Ethno-medicinal survey of plants used by Magar (Kham) community, Rolpa district, Western Nepal

Shanta Budha-Magar, Prabin Bhandari and Suresh Kumar Ghimire

Research

Abstract

Background: Medicinal plants (MP) are the primary source of health care in developing countries like Nepal. Specially, indigenous people depend on MP species for their basic livelihood. In this study, we aimed to document MP species and assess their indigenous use among Magar (Kham) community in Western Nepal.

Methods: A list of MP species was prepared through empirical ethnobotanical study and their indigenous use was assessed using a set of questionnaires. The data collected was generalized for MP species diversity, use categories, and life forms. Informant consensus factor (Fic), Use Frequency (UF) and Use Value (UV) were used to find the cultural importance of MP species.

Results: We recorded 82 MP species, belonging to 45 families and 75 genera of which nine species cited in Magar (Kham) community are ethnobotanically new to Nepal. Informant consensus factor value was found to be high (1) for eight ailment categories; cancer, warts, pneumonia, dandruff, frightening, anesthetic, skin disease, eye irritation and leeches. Based on use value index, the most important ethnomedicinal species were *Bergenia ciliata*, *Swertia chirayta*, *Acorus calamus* and *Aconitum gammiei*.

Conclusions: This study provides complete document of indigenous uses of MP species among Magar (Kham) community of Thabang Rural Municipality (RM), Rolpa district. Nine MP species were reported with new uses for the first time in Nepal. There is further possibility of recording of new use reports in other villages adjoining to the present studied Magar Kham community. The species with high cultural values must be tested further for their pharmacological properties.

Key words: Rolpa district, Jaljala Mountain, Indigenous Uses, Quantitative ethnobotany, Use Value Index

Correspondence

Shanta Budha-Magar[1]*, Prabin Bhandari[2] and Suresh Kumar Ghimire[3]

[1]City Campus, Auckland University of Technology, Auckland, New Zealand
[2]State Key Laboratory of Systematics and Evolutionary Botany, Institute of Botany, CAS
[3]Central Department of Botany, Tribhuvan University Kirtipur, Kathmandu, Nepal

*Corresponding Author: shantabmgr@gmail.com

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Background

The term “ethnobotany” was first given by John Harshberger in 1896 to specify use of plants by aboriginal people. It is the study of relationship between aboriginal society and their plant environment (Schults 1962). It is also defined as the science of people’s interaction with plants (Bennett 1996). It deals with the study of relationship of people with plants and the documentation of indigenous knowledge on how local plant resources are utilized by the ethnic groups or communities. The science of ethnobotany includes the understanding of knowledge system by using both the anthropological and botanical approaches (Ford 1978; Davis 1995).

Traditional medicine has been the focus for the primary health care in Nepal and rest of the world since time immemorial. It has been used in either explicably or inexplicably in diagnosis, prevention or elimination of a physical, mental or social disease

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based on past experiences or observation from generation to generation (WHO 2011). MP species are main element in traditional system of healing in developing countries which have been an integral part in history and cultural practices of people. In countries like Nepal, they have been especially valuable in the rural areas where majority (about 80%) of people depend for their primary health care (WHO 2011, UNEP 2012, Sathiyaraj *et al.* 2015). Traditionally, MP species are used as antidote to cure and prevent cuts, wounds, burns, allergies, insect/snake bites and other conditions such as fever, and eye irritation (Shrestha & Dillion 2003, Mahato & Chaudhary 2005, Malla & Chhetri 2009). Furthermore, people use MP species in treatment of illness such as cancer, diabetes, gastrointestinal disorder and skin diseases (Heinrich & Gibbons 2001, Rokaya *et al.* 2014, Kunwar *et al* 2014, Balaraju *et al.* 2015). Besides, people in rural areas harvest MP species for their economic subsistence too (Olsen 2003).

Moreover, MP species are the novel components and important sources of phytochemicals and antioxidants for drug production in pharmaceutical industries (Cunningham *et al.* 2008, Malla and Chhetri 2009, De Boer & Cotingting 2014). About one-third of currently available drugs come from natural products that have a plant origin (Stroh 2000). With an application of developing advance technology in biological activity for screening like high throughput screening and chemical analysis, there have increased interests of researchers towards naturally derived compounds. In this scenario, ethnomedicinal plant survey and recording their subsistence uses will definitely contribute to the identification of MP species (Albuquerque *et al.* 2013). On other hand, ethnomedicinal study analyzes the results of traditional use of plants together with the cultural context in which the plants and plant parts are used and contribute by its various approaches to preserve, promote and conserve indigenous knowledge (Alexiades 2003).

In documentation of indigenous knowledge and improvement of traditional compilation-style of ethnobotanical studies, there has been increasing incorporation of quantitative research methods in data collection, processing, and interpretation (Hoffman & Gallaher 2007). One of such key components in quantitative research is relative importance of plant taxa to different human groups. The relative importance such as use-value indices are elaborated based on the agreement or disagreement in the use of plant species. This depends on the geographical focus of survey, vital use of plant by informant number who mention its usefulness (Tardio & Santayana 2008). Thus, a plant with low importance in broad geographical region could be very important for the people of a small geographical region. Hence, quantitative data thus obtained can be used for macro scale comparison for further study of both biological and cultural diversity (Begossi 1996).

In Nepal, both qualitative and quantitative documentation on use of plants related to ethnomedicine were carried out by several botanists after publication of a paper on medicinal and food plants of eastern Nepal by Banerji in 1955 (Manandhar 2002). Some major studies worked out are; Manandhar 1985, 1986, 1990, 1993, 1995a, 1995b, 2002, Mahato & Chaudhary 2003, Shrestha & Pradhan 1986, Shrestha *et al.* 1998, Ghimire *et al.* 2000, Lama *et al.* 2001, Baral & Kurmi 2006, Shrestha & Dillion 2003, Mahato & Chaudhary 2005, Malla & Chhetri 2009, Uprety *et al.* 2010, Kunwar *et al.* 2013 and Singh *et al.* 2018. However, many communities in different parts of the country are still unexplored. Magar community mostly living in Himalayas or mountains from east to west is one of the least explored community. Only few ethnobotanical studies have been conducted among this community in several parts of Nepal such as; Sapkota 2008, Ale *et al.* 2009, Acharya 2012, Thapa 2012 and Singh *et al.* 2018. Among Magar community, Magar (Kham) community of Rolpa district is unmapped community regarding ethnobotanical knowledge, which constitutes 44% of the district (CBS 2011). They are involved in agriculture and hence highly dependent on local resources specially on MP for their basic health care requirements. But, ethnobotanical study regarding their indigenous knowledge is almost nil. Therefore, we aimed to document indigenous knowledge of this community on use of medicinal plants in Rolpa district, Western Nepal.

Materials and methods

Study area

This present study was conducted in ward one and two of Thabang RM in mid-mountain zone of Rolpa district western Nepal (Figure 1). The district is surrounded by Dang to South, Pyuthan to East, Rukum to North and Salyan to West. Geographically, Rolpa lies between 28.8^0 to 28.38^0 N latitudes and 82.10^0 to 83.90^0 E longitudes with an elevation range of 700-3600 m asl (meter above sea level). However, present study Thabang RM lies between $28^0$30'29.92" to $28^0$23'52.92" N latitude and $82^0$42'06.32" to $82^0$44'43.73" E longitude and the elevation ranges from 2000 m to 3580 m asl. This area is characterized by the monsoonal type of climate (mean annual precipitation; 1569.7 mm). Mean annual maximum temperature (Tmax.) varies from 19.60^0C to 35.12 ^{0}C and minimum temperature

(Tmin.) varies from 5.30^{0}C to 22.86 ^{0}C (*Source*: Department of Hydrology and Meteorology, GoN, Kathmandu). This topographic and climatic variability in Jaljala Mountain area have created complex ecological gradients within a small area allowing a great diversity of ecosystems; forests, grasslands or meadows, and wetlands. This zone is characterized by typical assembles of both western and eastern Himalayan elements of flora and fauna. Main inhabitants are Magar (Kham) people of Athâra magarât followed by occupational groups (Bishowkarma and Nepali). Agriculture (animal husbandry and crop production) is the main livelihood strategy adopted in the region. Besides this, collection of Non-timber forest products (NTFPs) including medicinal and aromatic plants is other source of Magar (Kham) people's income.

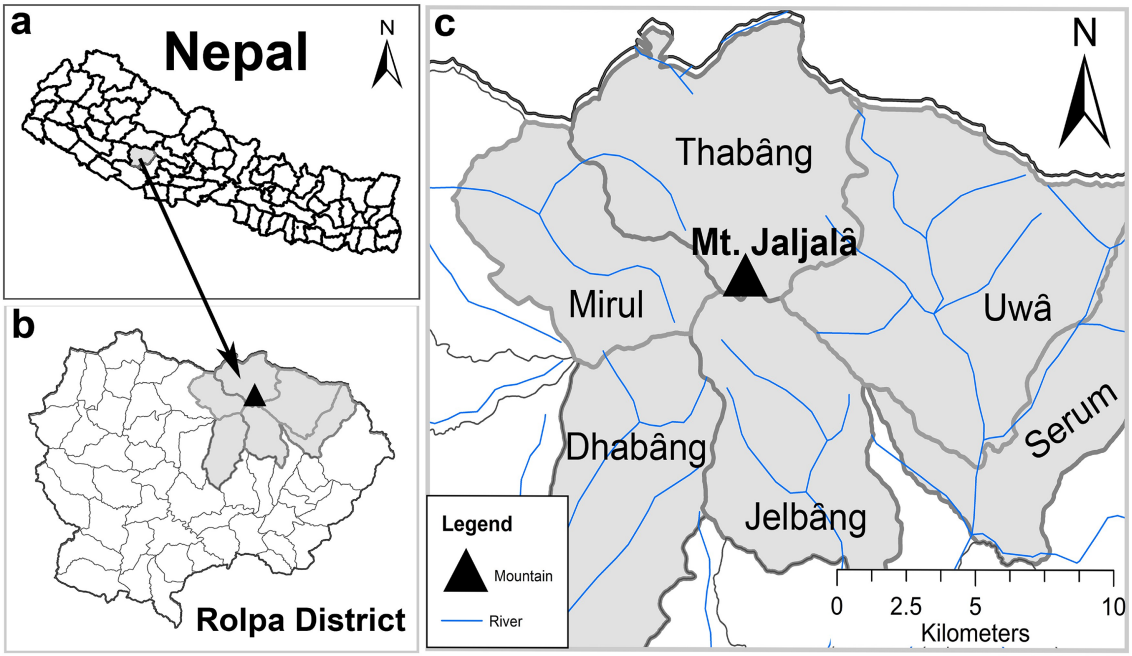

Figure 1. Map of Study area (a) Nepal (b) Rolpa District (c) Jaljala mountain, with surrounding VDCs (Source: Department of Survey, GoN)

Field work and ethnobotanical data collection

An ethnobotanical reconnaissance and data collection were conducted in two field visits in September 2014 and April 2015. Village heads, healers, herders and forest dwellers were invited to participate in FGD (Focus Group Discussion). But general informants were randomly selected, irrespective of age, occupation, sex, religion, education level and castes for interview. Ethical issues were made clear with local people and traditional healers of the communities as established by CBD (Conventional of Biological Diversity) erstwhile the group discussion and interview to share their knowledge. Then, ethnomedicinal data were collected based on an interaction with indigenous people through FGD and direct observation in the field and in-depth data was collected through individual interview

Focus Group Discussion (FGD)

A total of four Focus Group Discussion (FGD) were conducted in four different villages (Phuntibang, Kherbang, Thabang and Surbang). In each discussion, there were 20-30 people including traditional faith healers, village heads and other local people from different sex and age. The participants were selected based on their rich indigenous knowledge and long-term experience on utilization of plants as well as their living period in the study area as recommended by local administration and district forest officers. During FGD, basic ethnomedicinal information of medicinal plants regarding on their status, uses and priority species were listed. Two resource persons were chosen among participants in FGD conducted in Phuntibang village as recommended by them.

Interviews

We collected an in-depth information through individual interview employing a set of semi-structured questionnaires. We randomly interviewed a total of 50 [(30 male and 20 female) including 5 *Jhankries* - the traditional healers (4 male and 1 female)]. Our data set of questionnaires covered the respondents' backgrounds namely, the name, age, sex, occupation, level of education, annual income, MP plant taxa, their habitat and distribution, major use categories, part(s) used, mode of collection,

local status, trade, strategy for mainstay and people's perception on conservation (Additional file 1).

Onsite observation

Furthermore, transect walk was made to identify local habitat distribution zone of locally used MP species. This comprised of walking along the elevation gradient from 2000 to 3580 meter above sea level in different aspects. During transect walk, plant samples were collected and were cross-checked to confirm the plant use. Two resource persons were involved in the transect walk for collecting locally cited useful plant specimens.

Identification, nomenclature and reliability test of uses

The collected specimens were pressed, dried, mounted and preserved based on standard methods as given by (Forman & Bridson 1989). The specimens were identified with the help of standard literatures (Hooker 1872, Hara *et al.* 1978, 1982, Hara & Williams 1979, Grierson & Long 1983; Press *et al.* 2000, Pearce & Cribb 2002, Polunin & Stainton 1984, Polunin *et al.* 1987, Stainton 1988, Obha *et al.* 2008, Rajbhandari & Rai 2017). Furthermore, the species were confirmed by comparing with herbarium specimens deposited at KATH (National Herbarium and Plant Laboratories, Godawori, Lalitpur, Nepal), TUCH (Tribhuvan University Herbarium, Department of Botany, Kirtipur, Kathmandu) and digital specimens deposited at TI (Herbarium of the University of Tokyo, Japan), K (Herbarium, Royal Botanic Garden, Kew, UK) and E (Herbarium, Royal Botanic Garden, Edinburgh, UK). Then, voucher specimens were deposited in TUCH and KATH. For nomenclature of species; The plant list (http://www.theplantlist.org/), catalogue of life (www.catalogueoflife.org) and Shrestha *et al*. 2018, Eflora (www.efloras.org) for Latin name and Nepali name and EPPO Global Database (https://gd.eppo.int/) was followed for English names. Finally, various literatures of recent reviews on flora of Nepal and ethnobotany (e.g. Lama *et al.* 2001, Rajbhandari 2001, Manandhar 2002, Baral & Kurmi 2006, Bhattarai & Ghimire 2006, Dutta 2007, Ghimire & Pyakurel 2008, Rokaya *et al.* 2010, Shrestha *et al.* 2018) were consulted to compare plant uses.

Data analysis

Both qualitative and quantitative techniques were used to document MP species, compare their uses and cultural importance. Quantitative analyses, especially cultural importance is of great scientific interest as they reflect the cultural value systems, and they aid in the conservation of the biodiversity (Byg & Baslev 2001) have been used. The data collected through interview was generalized qualitatively for documentation of MP species diversity, life forms and analyzed using three different quantitative tools: Informant consensus factor (Fic), Use Frequency (UF) and Use Values (UV). The Fic was calculated to estimate use variability of plant species and determine which species are particularly interesting (Trotter & Logan 1986, Heinrich *et al.* 1998). Fic values range from 0 to 1. High Fic values are obtained when only one or few plant species are reported to be used by high proportion of informants for particular use, but low Fic values indicate that informants disagree over which plant species to use. Thus, high Fic value can be used to point out interesting plant species for further research. Fic was calculated using the following formula:

$$\text{Fic} = \frac{\text{Nur} - \text{Nt}}{\text{Nur} - 1}$$

Where, Nur is the number of informants using particular plant species for particular use category and Nt is the total number of plant species used by all informants for that particular use category.

Similarly, use frequency (UF) was calculated in order to find out the frequency of use of medicinal plant species. It is high when many informants cite the given plant species and approach to zero when only few informants cite a given plant species. It does not show whether a plant species is used for single or multiple purposes. UF was calculated using the following formula used by Tardio & Santayana 2008:

$$\text{UF} = \frac{\text{U}}{\text{n}}$$

Where U is the number of informants who cite the given plant species and n is the total number of informants interviewed in the survey.

Likewise, use value (UV) was calculated in order to find out the importance of medicinal plant species (Arulappan *et al.* 2015). It is high when a given species is cited for many categories and approach to zero when a species is cited for a single or few categories. It shows whether a plant species is used for single or multiple purposes. UV was calculated using the following formula given by (Philips & Gentry 1993):

$$\text{UV} = \frac{\sum \text{Uc}}{\text{n}}$$

Where Uc is the number of uses mentioned by each informant for a given species and n is the total number of informants.

Results

Diversity of medicinal plants and their indigenous uses

In present study, a total of 82 MP species out of 175 useful species were recorded, belonging to 45 families and 75 genera based on empirical

Table 1. Medicinal plant species and their indigenous uses in Magar Kham people reported in study area. (†=Voucher specimen not collected)

Botanical name	Nepali name	English name	Local name (Magar)	Life form	Parts used	Use category	UV	UF	Collection number / Herbarium	Present findings (indigenous uses)	Previous findings
FERNS AND FERN ALLIES											
Equisetaceae *Equisetum arvense** L.		Common horsetail	*Mikrop*	Herb	RtSh	Md	0	0	88 TUCH	Root and stem pieces are mixed with algae and *Rumex acetosella* roots, and grunt then wrapped on cotton and hang around child's neck during fever.	
Pteridaceae *Cheilanthes albomarginata* C.B. Clarke			*Dumni sinkâ*	Herb	Lf	Md	1	0.02	95 TUCH	Leaf paste is used externally in cuts and wounds.	Rh; medicine (2) Wp, Rh, Lf: medicine (1,9)
Selaginellaceae *Selaginella biformis* A. Braun ex Kuhn			*Pa*	Herb	Lf	Md	1	0.06	68 TUCH	Plant paste is applied on cuts and wounds for quick healing.	Lf, Rh: medicine (2)
GYMNOSPERMS											
Pinaceae *Pinus wallichiana* A.B. Jacks.	Gobre sallo	Himalayan pine	*Dhupi*	Tree	Wd Rn	FWTm Md	1	0.22	97 TUCH	Woods are used as fuelwood and timber. The resin is applied externally to treat skin fracture.	Rn: medicine (1,5), Wd, Rn: material, commercial (2,3); Rn: medicine (1), Wd: religious (8)
Taxaceae *Taxus contorta* Griff.	Loth sallo	Western Himalayan yew	*Jham chettri*	Tree	Sh	FWTm Fd Md	1	0.12	431 KATH/ TUCH	Wood pieces simply used as tea or are boiled, and decoction obtained is drunk to treat cancer. Also, woods are used as fuelwood and timber. And, leaves are used as incense.	Wd, Lf: incense, medicine (2), religious (8)
Botanical name	**Nepali name**	**English name**	**Local name (Magar)**	**Life form**	**Parts used**	**Use category**	**UV**	**UF**	**Collection number / Herbarium**	**Present findings (indigenous uses)**	**Previous findings**
ANGIOSPERMS											

Amaryllidaceae											
Allium sativum L.	Lasun	Garlic	*No*	Herb	Rt	Md	1	0.08	†	Bulbs are ground and mixed with dried human placenta (*Nâbi*) and given to cattle during poison.	Bu: medicine (1,5), food (2,11)
Allium tuberosum Rottler ex Spreng.	Dundu	Fragrant Onion	*Haddi jor*	Herb	Rt	Md	1	0.06	550 TUCH	Bulb juice applied on bone fracture and wrapped with cloth.	Lf, Sd: medicine (1)
Apiaceae											
Heracleum candicans var. *obtusifolium* (Wall. ex DC.) F.T. Pu & M.F. *Watson*			*Tee*	Herb	Rt	Md Fd	2	0.12	307 KATH/ TUCH	A small root piece is chewed to treat stomach pain. Tender shoots are cooked as vegetable. Dried leaves are used by witch doctors (*Jhankries).*	Rt, Fr: medicine (3,7)
Araceae											
Arisaema jacquemontii Blume	Sarpako makai	Jacquemont's Cobra lily	*Bhinu*	Herb	Rt	Md Fd	2	0.12	†	Seeds are swallowed without chewing in case of worm infestation (*Chânpâkirâ*). Leaves are cooked with *Rumex hastatus* as vegetable. Fresh corms are considered to be poisonous.	Wp: medicine (1,5); Lf, Cm: food (2); Tu: medicine (7)
Asparagaceae											
Agave americana L.	Ketuki	Century plant	*Siundi*	Tree	Lf	Md	1	0.02	†	Leaf paste is applied to cure gout (*Chhâre*).	Wp: food, medicine, fiber, material poison (1,4,5); Rt: medicine (5)
Asparagus racemosus Willd.	Kurilo	Asparagus	*Kurilâ*	Herb	Rt	Fd	1	0.18	†	Tender shoots are used as vegetable and root juice is used as antidote	
Asteraceae											
Ageratina adenophora (Spreng.) R.M. King & H. Rob.	Ban mara	Sticky snakewort	*Mawobâ di jangal*	Herb	Lf	Md	1	0.36	†	Juice of the leaves is applied to stanch bleeding wounds. The juice is also used to treat chicken suffering from diarrhea.	Lf: medicine (1,2,9,11)
Botanical name	**Nepali name**	**English name**	**Local name (Magar)**	**Life form**	**Parts used**	**Use category**	**UV**	**UF**	**Collection number / Herbarium**	**Present findings (indigenous uses)**	**Previous findings**
Artemisia dubia L. ex B.D.Jacks.	Titepati	Mugwort	*Pâti*	Herb	Sh	SRMd	1	0.22	835	Leaf juice is applied on wounds. Dried leaves	Lf: medicine (2,9); Lf, Fl:

									KATH/ TUCH	and flowers are used as incense.	Social and Religious (1)
Cirsium verutum (D. Don*)* Spreng.	Thakal	Thistle	*Jhyankâl*	Herb	Rt	Md Fd	1	0.1	810 TUCH	Root juice is taken to relieve fever (*Joro*). A piece of root wrapped in cloth and hung over the weepy child's neck as necklace (*Jantar)* to cure Marasmus. Inner portion of stem eaten fresh.	Rt: medicine (1,2), food (2); Rt and Sh: (9)
Leibnitzia nepalensis (Kunze) Kitam.			*Jhula*	Herb	Sh Rt Lf	Md	1	0.08	625 TUCH	A piece of root chewed to cure stomachache. Leaf paste is applied on wounds. Dry leaves are used as tinder.	St, Lf, Fr: medicine (3)
Myriactis nepalensis Less.	Thuke phool		*Lese kura*	Herb	Lf	Md	1	0.34	661 TUCH	Plant juice or powder is applied to cuts, wounds and burns.	Fr: food (2)
*Taraxacum parvulum** DC.	Tuki phool	Dandelions	*Dhalmu ndrâ*	Herb	Rt Lf	Md	2	0.2	426 KATH/ TUCH	Leaf juice or latex is applied on cuts and wounds. Roots are traded. Dried plant is used in tea.	
Begoniaceae											
Begonia picta Wall.	Magar kanche		*Kumkum*	Herb	Fr	Md	1	0.02	530 KATH/ TUCH	Fruits are chewed to cure toothache.	Wp: medicine, food (2,10)
Berberidaceae											
Berberis aristata DC.	Chutro	Tree turmeric	*Kâtike chyântro*	Shrub	Rt	DT Md	2	0.48	1011J KATH/ TUCH	Extract from the root bark is taken twice a day to treat jaundice (*Pihile*) and diarrhea (fu). Stem bark is used as a source of yellow dye. Ripe fruits are eaten raw. Alcohol is distilled from ripe fruit.	Fr,St,Rt,Br: medicine,food (8),dye (1,2,8,9)
Botanical name	**Nepali name**	**English name**	**Local name (Magar)**	**Life form**	**Parts used**	**Use category**	**UV**	**UF**	**Collection number / Herbarium**	**Present findings (indigenous uses)**	**Previous findings**
Cannabaceae											

Cannabis sativa L.	Bhang	Hemp	*Bhângo*	Herb	Br	Md Fb Ol	1	0.32	†	Bark fiber used for rough clothes (*Bhangaurâ*), sacks, bags. Resinous exudations of the stem, and young leaves and inflorescence yields intoxicating drug 'Gânâ" (*Attar)*. Applied on body to treat pneumonia and fever. Seeds are roasted and pickled. Oil extracted from seeds used to treat gout.	Br, Lf, Sd: fiber, medicine, food (1,2,4,5,9)
Caprifoliaceae											
Morina longifolia Wall. ex DC.		Long-leaved whorl flower	*Jhyankâ tu*	Herb	Rt	Md	1	0.02	656 KATH/ TUCH	A small piece of root or latex, mixed with other herbs is given to relieve from fever.	Wp: incense (2); St, Lf, Fl: medicine (1)
Valeriana hardwickii Wall.	Nakkali jatamasi		*Somâyâ*	Herb	Rh	Md	1	0.1	478 KATH/ TUCH	Root paste is applied on forehead to treat headache. Root traded.	Lf, Rh: medicine, food, religious (3), Rh: incense, medicine (8)
Caryophyllaceae											
Drymaria cordata (L.) Willd. ex Schult.	Abhiijaalo	Whitesnow	*Nayâ jungle*	Herb	Sh,	Md	1	0.06	†	Plant juice is applied to cure wounds and itches.	Wp, Lf, Ts: medicine, food (2)
Stellaria himalayensis Majumdar			*Armâle*	Herb	Lf	Fd	1	0.14	†	Leaf juice is applied on cuts and wounds. Tender shoots and leaves cooked as vegetable.	Wp: medicine (1,2); Ts, Lf: (2)
Cornaceae											
*Cornus capitata** Wall.	Dimur	Strawberry dogwood	*Phuli*	Tree	Wd	Fw	1	0.06	510 KATH/ TUCH	Ripe fruits eaten fresh and believed to cure headache. They are also brewed to distill alcohol. Wood used as fuelwood.	
Cucurbitaceae											
Solena heterophylla Lour.	Bankankro		*Bidumbâ*	Climb er	Rt	Md	1	0.1	450 KATH	Plant juice is given to treat stomachache. Fruits are eaten fresh.	Wp, Fr: medicine, fodder, food (2)
Botanical name	**Nepali name**	**English name**	**Local name (Magar)**	**Life form**	**Parts used**	**Use category**	**UV**	**UF**	**Collection number / Herbarium**	**Present findings (indigenous uses)**	**Previous findings**
Cyperaceae											
*Cyperus cyperoides** (L.) Kuntze	Karaunte	Pacific island flatsedge	*Tolâgâth â*	Herb	Rt	Md	2	0.08	†	Roots are chewed in case of gastritis (*Gâno*).	

Imperata cylindrica (L.) P. Beauv.	Siru	Silver spikegrass	*Siru*	Herb	Lf	Fo	1	0.02	†	Plant is used for fodder purposively to kill worms and to treat diarrhea in cattle and goats.	Wp, Rt; fodder, medicine (1,2)
Dipsacaceae											
Dipsacus inermis Wall	Ban Karyal		*Mipâ/ Taukejhâr*	Herb	Lf	Md	1	0.12	537 KATH/ TUCH	Leaf juice is applied to treat burns and cuts daily till it heals up.	Wp: fodder (2); Lf,Td: food(8)
Ericaceae											
Rhododendron arboreum Sm.	Laali gurans	Tree rhododendron	*Sarwâi*	Tree	WdLf	FW	1	0.22	509 TUCH	Flower powder or petals used to extract fish bone stuck in throat. Tender leaves and wilted flowers considered to be poisonous. Wood used as fuelwood and timber.	Wd, Br, Lf, Fl: material, medicine, food, poison (2), Br, Lf, Fl: medicine, poison (4,5,9)
Rhododendron campanulatum D. Don	Bell rhododendron	Chimal	*Kawai*	Tree	Fl	Md	1	0.1	816 TUCH	Flower juice applied on scabies (*Dâda).* Leaf juice used to kill rats.	Fl: medicine (1)
Fabaceae											
Campylotropis speciosa subsp. *eriocarpa* (Schindl.) Iokawa & H. Ohashi	Sakino		*Sângkhinâ*	Shrub	Rt	Md	1	0.14	708 KATH/ TUCH	Root juice is taken to cure diarrhea.	Fl: food (2,9)
Flemingia strobilifera (L.) R. Br.	Bhatwasi	Wild Hops	*Bhuisânkhinâ*	Shrub	Rt	Md	1	0.14	700 KATH/ TUCH	Root juice is taken in case of diarrhea and dysentery.	Rt,Br, Fr: medicine food (2), Rt, Br: medicine (1,9)
Fagaceae											
Quercus lanata Sm.	Baajh	Woolly-leaved Oak	*Mising*	Tree	Sh Br Rn	FW Md	1	0.16	†	Bark exudation (*Bânjhakhutti*) applied on or drunk for sprains. Resin is useful for soothing body aches caused by heavy physical work. Plant is lopped for fodder. Woods are used as fuelwood and timber. Fruits eaten by pigs.	Br: medicine (1,2), Wd: Fl (2)
Botanical name	**Nepali name**	**English name**	**Local name (Magar)**	**Life form**	**Parts used**	**Use category**	**UV**	**UF**	**Collection number / Herbarium**	**Present findings (indigenous uses)**	**Previous findings**
Quercus semecarpifolia Sm.	Khasru	Brown Oak	*Kar*	Tree	Wd	FW	1	0.16	†	Bark exudations (*Bânjhakhutti*) applied or drunk for sprains. Resin is taken for soothing	Wd, Br,Lf,Rn,Sp:Timber, fuelwood,

										body aches caused by heavy physical work. Plant is lopped for fodder. Woods used as fuelwood and timber.	medicine, food (2)
Gentianaceae *Swertia chirayta* (Roxb). Karst.	Chiraito		*Runkâ*	Herb	RtShLf Fl	Md	2	0.48	600 TUCH	Plant juice is given to treat cold, cough, headache and jaundice.	Wp: medicine (1,2,3,4,5,9)
Geraniaceae *Geranium procurrens** Yeo			*Châpâ*	Herb	Sh,	Md	1	0.04	554 KATH/ TUCH	Plant mixed with other plants (*Giardinia, Rheum austral, Rumex* and *Prunus cerasoides)* pounded and applied on sprains (*Piriu)*	
Juglandaceae *Juglans regia* L.	Sano Okhar	Walnut	*Khâsai*	Tree	SR		1	0.24	757 TUCH	Bark is chewed in case of toothache. Also yields dye and sometime used as fish poison. Woods serve as essential item during funeral. Kernel eaten raw.	Br: medicine (1)
Lamiaceae *Leucosceptrum canum* Sm.	Bhusure		*Phusaryâ*	Shrub	Rt	Md	1	0.02	806 TUCH	Root paste is applied to wounds.	Lf, Fr; fodder, food (2)
Prunella vulgaris L.		Common selfheal	*Dhâkar*	Herb	Lf	Fd,	1	0.08	†	Plant paste is used to treat backaches.	Wp: medicine (2)
Lauraceae *Lindera neesiana* (Wall. ex Nees) Kurz	Sil timur		*Tiipâ*	Tree	Fr	Fd,	2	0.14	697 KATH/ TUCH	When cattle, eat poisonous plants, dry fruits given and also to remove placenta during delivery. People eat fruits in case of stomach problems and flatulence and sometime use as spices in vegetable too.	Rt, Br, Lf, Fr, Sd: medicine (1,5); Fr, Sd: medicine (2,9)
Botanical name	**Nepali name**	**English name**	**Local name (Magar)**	**Life form**	**Parts used**	**Use category**	**UV**	**UF**	**Collection number / Herbarium**	**Present findings (indigenous uses)**	**Previous findings**
Melianthaceae *Paris polyphylla* Sm.	Satuwa	Love apple	*Satawâ*	Herb	Rh	Md	1	0.32	836 TUCH	Rhizome powder in low amount is applied to cuts and wounds for rapid healing. High use of powder gets plugged	Rh: medicine (1,2,3,4,8,9), commercial (3)

										in the muscles. Root juice is taken twice a day as antidote in poison.	
Orchidaceae											
Dactylorhiza hatagirea (D. Don) Soó	Panchaule	Marsh orchid	*Pâncha*	Herb	Rh	Md	2	0.18	†	A piece of rhizome is simply chewed to cure stomachache, headache and typhoid.	Rh, Lf: medicine (2,9); Tu: medicine (1,7), Tu: medicine, food, Commercial (3,8)
Pleione humilis (Sm.) D. Don			*Ghabeto*	Herb	Rh	Md	1	0.02	742 KATH	Bulb is simply eaten for quick expedite of bone fracture.	Bu: medicine (1,2)
Satyrium nepalense D. Don			*Sirki*	Herb	Rh	Md	1	0.08	613 KATH	Roots are simply chewed to treat stomach pain.	Rt: medicine (1, 11); Bu,Lf: food (2)
Orobanchaceae											
Lindenbergia muraria (Roxburgh ex D. Don) Brühl	Bagh mukhe ghans		*Garichan*	Herb	Rt	Md	1	0.12	705 TUCH	Plant juice is applied daily to cuts, wounds and burns healing.	Lf: medicine (1)
Phytolaccaceae											
Phytolacca latbenia (Moq.) H. Walter	Jaringo	Pokeweed	*Jargo*	Herb	Rt	Md	1	0.06	†	Root juice is taken to treat gastritis. Large amount is considered to be fatal and may result into death too. Tender leaves and shoot are cooked as vegetable.	Lf, Ts: food (2); Rt: medicine (9); Rt, Fr: medicine, condiment (1); Rt: medicine (5)
Plantaginaceae											
Plantago asiatica subsp. *erosa* (Wall.) Z.Yu Li		Asiatic plantain	*Hâte/ Gândowâsa/ântakatawâ*	Herb	Rt	Md	1	0.12	501 KATH/ TUCH	A small piece (about 1 gm) of root is chewed or juice mixed with other herbs (root of *Potentilla and Rumex)* is taken daily before meal to treat gastritis. Large amount is considered and may result in bloody vomiting.	Rt: medicine (2)
Botanical name	**Nepali name**	**English name**	**Local name (Magar)**	**Life form**	**Parts used**	**Use category**	**UV**	**UF**	**Collection number / Herbarium**	**Present findings (indigenous uses)**	**Previous findings**
Polygonaceae											
Bistorta milletii (H. Lév.) H. Lév.	Myakure	Crimson knotweed	*Pâtwa/Lâpse*	Herb	Rt	Md	1	0.2	331 KATH/ TUCH	Root juice given in case of dysentery and diarrhea and applied on cuts and wounds.	Sd: food (2)

Fagopyrum megarcarpum H.Hara			*Ban bhâde*	Herb	Rt	Md	1	0.14	538 KATH/ TUCH	Root is used to treat diarrhea and gastritis. Leaves are given to pigs	Lf, Ts: food (2,9)
Rheum australe D. Don	Padamcha al	Himalayan rhubarb	*Chhikum*	Herb	Rh	DT	1	0.28	308 KATH/ TUCH	A piece of rhizome is simply chewed, or juice is taken to treat stomach pain. Petioles are used as pickle. Root extract is used as light-yellow dye.	Rh: medicine (1,2,3,6), dye (2,8), trade (8) Pt: food (3,8)
Rumex nepalensis Spreng.	Halhale		*Theulâ*	Herb	Rt	Md	1	0.3	381(CP) KATH/ TUCH	Root is simply chewed, or juice mixed with other herbs (*Potentilla and Plantago* root) is taken before meal to treat gastritis and diarrhea.	Wp: medicine, food (1,2,3)
Ranunculaceae											
Aconitum gammiei Stapf	Bish		*Bikhamâ*	Herb	Rt	Md	1	0.18	*	A small piece of root is chewed for heartburn (gastritis) and stomachache (*Khâyopiyo).*	Rt: Medicine (1,2,5)
Aconitum spicatum Don	Bish	Nepal aconite	*Ning*	Herb	Rt	Md Po	2	0.2	670 KATH/ TUCH	Leaf juice is applied on cuts and wounds, then wound is properly washed. Application for longer periods might be toxic. Small root pieces swallowed as anthelmintic. Large amount can be fatal. *Aconitum gammiei* (bikhamâ) is considered to be antidote for the poisonous effect of *Aconitum spicatum.*	Wp: Medicine (4,6), Rt: Poison (2), Trade, medicine (3,7), Tu: poisonous (5,9), commercial (8)
Anemone rivularis Buch. -Ham. ex DC.	Haatti paaile	Riverside Windflower	*Dhaskim*	Herb	Lf	Po	1	0.06	†	Leaf juice applied to treat gout and used to kill leeches. Large amount is fatal.	Wp: medicine (1,2,5,9,11), Sd: food (2,9); Fr, Sd: (7)
Botanical name	**Nepali name**	**English name**	**Local name (Magar)**	**Life form**	**Parts used**	**Use category**	**UV**	**UF**	**Collection number / Herbarium**	**Present findings (indigenous uses)**	**Previous findings**
Anemone vitifolia Buch. -Ham. ex DC.	Maaure Mulo	Windflower	*Kapâso*	Herb	Fr	Md	1	0.34	560 KATH/ TUCH	Powdered achene is applied in cuts and wounds. Wooly hairs of achenes used as tinder.	Rt, Lf, Fr: medicine (1,2,9)

*Clematis terniflora** DC.		Sweet autumn clematis	*Abijâle*	Climber	Sh	Md	1	0.08	829 †	Aerial part paste is applied to treat gout. Whole plant juice is applied on cloth and is applied to cure itching and joint ache. Large amount is considered to be fatal.	
Delphinium himalayae Munz		Himalayan larkspur	*Nirmasii*	Herb	Rt	Md	1	0.1	†	A small piece of root is simply chewed before breakfast daily for 2 to 4 days in case of headache. Large amount is fatal.	Rt: Medicine (1), Tu: medicine (1,3,8,11), poison (1), Commercial (3,8)
*Delphinium grandiflorum** L.		Bouquet larkspur	*Atis*	Herb	Rt	Md	1	0.02	830 KATH/ TUCH	A small piece of root is chewed to treat stomach pain and typhoid each morning before breakfast. Root paste is applied for joint pain.	
Delphinium vestitum Wall. ex Royle	Mawar-mul		*Mangrâ mhul*	Herb	Rt,Lf	Md	2	0.28	612 KATH/ TUCH	The root is used as anthelmintic. It is also used to poison dogs. Root and leaf paste mixed with *Aconitum sp.* is applied on wounds and juice is given to animal during delivery.	Rt: medicine (1,2,9,11), poison (2)
Rosaceae											
Cotoneaster microphyllus Wall. ex Lindl.	Khoreto	Rock-spray cotoneaster	*Sapithâlâ*	Shrub	Fr	Fw	1	0.02	525 KATH/ TUCH	Raw fruits are eaten and believed to cure asthma	Wd, Fr: Fuel, food (2)
Potentilla lineata Trevir.	Bajradanti		*Ban mulâ*	Herb	Rt	Md	1	0.32	†	A piece of root (about 1 gm) is simply chewed or juice mixed with root juice of *Potentilla* and *Rumex* in equal amount is taken daily before meal to treat gastritis. Large amount is considered to be fatal.	Rt: medicine (1,9)
Botanical name	**Nepali name**	**English name**	**Local name (Magar)**	**Life form**	**Parts used**	**Use category**	**UV**	**UF**	**Collection number / Herbarium**	**Present findings (indigenous uses)**	**Previous findings**
Prinsepia utilis Royle	Dhatelo	Cherry prinsepia	*Kaikirâm*	Shrub	Sh,	FWMd	1	0.12	†	Seed oil is used in case of joint ache or gout.	Sd: medicine (1,10)

Prunus cerasoides Buch. -Ham. ex D. Don	Painyu	Wild Himalayan cherry	*Paiyâ*	Tree	St	SRDTMd	0	0.38	†	Stems are used in funerals and by *Jhânkri*. Barks are cooked and juice thus extracted is taken daily in case of sprains and backaches (*Pireko*), swellings and also used as dye.	Wp, Br, Lf, Sd: material, fodder, medicine (2), Br, Lf, Sd: medicine (5), Br: medicine (9);
Rosa macrophylla Lindl.	Bhainsi kaandaa	Himalayan Rose	*Bhârmâse*	Shrub	Rt	Md	1	0.04	418 KATH/ TUCH	A small piece of root is chewed to treat heartburn and stomach pain. Large amount is considered to be fatal.	Fl, Lf: medicine, food, fodder (2,3); Fr: medicine (7)
*Rubus hoffmeisterianus** Kunth & Bouché		Hoffmeister Raspberry	*Zoosai*	Shrub	Fr	Fd,	1	0.3	831 TUCH	Fermented leaf juice mixed with *Pteris* sp. is given to treat Marasmus and in-appetite. Ripe fruits are eaten fresh.	
Rubiaceae											
Galium asperuloides Edgew.			*Khasare*	Herb	Lf	Md	1	0.1	303 KATH/ TUCH	Plant juice is used on cuts and wounds.	Wp: medicine (1)
Rubia manjith Roxb. ex Fleming	Majitho		*Khasare*	Herb	Lf	Md	1	0.08	539 TUCH	Leaf juice is applied on cuts and wounds.	Rt, St: medicine, dye (2); Lf: medicine (1), Rt: dye (8)
Rutaceae											
Zanthoxylum armatum DC	Timur		*Tinbur*	Shrub	Fr	Fd	1	0.2	†	Seeds are chewed in case of cold, stomach disorder and poison. Fruits used as pickle.	Rt, Br, Lf,Fr,Sd: medicine, food (1,2,4,5,9)
Santalaceae											
Viscum album L.	Hadchur	White-berried mistletoe	Jokhâre	Shrub	Wp	Md	1	0.12	779 KATH/ TUCH	Plant paste is applied on dislocated and disjointed bones in sheep / goats.	Wp: medicine (1)
Sapindaceae											
Aesculus indica (Wall. ex Cambess.) Hook.	Ghode paangro	Horse Chestnut	*Pângar*	Tree	Sh	FWTmMd	3	0.08	782 TUCH	Dry fruit is rubbed against stone, thus produced powder is made paste and applied to cure Mumps (*Bâgale)*. Wood used as fuelwood.	Br, Lf: Medicine, fodder (1); Sd: food (1,2,4,9) medicine (5), Sh, Lf: food (4), Wd; Material (4)
Botanical name	**Nepali name**	**English name**	**Local name (Magar)**	**Life form**	**Parts used**	**Use category**	**UV**	**UF**	**Collection number / Herbarium**	**Present findings (indigenous uses)**	**Previous findings**
Saxifragaceae											
Bergenia ciliata Sternb.	Paakhanbed	Bergenia	*Hângawo*	Herb	Rh	Md	3	0.42	775	Rhizome juice is taken to treat, typhoid	Wp, Fl,Rh,Lf: medicine

									KATH/ TUCH	(*Ghâmjoro*), diarrhea, dysentery and vomiting. A small piece of rhizome is chewed in case of stomach pain, headache and menstruation disorder. Large piece is fatal.	(2,4,5,7,9);Rh,Sd, Wp: medicine (1,8); commercial (3)Rh,Rt:medicine (4,11); Rt: medicine (5)
Scrophulariaceae *Verbascum thapsus* L.	Bandarpuchhre	Candlewick	*Yume*	Herb	Rt	Md	1	0.04	527 TUCH	Root juice is given to child to treat diarrhea, dyspepsia and fever.	Wp,Rt: medicine, poison (1,2,9); Lf, Rt, St,FL; medicine, poison (5); Lf, St,Fl: medicine (7)
Simaroubaceae *Brucea javanica* (L.) Merr.	Bhakimlo	Kosam	*Bhakimblâ*	Tree	Fr	Fd	1	0.14	566 KATH/ TUCH	Fruit decoction is taken to cure diarrhea and dysentery. Ripe fruits are eaten either raw or pickled	Fr: medicine (1, 10)
Thymelaeaceae *Daphne bholua* Buch.-Ham. ex D. Don	Lokata	Jacqueline Postill	*Barruwâ / Ratuwâchhâro*	Shrub	Rt	Md Fb	0	0.16	788 KATH/ TUCH	Root juice mixed with other herbs is taken to treat fever. Bark is extracted for fiber.	Rt,Br,Lf: medicine, material, poison (2,4); Rt: medicine (9); Rt, Br: (5) Br: material, medicine, poison (3,11)
Urticaceae *Girardinia diversifolia* (Link) Friis	Allo sisnu	Giant Asian Nettles	*Puuwâ*	Herb	Rt	Fd	1	0.32	880J KATH	Bark is extracted for fiber which is used to make threads, ropes and rough clothes. Root decoction is applied on sprains.	Rt: medicine (1,2,10)
Botanical name	**Nepali name**	**English name**	**Local name (Magar)**	**Life form**	**Parts used**	**Use category**	**UV**	**UF**	**Collection number / Herbarium**	**Present findings (indigenous uses)**	**Previous findings**
Gonostegia hirta (Blume ex Hassk.) Miq.	Chiple Ghaans	Glutious rice-clumps	*Barmitinâ*	Herb	Rt	Md	1	0.12	†	Root paste is applied to treat bowls (*Pilo*). And, also roots are eaten raw.	Wp, Rt: medicine, food, material (1,2,9,11)
Urtica dioica L.	Sisnu	Stinging nettle	*Nganti*	Herb	Lf	Fd,	1	0.32	†	Root decoction is used to treat dandruff and stomachache. Tender	Rt: medicine (1)

									shoots and leaves are cooked as vegetable.	
Vitaceae										
Ampelocissus rugosa (Wall.) Planch.			*Jiprang*	Climber	Lt	Fd	1	0.14	773 KATH/ TUCH	Ripe fruits are eaten raw. Water content (Sap) in internodes is used to treat conjunctivitis and latex is used to treat warts (*Jojhai)*.	St: medicine (2)
Zingiberaceae										
Acorus calamus L.	Bojho	Calamus root	*Baja*	Herb	Rh	Md	2	0.08	†	A small piece of rhizome is chewed for cough or sore throat. Rhizome juice is used to treat scabies. Necklace (*Hâr*) is made for dog in case of scabies (*Khairâ)*.	Rh: medicine (1,2,4,5,9,11)
Curcuma angustifolia Roxb.	Barkhe sarro	East India arrowroot	*Kachur*	Herb	Rt	Md	1	0.14	†	Root paste is applied to expedite the union of fractured and dislocated bones.	Rt: medicine (2,9)
*Hedychium coronarium** J. Koenig	Dudh kewara	Garand lily	*Tunti*	Herb	Rt	Md	1	0.04	†	Root paste is applied as antidote for allergic effect of *Rhus succedeana*. Beads woven on rope are put around child's neck to relieve fever.	

Parts use: Rt: Root, Wd: Wood, St: Stem, Sh: Shoot, Br: Bark, Lf: Leaf, Fr: Fruit, Fl: Flower, Sd: Seed, Cu: Culm, Tu: Tuber, Rh: Rhizome, Rn: Resin, Ts: Tender shoot, Ct: Cotyledon, Wp: Whole Plant, Tr: Tree, Bu: Bulb, Lt: latex

Use categories: Dt: Dye and Tanning, Fb: fiber, Fd: Food, Fo: Fodder, FW: Fuelwood, Md: medicine, Po: Poison, SR: Social and Religious, Tm=Timber, Tr: Trade, Ol: Oil

Others: â: aa *: voucher specimen not available

Previous findings based on: 1-Baral and Kurmi (2006), 2- Manandhar (2002), 3- Ghimire *et al*. (2008), 4- Dutta (2007), 5-DPR (2007), 6- Bhattarai *et al.* (2006), 7- Lama *et al.* (2001), 8-Gautam (2009), 9-Rajbhandari (2001), 10- Rajbhandary (2013), 11-Shrestha *et al.* (2017)

*New medicinal plants for Nepal

Of all these MP species, 9 species cited by local Magar (Kham) people in the study area were reported as ethnomedicinally new to Nepal. The rest 73 species were found used both in the study area and elsewhere in other parts of the country. The species with new use reports are; *Equisetum arvense*, *Cyperus cyperoides, Hedychium coronarium, Clematis terniflora, Delphinium grandiflorum, Rubus hoffmeisterianus, Geranium procurrens, Cornus capitata,* and *Taraxacum parvulum.* MP species like *Aconitum gammiei* not found in the study area, brought from other parts of Nepal has also been used by the local people to treat disease since long before. Among total MP species, 44 species were used only for medicinal purpose whereas 38 species were used for multi-purposes besides medicine. Of the total plant species with multiple uses; 20 MP species were used for medicine and food, followed by medicine and socio-religious (5spp.), medicine and timber (4 spp.), medicine and dye (4 spp.), and medicine and fiber (3). Likewise, 3 MP species were used for medicine, food and socio-religious and 3 species for medicine, food and poison (Figure 2). While comparing the families that contributed more medicinal species was Ranunculaceae represented by 8 species (9.75%) followed by Fabaceae and Rosaceae with 6 species each (7.32%), Polygonaceae with 4 species (4.88%), Orchidaceae, Urticaceae and Zingiberaceae with 3 species each (3.66%) where other 38 families were with 49 species (59.76%) represented by 1 or 2 species. Of the total species, 5% were traded.

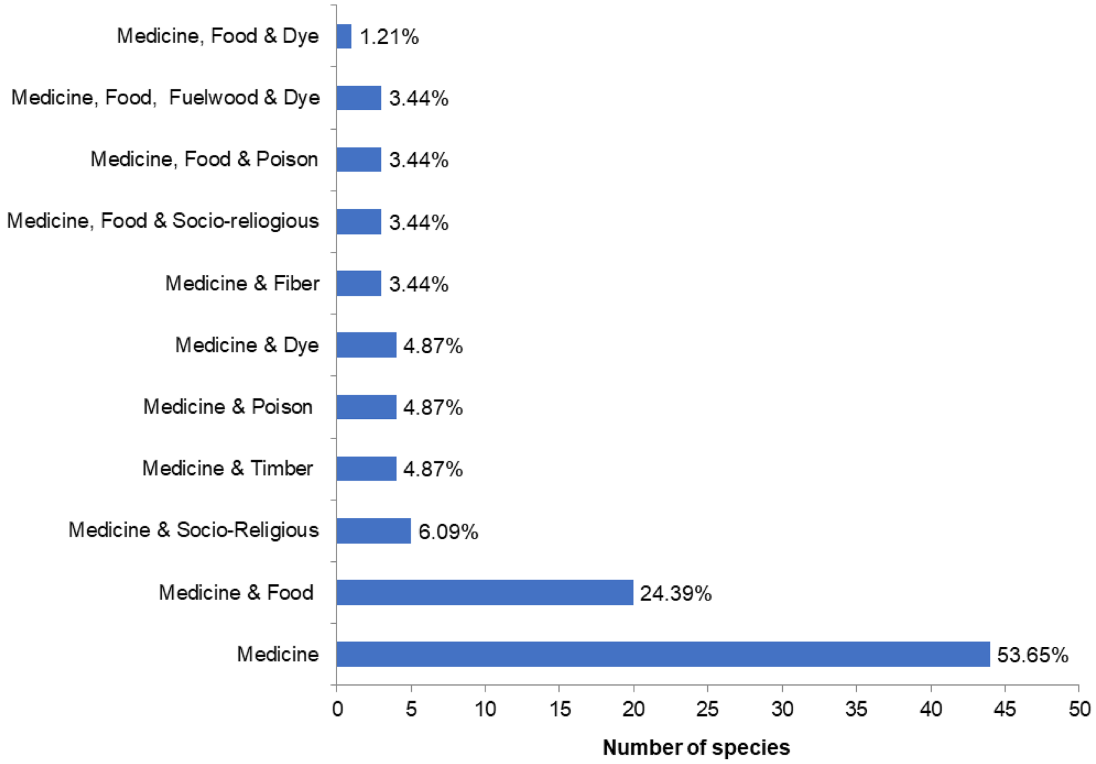

Figure 2. Number of MP species with single and multiple uses.

In FGD, there were 95 participants whereas in individual there were 50. Out of 95 participants in FGD, there were more male (n=55) compared to female (n=40). However, among the 50 interviewees in individual interview, majority of them were female (n= 30) and rest (n=20) were male where 5 were *Jhankries*; the traditional healers. Mostly all informants (38) were Magar (Kham) people belonging to different sub-castes (Roka, Budha, Gharti and Jhankri) and 12 were occupational groups (Nepali and Bishowkarma). While by occupation 90% of the people were involved in agriculture and animal husbandry. Only 5% were engaged in business and services like teaching whereas rest 5% were in other occupation. Regarding their level of knowledge on use of MP species, the traditional healers were more knowledgeable compared to other local people. Among the interviewee, male and old participants had more knowledge than female on use of MP species.

Life forms, plant parts used, method of preparation and administration

Majority of MP species were herbs (67%, n = 55), followed by trees (16%, n=13), shrubs (13%, n=11) and climbers (4%, n=3). Altogether, 8 different parts of these plants were used. Most of these species were harvested for root (36.58%), followed by leaves (14.63%), bark (9.75%), fruits (6. 09%) and the

whole plant in case of herb species (12.19%) (Figure 3). According to local people, there are certain MP species that should be collected on specific time for their medicinal potentiality. For instance, *Zanthoxylum armatum* and *Lindera neesiana* must be collected on 12th of Bhadra (28th August). Since, they have faith that fruits collected on that particular date have effective medicinal property. On the other hand, they use MP species in mixed form. They use species such as *Allium sativum, Potentilla* spp., *Plantago asiatica, Quercus semecarpifolia* and *Prunus cerasoides* in mixed form. In some cases, species like *Allium sativum* was mixed with dried human placenta and used as an antidote for cattle. Barks of *Quercus semicarpifolia, Quercus lanata* and *Prunus cerasoides* were cooked together, thus the decoction obtained was used to get relief from sprains. As far as the mode of preparation was concerned, majority of MP species were used in the form of mastication (21) followed by juice (16), paste (15) and decoction (13) (Figure. 4). In some cases, sap, latex and resins of the plants were also used as an ointment. A decoction was prepared by boiling the plant in water until reduced to the half volume or less than the original volume of the liquid. The juice was obtained by squashing leaf or whole plant. The paste was prepared by grinding plant parts with water. Tea was prepared by just boiling the plant part in water.

On mode of admission, the most common method was oral (51%, n=42), followed by external or topical application (47%, n=39) and inhalation (2%, n=2).

Ailments treated in the study area

Medicinal plants were used to treat 32 ailments in the study area. With regard to ailments, the highest number of medicinal plants (20 spp.) were prescribed for the stomachache followed by external wounds (burns, cuts & wounds) (19 species), diarrhea (17 species), gastritis and fever (10 species each), arthritis (9 species) and sprains (8 species) (Table 1).

Informant consensus factor and important values

The results of informant consensus factor (Fic) calculation showed that the Fic values ranged from 0 to 1. Dandruffs, cancer, frightening, warts, pneumonia, jaundice, skin and eye problem ailments had the highest Fic value 1 with 2, 3 or 4 use reports for single species. The second highest Fic value obtained was for cough ailments with 26 use-reports for 6 species followed by gastritis (Fic=0.7, UR=31 and 10 spp.). The least Fic value was observed for typhoid with 4 use-reports and for 4 species, scabies with 3 use-reports and 3 species and toothache with 2 use reports and 2 species (Table 2).

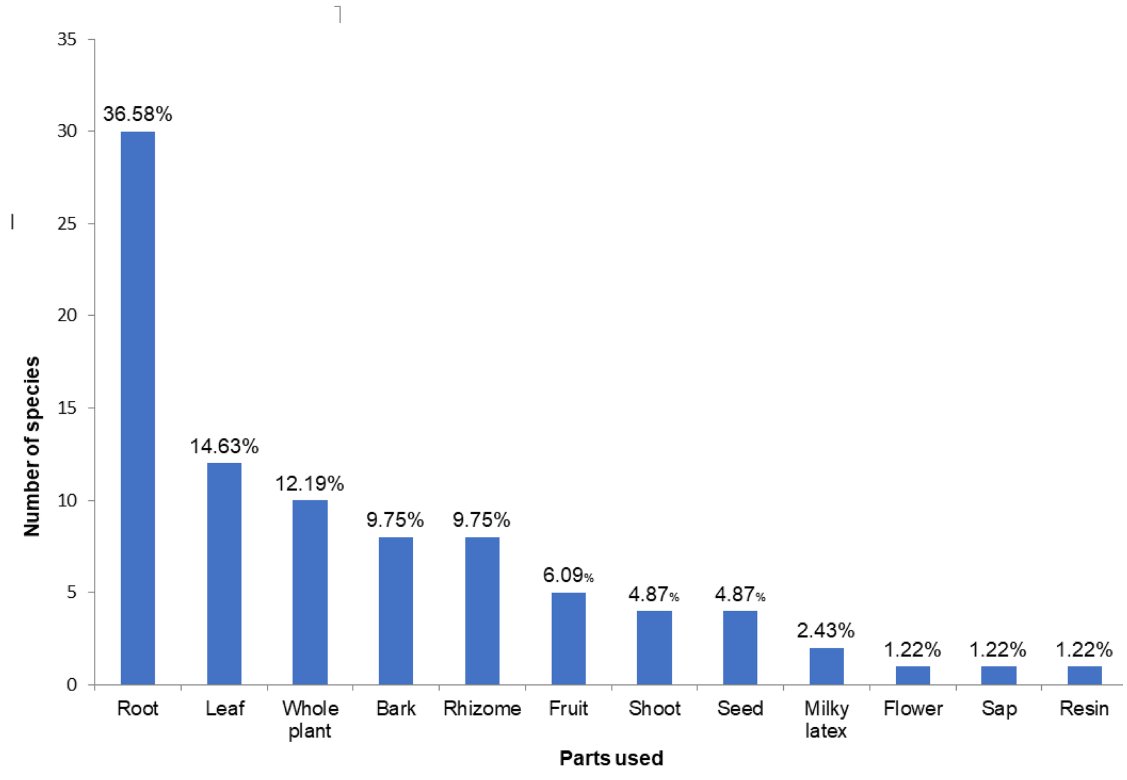

Figure 3. Plant parts used based on field survey.

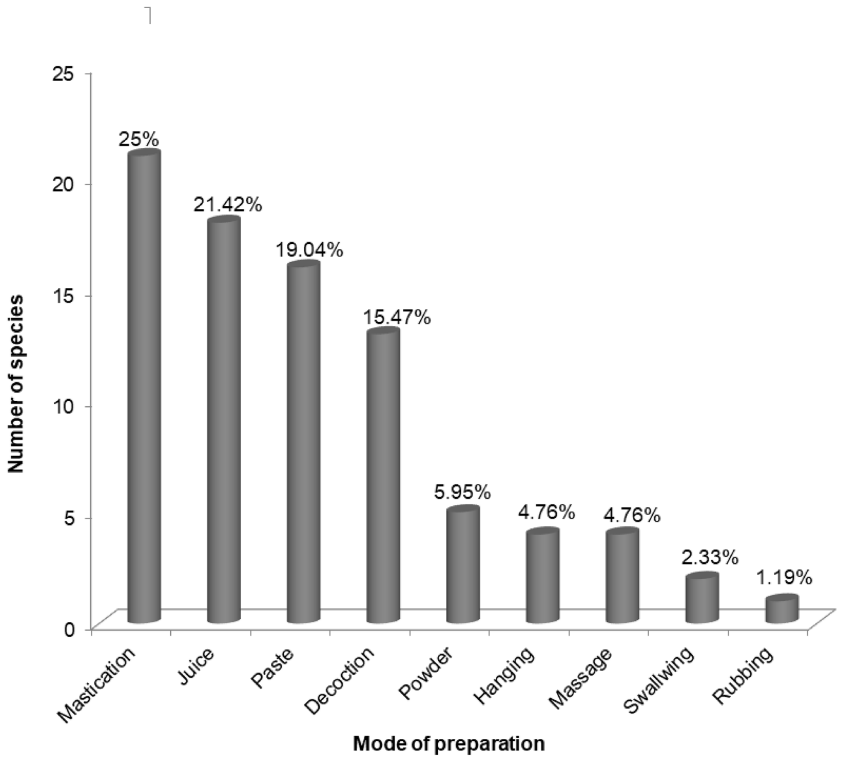

Figure 4. Number of plant species used in different mode for medicinal purpose

Table 2. Informant consensus factor (Fic) for different ailment categories.

Ailments	Number of Taxa (Nt)	Number of use reports (Nur)	IFC	Name of species
Stomachache	20	31	0.37	*Aconitum gammiei, Aconitum spicatum, Bergenia ciliata, Brucea javanica, Dactylorhiza hatagirea, Delphinium grandiflorum, Delphinium vestitum, Fagopyrum megacarpum, Flemingia strobilifera, Heracleum candicans var. obtusifolium, Leibnitzia nepalensis, Paris polyphylla, Potentilla lineata, Quercus semecarpifolia, Rheum australe, Rhododendron campanulatum,* and *Rosa macrophylla, Satyrium nepalense, Solena heterophylla, Urtica dioica, Zanthoxylum armatum*
Burns, Cuts & Wounds	19	72	0.75	*Aconitum spicatum, Ageratina adenophora, Anemone vitifolia, Cheilanthes albomarginata, Delphinium vestitum, Dipsacus inermis, Drymaria cordata, Galium asperuloides, Leibnitzia nepalensis, Lindenbergia muraria, Myriactis nepalensis, Paris polyphylla, Pinus wallichiana, Bistorta milleti, Rubia manjith, Selaginella biformi, Stellaria himalayensis, Swertia chirayta, and Taraxacum parvulum*
Diarrhea	17	40	0.59	*Ageratina adenophora, Bergenia ciliata, Brucea javanica, Campylotropis speciosa subsp. Eriocarpa, Cornus capitate, Daphne bholua, Equisetum arvense, Fagopyrum megacarpum, Flemingia strobilifera, Imperata cylindrical, Leucosceptrum canum, Plantago asiatica subsp. erosa, Potentilla lineata, Rheum austral, Rumex nepalensis, Swertia chirayta* and *Verbascum thapsus*
Gastritis	10	31	0.70	*Bergenia ciliata, Myriactis nepalensis, Fagopyrum megacarpum, Cyperus cyperioides, Plantago asiatica subsp. erosa, Potentilla lineata, Rubus hoffmeisterianus, Rumex nepalensis, Zanthoxylum armatum,* and *Phytolacca latbenia*

Ailments	Number of Taxa (Nt)	Number of use reports (Nur)	IFC	Name of species
Fever	10	12	0.18	*Aconitum gammiei, Bergenia ciliata, Cirsium verutum, Cynodon dactylon, Daphne bholua, Paris polyphylla, Taraxacum parvulum, Verbascum thapsus, Morina longifolia,* and *Hedychium coronarium*
Arthritis	9	18	0.53	*Anemone rivularis, Arisaema jacquemontii, Cannabis sativa, Clematis terniflora, Agave Americana, Swertia chirayta,* and *Curcuma angustifolia*
Antidote	8	24	0.70	*Aconitum gammiei, Allium sativum, Asparagus racemosus, Lindera neesiana, Solena heterophylla, Delphinium vestitum, Paris polyphylla,* and *Zanthoxylum armatum*
Sprain	8	22	0.67	*Cerasus cerasoides, Geranium procurrens, Girardinia diversifolia, Prunella vulgaris, Quercus lanata, Q. semecarpifolia, Rheum australe,* and *Rumex nepalensis*
Cough	6	26	0.80	*Acorus calamus, Bergenia ciliata, Lindera neesiana, Rhododendron arboreum, Swertia chirayta,* and *Zanthoxylum armatum*
Bone fracture	5	9	0.50	*Allium tuberosum, Pleione humilis, Ageratina adenophora, Aconitum gammiei,* and *Viscum album*
Headache	5	7	0.33	*Dactylorhiza hatagirea,* and *Swertia chirayta*
Worms	5	6	0.20	*Acorus calamus, Arisaema jacquemontii, Artemisia dubia, Imperata cylindrica,* and *Rubia manjith*
Allergy	4	5	0.25	*Aconitum gammiei, Acorus calamus, Rumex nepalensis,* and *Hedychium coronarium*
Delivery	4	5	0.25	*Lindera neesiana, Delphinium vestitum, Paris polyphylla,* and *Zanthoxylum armatum*
Typhoid	4	4	0.00	*Aconitum gammiei, Dactylorhiza hatagirea, Swertia chirayta,* and *Delphinium grandiflorum*
Heart Pain	3	5	0.50	*Aconitum gammiei, Allium sativum,* and *Rosa macrophylla*
Mumps	3	4	0.33	*Verbascum thapsus, Gonostegia hirta, Aesculus indica*
Scabies	3	3	0.00	*Acorus calamus, Rhododendron campanulatum,* and *Rumex nepalensis*
Jaundice	2	8	0.86	*Berberis asiatica,* and *Swertia chirayta*
Vomiting	2	3	0.50	*Bergenia ciliata,* and *Swertia chirayta*
Asthma/ Dam	2	3	0.50	*Cotoneaster microphyllus,* and *Rheum australe*
Itching	2	3	0.50	*Acorus calamus,* and *Clematis terniflora*
Toothache	2	2	0.00	*Juglans regia,* and *Begonia picta*
Dandruffs	1	3	1.00	*Urtica dioica*
Cancer	1	2	1.00	*Tsuga dumosa*
Frightening	1	2	1.00	*Equisetum arvense*
Warts	1	5	1.00	*Ampelocissus rugosa*
Pneumonia	1	3	1.00	*Cannabis sativa*
Anesthetic	1	7	1.00	*Swertia chirayta*
Skin fractures	1	2	1.00	*Pinus wallichiana*
Eye irritation	1	5	1.00	*Ampelocissus rugosa*
Leech	1	4	1.00	*Anemone rivularis*

The most frequently used species reported in the study area were *Berberis aristata* and *Swertia chirayta* (UF=0.48 each) with 24 informants among the total informants interviewed. The second most frequently used species was *Bergenia ciliata* (UF=0.42) with 21 informants followed by *Cerasus cerasoides* (UF=0.38, n=19), *Ageratina adenophora* (UF=0.36, n=18) and *Anemone vitifolia* (UF=0.34, n=18). Similarly, the plant species with highest use value (UV) was *Bergenia ciliata* (3.29) followed by *Aesculus indica* (2.75), *Berberis aristata* (2.42), *Swertia chirayta* (2.08), *Acorus calamus* (2.00), *Arisaema jacquemontii* (2.00), *Delphinium vestitum* (1.93), *Cyperus cyperiodes* (1.75), *Dactylorhiza hatagirea* (1.67), *Taraxacum parvulum* (1.60) and *Lindera neesiana* (1.57) (Table 1).

Threats to MP species and their conservation

During FGD, informants deciphered unsustainable harvesting of NTFPs (non-timber forest products) including premature collection of MP species from wild for swift monetary gain, lack of forest management system, deforestation and increasing population are the main threats to MP species in the study area. They were with single voice to save important MP species for their future generation.

Similarly, most informants (95%) of individual interview confirmed that MP species are collected from wild for both medicinal uses and trade. Moreover, traditional healers were reluctant to share their knowledge. 10% of the informants were cultivating few traded MP species in their home gardens. The species included *Valeriana hardwickii*, *Bergenia ciliata*, *Paris polyphylla*, and *Rheum australe*. However, all informants were aware for the conservation of the MP species.

Discussion

Medicinal Plant and their indigenous use

This very first ethno-medicinal research carried out among the Magar (Kham) people identified 82 MP species from Thabang RM in Jaljala region, of which 9 MP species were identified as new use report to Nepal. These nine species were used differently in treatment of various disorders (Additional file 2) while comparing to previous ethnobotanical studies in Nepal himalaya (Lama *et al.* 2001, Rajbhandari 2001,2013, Manandhar 2002, Baral & Kurmi 2006, Bhattarai & Ghimire 2006, DPR 2007, Dutta 2007, Ghimire & Pyakurel 2008, Rokaya *et al.* 2010, Shrestha *et al.* 2018). For instance, root and stem of *Equisetum arvense* were mixed with algae and *Rumex nepalensis.* during fever, root of *Cyperus cyperoides* were used in case of gastritis, root of *Hedychium coronarium* as antidote in allergies of *Rhus succedeana,* aerial parts of *Clematis terniflora* in gout*,* root of *Delphinium grandiflorum* in stomachache*,* leaf juice of *Rubus hoffmeisterianus* in in-appetite*,* root of *Geranium procurrens* mixed with other plants (such as *Girardiana diversifolia*, *Rheum austral, Rumex nepalensis*. and *Prunus cerasoides*)*,* ripe fruit of *Cornus capitata* in headache*,* and leaf juice or latex of *Taraxacum parvulum* in healing cuts and wounds*.* Furthermore, there was trend of using MP species such as *Aconitum gammiei* which is not found in the study area to treat stomachache since long before, typically in families of sheepherders. Since, the sheepherders collect the roots of *Aconitum gammiei* from high altitude during their summer grazing season and store for the future use.

Out of 82 species, most of MP species (44 spp.) were used only for medicinal purpose and rest 38 MP species had multi-purposes, such as food, socio-religious, fibber, fodder and dye in addition to their medicinal uses. In general, MP species with multiple use purposes are more threatened rather than single use. So, these species should be prioritized for cultivation, conservation and management for their sustainability (Geng *et al.* 2017, Napagoda *et al.* 2018, Kidane *et al.* 2018). Additionally, they should be considered as an ideal resource for management tenure for future income generation of forest dwelling people and wildlife (Cummings 2013). While comparing the families, Ranunculaceae was the most frequently used family. Since, it is one of the largest families among the vascular plant species and most species of this family contain high biochemical compounds with anti-inflammatory and antioxidant properties (Malik *et al.* 2017).

Regarding the livelihood activities, most of Magar (Kham) people were engaged in agriculture and animal husbandry. So, the most of them were dependent on plant resources mainly on MP for their basic primary health care specifically in cuts and wounds, gastro-intestinal disorders and sometimes in case of eye irritation too. Furthermore, the tendency of use may be because of their traditional practice which has been more culturally acceptable and practiced since time immemorial (Saslis-Lagoudakis *et al.* 2014). The older people were more knowledgeable but trend of passing their knowledge was found to be declining.

Life forms, plant parts used, method of preparation and administration

Regarding the collection and utilization of MP species, local Magar (Kham) people have quite specialized knowledge. Among different life forms, herbs were most commonly used species where local people harvest mainly their roots (similar to previous studies e.g. Baral & Kurmi 2006, Rokaya *et al.* 2010, Kunwar *et al.* 2006). This may be because herbs are more abundant, easy to collect and roots contain high concentration of bioactive compounds compared to other parts (Srithi *et al.* 2009). But, the removal of whole plant or roots or excessive use of herbs for medicine lead to the decline in population of the MP species (Ghimire & Pyakurel 2008). The removal of underground part is much more unsustainable compared to aerial part (Kunwar *et al.* 2006). But only few species have been harvested for their aerial parts such as fruits, leaves and barks in the study area. Concerned with plant collection time and condition, Magar (Kham) people are quite specific in harvesting MP species as Gurungs of Kaski, Central Nepal (KC *et al.* 2010). They harvest according to different seasons, climatic conditions and habitat types for treatment of ailments similar to the Yao people in China (Long & Li 2004). For example, informants reported that the fruits of *Zanthoxylum armatum* and *Lindera neesiana* should be collected on particular date. This is supposed to be true because, these plants contain highly volatile compounds (Ivanova *et al.* 2004) which are altered by multiple parameters; seasonal variations, degree of maturity of plant atmosphere, precipitation, or geographic location of the plant (Marotti *et al.*1994, Hussain *et al.* 2008, Anwar *et al.* 2009).

Regarding mode of preparation, they followed different techniques for various MP species. They were quite specific for way of using. For example, they know how much amount and in which form to apply and administer for particular ailment categories such as stomachache, external wounds, breathing problems and excessive physical works (Manandhar 2002). Generally, they used MP species singly whereas they use species such as *Plantago asiatica, Potentilla lineata, Allium sativum, Equisetum arvense* and *Verbascum thapsus* in mixed form either with 2, 3 or 4 species. This multiple preparation methods were based on the knowledge provided to the individual by their predecessor (Uprety *et al.* 2012, Bhattarai *et al.* 2006). They follow simple techniques while using MP species. Hence, majority of plant species were used simply just after mastication. In case of gastro-intestinal disorders like stomachache, gastritis, heartburn and jaundice, masticated form of MP species was used. In some cases, like cuts, wounds and burns, juice and paste of the plant were applied. In sprains and some gastrointestinal disorders, decoction prepared by distillation of plant parts was used. Regarding, mode of administration MP species were commonly used orally which was followed by topical i.e. an external application and then inhalation (similar to Shrestha & Dillion 2003, Bhattarai *et al.* 2006, Luitel *et al.* 2014, Singh *et al.* 2012). According to informants, antidotes are diluted in case of adverse effects either by minimizing size of use parts or mixed with water. For instance, minimal powder of *Paris polyphylla* was used on wounds, small piece of roots of *Bergenia ciliata,* and *Aconitum gammiei* during stomachache. Furthermore, they were specifically knowledgeable on the use of plant parts. We found that they use various parts of single species in different use categories. For example, from the single species *Arisaema jacquemontii* they use fresh seeds against worm infestation as medicine, leaves cooked with *Rumex hastatus* as vegetable and fresh corms as poison. Thus, the area is medicinally biodiverse and hence there is ethnodiverse on use of plants (Begossi 1996).

The highest number of MP (20) species were prescribed for stomachache. This may be because, these species were easily available and their extensive ethnomedicinal usage become an important component in their medical system and hence their part of culture too (Tardio & Santayana 2008, Kunwar et al. 2014)

Cultural values of MP species

To understand the cultural values of MP species, quantitative techniques; Informant Consensus Factor (Fic), Use Frequency (UF) and Use Value (UV) are important parts of ethnobotany. Fic values were determined in order to know the agreement among the informants of the study area for the use of plants to treat certain ailment categories. The Fic value in 8 ailment categories was found '1' (Table 2). This indicated a high level of informant agreement compared to similar studies conducted in Nepal Himalaya (Kunwar *et al.* 2010). The plant species having high value of Fic were supposed to be efficient in treating particular ailment. In this study *Urtica dioica* with Fic=1 may be sufficient in treatment of dandruffs, similarly *Ampelocissus rugosa* in treatment of warts, *Taxus contorta* in treatment of cancer and *Swertia chirayta* in treatment of jaundice. So, the plant species that have high consensus value are of socio-economically significant and important for further pharmacological research (Rossato *et al.* 1999, Canales *et al.* 2005, Hong *et al.* 2015).

The UF of MP species *Berberis aristata*, *Swertia chirayta*, *Bergenia ciliata*, *Prunus cerasoides*, *Ageratina adenophora* and *Anemone vitifolia* was high. This is because these MP species are effective to use and easy for accessibility during collection. Similarly, the high UV obtained for *Bergenia ciliata*, *Asesculus indica*, *Berberis aristata, Swertia chirayta*, *Acorus calamus*, *Arisaema jacquemontii*, *Delphinium vestitum*, *Cyperus cyperoides*, *Dactylorhiza hatagirea*, *Taraxacum parvulum* and *Lindera neesiana*. Since, informants reported that these MP species are used in multiple number of ailment categories. Thus, the highest important (Fic, UF & UV) values shown by these MP species indicate that these species are highly preferred. Furthermore, this shows that these species are contextually, culturally more important and theoretically they have high cultural consensus (Tardio & Santayana 2008). Additionally, they may have high phytochemical constituents. Therefore, those species must be tested further for their phytochemical property (Akgul *et al.* 2018).

Medicinal plant cultivation, trade, threats and conservation practices

The Magar (Kham) people of the study area have the knowledge on the benefits of conserving the medicinal plants. However, the effort of conserving MP species was hard because mostly all of the MP species were collected from wild. Even the traditional healers (*Jhankries*) who most frequently use did not practice cultivating common MP species in their home garden, they preferred to harvest from wild. Since, they wanted to have secrecy over their use of MP species and worry about their occupation (Bhattarai *et al.* 2006). Therefore, they were unwilling to share their knowledge of using MP species they use with local villagers. Few MP species like *Valeriana jatamansii*, *Bergenia ciliata*, *Paris*

polyphylla, and *Rheum australe* were locally traded from study area. Therefore, recently there is increasing interest for cultivating the MP species among the local people. Many of them are in search of possibility of MP species cultivation.

Various factors that were considered as main threats for medicinal plants were recorded during discussion with the informants in the study area. The major threats of MP species include lack of forest management system, pressure from anthropogenic activities such as deforestation, unsustainable harvesting of NTFPs (non-timber forest products) including premature collection of MP species from wild. Moreover, the population expanding throughout has accelerated the expansion of the agricultural land, urbanization, overharvesting of MP species and fuelwood collection. On discussion with local people, they suggested that there should be the establishment of community forest, initiation of cultivation NTFPs and enforce strict law for the conservation of MP as well as other useful plant species.

Reliability of reported uses

The indigenous uses of plants obtained in present study were compared with the published information from other parts of Nepal (e.g. Lama *et al.* 2001, Manandhar 2002, Baral & Kurmi 2006, Rajbhandari 2001, 2013, Bhattarai & Ghimire 2006, Dutta 2007, DPR 2007, Ghimire & Pyakurel 2008, Rokaya *et al.* 2010). Comparing with these available literatures, 73 ethnomedicinal species used in the study area were similar to uses in other parts of the country but 9 ethnomedicinal species which are indicated by asterisk (*) were reported new for Nepal (Table 1).

Conclusions

This very first ethnomedicinal study carried out in Magar (Kham) people added nine species in the list of medicinal plants to the country. The new reported species were *Equisetum arvense*, *Cyperus cyperoides, Hedychium coronarium, Clematis terniflora, Delphinium grandiflorum, Rubus hoffmeisterianus, Geranium procurrens, Cornus capitata,* and *Taraxacum parvulum.* Thus, there is furthermore possibility of recording new use species through extensive ethnobotanical study in adjoining villages of present study area. Magar Kham people are highly knowledgeable, specifically in the use of medicinal plant, so high diversity of medicinal species has been reported. Quantitative ethnobotanical analysis revealed that 82 species were used for various ailment categories. Species such as *Berberis aristata*, *Swertia chirayta*, *Bergenia ciliata*, *Cerasus cerasoides*, *Ageratina adenophora* and *Anemone vitifolia* were frequently used species and species such as *Bergenia ciliata, Aesculus indica*, *Berberis aristata*, *Swertia chirayta*, *Acorus calamus*, *Arisaema jacquemontii*, *Delphinium vestitum*, *Cyperus cyperodes*, *Dactylorhiza hatagirea*, *Taraxacum parvulum* and *Lindera neesiana* were most valuable species based on use value. The highest important (Fic, UF & UV) values shown by medicinal plants indicated that these species were highly preferred by local people which might be due to their effectiveness because of high phytochemical constituents. So, these MP species with high important values are highly recommended for further pharmacological tests.

Declarations

Lista de Abreviaturas: No aplica

Ethics approval and consent to participate: Permission letters were taken from Department of Forest and Soil Conservation, Babarmahal, Kathmandu prior to data collections. Oral agreements were obtained from the local informants about the aims and objectives of the study prior to interviews and all field data were collected through their oral consents. No further ethics approval was required.

Consent for publication: This paper does not include any individual person's data and further consent for publication is not required.

Availability of data and materials: The data are available from the autjors upon request.

Competing interests: The authors declare that they have no competing interest.

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Authors' contribution: SBM and PB carried out field work, collected data and identified Taxa. SBM analyzed data and prepared the draft for the manuscript. PB made map of study area and edited the manuscript. SKG supervised the project.

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Additional file 1. Ethnobotanical Data Collection in Thabang VDC, Rolpa District

Date……

Demographic information
1. Name of (a) informant(s)……..….
(b). Age……. (c) Sex: Male Female
(d) VDC……..... Ward no.:…… Tole:……..
(e) How long have you been living in this area?
i) Since 10 years ii) Since 30 years iii) Since 50 years iv) More than 50 years
f) Main occupation……..
Category :-

Agriculture = 1; Services = 2; Business = 3; Student = 4; Wagelabour = 5; Other (Specify)…….= 6

2. Ethnobotanical knowledge of respondent on different plant groups

Groups	Name of species	
	Local name	Scientific name
Fuel wood		
Wild vegetables and fruits		
Fodder		
Timber		
Social and religious use		

Groups	Name of species	
Fibre		
Dye and tanning		
Oil		
Poisonous		

3. Ethnobotanical knowledge of respondent on Medicinal plants.

Name of of the plant		Name of disorder	Symptoms	Plant parts used						Mode of use
Local name	Latin name			Root	Shoot	Leaf	Bark	(Fr, Sd, Fl)	Whole plant	

4. Why do you choose plants from that locality?
Ans……

5. Mostly which staged plants are preferred for harvest?
Ans…….

6. How can these plants be preserved?
Ans……