethnobotanical study of plants used by Thami community in Ilam District, eastern Nepl. Our Nature 16(1):55-67.

Brosi BJ, Balick MJ, Wolkow R, Lee R, Kostka M, Raynor W, Lee LD. 2007. Cultural Erosion and Biodiversity: Canoe-Making Knowledge in Pohnpei, Micronesia. Conservation Biology 21(3): 875–879.

Budha-Magar S, Bhandari P, Ghimire SK. 2020. Ethnomedicinal survey of plants used by Magar (Kham) community, Rolpa District, Western Nepal. Ethnonobotany Research & Applications 19:18.

CBS (Central Bureau of Statistics). 2005. District Profile of Palpa. Central Bureau of Statistics, Kathmandu, Nepal.

CBS (Central Bureau of Statistics). 2011. National Population and Housing Census. Central Bureau of Statistics, Kathmandu, Nepal.

Chaudhary RP, Nepal M, Gupta VNP, Vetaas OR. 2002. Traditional use of plants by the indigenous people of Makalu-Barun Region, Eastern Nepal. Vegetation and Society: Their Interaction in the Himalayas. (Eds.) Chaudhary RP, Subedi BP, Vetaas OR, Aase TH. Tribhuvan University, Nepal, and the University of Bergen, Norway, Pp 83-97.

Choudhary R. 2000. Ethnobotanical studies of the Tharu community of Bhadgaun Sinuwari VDC of Sunsari District (M.Sc. Dissertation). Central Department of Botany, Tribhuvan University, Kirtipur, Kathmandu, Nepal.

Coburn B. 1984. Some native medicinal plants of the western Gurungs. Kailash 11(1-2):55-88.

Dutta IC. 2007. Non-timber forest products of Nepal: Identification, classification, ethnic uses and cultivation. Institute of Forestry, Pokhara, Nepal.

Frodin DG. 2001. Royal Botanic Gardens, Kew. Guide to Standard Floras of the World. An Annotated, Geographically Arranged Systematic Bibliography of the Principle Floras, Enumerations, Checklists and Chorological Atlases of Different Areas. Cambridge University Press.DOI: https://doi.org/10.1017/CBO9780511541803

Gaire BP, Subedi L. 2011. Medicinal plant diversity and their pharmacological aspects of Nepal Himalayas. Pharmacognosy Journal 3(25):6-17.

Gewali MP. 2008. Aspects of Traditional Medicine in Nepal. Institute of Natural Medicine, University of Toyama.

Ghimire K, Bastakoti RR. 2009. Ethnomedicinal knowledge and healthcare practices among the Tharus of Nawalparasi District in central Nepal. Forest, Ecology and Management 257:2066-2072.

Ghimire SK, Pyakurel D. 2008. A Manual of NTFPs of Nepal Himalaya (Gair Kastha Banpaidawar Digdarshan), Kathmandu, Nepal. WWF Nepal.

Grierson AJC, Long DG. 1983-2001. Flora of Bhutan, Vol. (1-2). Royal Botanic Garden, Edinburgh and Royal Government of Bhutan.

Groombridge B, Jenkins MD. 2002. World Atlas of Biodiversity. Prepared by the UNEP World Conservation Monitoring Centre, University of California Press, Berkeley.

Hara H, Chater AO, Williams LHJ. 1982. An Enumeration of the Flowering Plants of Nepal.Volume III, British Museum (Natural History) London, UK.

Hara H, Stearn WT, Williams LHJ. 1978. An Enumeration of the Flowering Plants of Nepal. Volume I, British Museum (Natural History) London, UK.

Hara H, Williams LHJ. 1979. An enumeration of the flowering plants of Nepal. Volume II, British Museum of Natural History, London, UK.

Hooker JD. (Ed) 1872-1897. The Flora of British India, 1-7. L.Reeve Co.London.

Jain SK, Mudgal V. 1999. A handbook of Ethnobotany. Bishen Singh Mahendra Pal Singh, Dehra Dun, India.

Joshi AR, Joshi K. 2000. Indigenous knowledge and uses of medicinal plants by local communities of the Kaligandaki watershed area, Nepal. Journal of Ethnopharmacology 73:175-183.

Kargioglu M, Cenkci S, Serteser A, Evliyaoglu N, Konuk M, Kok MS, Bagci Y. 2008. An ethnobotanical survey of Inner-West Anatolia, Turkey. Human Ecology 36:763-777.

Karna K. 1997. Medicinal plant and traditional medicinal practices in Chapagaun Village Development Committee of Lalitpur district, central Nepal (M.Sc. Dissertation). Central Department of Botany, Tribhuvan University, Kathmandu.

Kunwar RM, Mahat L, Acharya RP, Bussmann RW. 2013. Medicinal plants, traditional medicine, markets and management in far-west Nepal. Journal of Ethnobiology and Ethnomedicine 9:24.

Kunwar RM, Shrestha KP, Bussmann RW. 2010. Traditional herbal medicine in Far-West Nepal: A pharmacological appraisal. Journal of Ethnobiology and Ethnomedicine 6(1):35.

Lama YC, Ghimire SK, Aumeeruddy-Thomas Y. 2001. Medicinal plants of Dolpo. Amchis' knowledge and conservation.WWF Nepal Program, Kathmandu, Nepal.

Mahato RB, Chaudhary RP. 2005. Ethnomedicinal study and antibacterial activities of selected plants of Palpa district, Nepal. Scientific World 3(3):26-30.

Mahato RB. 2006. Diversity, use, and conservation of plants in Palpa District, Nepal (Ph.D.Thesis). Central Department of Botany, Tribhuvan University, Kirtipur, Nepal.

Maheshwari JK. 1995. Ethnobotanical resources of hot, arid zones of India. In: Ethnobotany-Evolution of a discipline (Eds. Schultes RE, von Reis S). Timber Press, Portland & Cambridge, UK, Pp. 235-249.

Malla B, Gauchan DP, Chhetri RB. 2015. An ethnobitanical study of medicinal plants used by ethnic people in Parbat District of western Nepal. Journal of Ethnopharmacology 165:103-117.

Malla SB. 1994. Medicinal herbs in the Bagmati Zone. Area Development Planning and Implementation, ADPI series No.8, ICIMOD.

Manandhar NP. 1995. A survey of medicinal plants of Jajarkot District, Nepal. Journal of Ethnopharmacology 48:1-6.

Manandhar NP. 2002. Plants and people of Nepal. Timber Press, Portland, Oregon, USA.

Miehe G, Miehe S, Bohner J, Baumler R, Ghimire SK, Bhattarai K, Chaudhary RP, Subedi M, Jha PK, Pendry C. 2015. Vegetation ecology. In: Nepal – An introduction to the natural history, ecology and human environment in the Himalayas: Acompanion to the Flora of Nepal (Eds. Miehe G, Pendry C, Chaudhary RP). Royal Botanic Garden, Edinburgh, UK. Pp. 385-472.

MoFSC/GoN. 2014. Nepal Biodiversity Strategy and Action Plan 2014-2020. Government of Nepal, Ministry of Forests and Soil Conservation, Kathmandu, Nepal.

Pandey MM, Rastogi S, Rawat AKS. 2013. Indian Traditional Ayurvedic System of Medicine and Nutritional supplementation. Evidence-based Complementary and Alternative Medicine, 1-12. http://dx.doi.org/10.1155/2013/376327.

Pangeni B. 2009. Ethnobotanical study of Magar community of Palpa District, Western Nepal (M.Sc. Dissertation). Central Department of Botany, TribhuvanUniversity, Kirtipur, Nepal.

Panthi MP, Chaudhary RP. 2003. Antibacterial activity of some selected medicinal folklore medicinal plants from west Nepal. Scientific World 4(4):16-21.

Panthi MP. Singh AG. 2013. Ethnobotany of Arghakhanchi District, Nepal: Plants used in dermatological and cosmetic disorders. International Journal of Applied Sciences and Biotechnology 1(2):27-32.

Parajuli S. 2001. Antibacterial activity of medicinal plants used to treat skin ailments in the Kaski District (M.Sc. Dissertation). Central Department of Botany, Tribhuvan University, Kirtipur, Nepal.

Polunin O, Stainton A. 1987. Flowers of the Himalaya. Oxford University Press, New Delhi.

Press JR, Shrestha KK, Sutton DA. 2000. An annotated checklist of the flowering plants of Nepal.The Natural History Museum, London.

Rajbhandari KR. 2001. Ethnobotany of Nepal. Ethnobotanical Society of Nepal. Kishor Offset Press, Kathmandu, Nepal.

Risal K. 1994. Preliminary study on some medicinal plants and essential oils for their antimicrobial activities. Proceedings of IInd National Conference on Science and Technology (NAST), Kathmandu, Nepal, 390-393.

Roberson E. 2008. A Native Plant Conservation Campaign Report. Center for Biological Diversity.

Rokaya MB, Münzbergová Z, Timsina B. 2010. Ethnobotanical study of medicinal plants from the Humla District of western Nepal. Journal of Ethnopharmacology 130(3):485-504.

Royal Botanic Gardens Kew. 2016. State of the World's Plants.

Schippmann U, Leaman DJ, Cunningham AB. 2002. Impact of Cultivation and Gathering of Medicinal Plants on Biodiversity: Global Trends and Issues. World 422:000.

Schippmann U, Leaman DJ, Cunningham AB. 2006. A comparison of cultivation and wild collection of medicinal and aromatic plants under sustainability aspects. (Eds: Bogers RJ, Craker LE, Lange D). Medicinal and aromatic plants. Springer, Netherlands, Pp. 75–95.

Sharma J, Gairola S, Sharma YP, Gaur RD. 2014. Ethno-medicinal plants used to treat skin diseases by Tharu community of district Udham Singh Nagar, Uttarakhand, India. Journal of Ethnopharmacology 158:140-206.

Shrestha I, Pradhan N. 1986. Medicinal Plants of Chobhar village of Kathmandu district, Nepal. Natural History Museum 10(1-4):65-72.

Shrestha KK, Bhattarai S, Bhandari P. 2018. Handbook of flowering plants of Nepal: Scientific Publishers, Jodhpur, India.

Shrestha N, Shrestha S, Koju L, Shrestha KK, Wang Z. 2016. Medicinal plant diversity and traditional healing practices in eastern Nepal. Journal of Ethnopharmacology 192:292-301.

Shrestha P.1985. Contribution to the Ethnobotany of Palpa Area. Contribution to Nepalese Studies (CNAS), Tribhuvan University, Kathmandu, Nepal 12(2):63-74.

Shrestha PM, Dhillion SS. 2003. Medicinal Plant diversity and use in the highlands of Dolakha District, Nepal. Journal of Ethnopharmacology 86:81-96.

Singh AG, Kumar A, Tewari DD. 2012. An ethnobotanical survery of medicinal plants used in Terai forest of Western Nepal. Journal of Ethnobiology and Ethnomedicine 8:19. https://doi.org/10.1186/1746-4269-8-19

Siwakoti M, Varma SK. 1996. Medicinal plants of the Tarai of eastern Nepal. J. Econ. Taxon. Bot. Additional Series 12:.423-438. Scientific Publishers, Jodhpur, India.

Stainton A. 1988. Flower of the Himalayas- A supplement. Oxford University Press, New Delhi, India.

Stainton JDA. 1972. Forests of Nepal, John Murray, London.

Trotter R, Logan M. 1986. Informant Consensus: A New approach for identifying potentially effective medicinal plants. In: Etkin NL. (Ed.) Plants in indigenous medicine and diet, behavioural approaches, Redgrave publishing Company, Bedford Hills, NY, Pp 91-112.

Uprety Y, Asselin H, Boon EK, Yadav S, Shrestha KK. 2010. Indigenous use and bio-efficacy of medicinal plants in the Rasuwa District, central Nepal. Journal of Ethnobiology and Ethnomedicine 6(1):3.

WCMC (World Conservation Monitoring Center). 1992. Global Biodiversity: Status of the Earth's Living Resources, Chapman and Hall, London, UK, Pp 585.

WHO (World Health Organization). 2013.Traditional medicine. Report by the Secretariat December.

WHO (World Health Organization). 2019. Global Report on Traditional and Complementary Medicine; Geneva, Switzerland.

http://www.tropicos.org. Accessed on August 2020.

http://www.plantlist.org. Accessed on August 2020.

http://www.gbif.org. Accessed on August 2020.