Ethnobotanical study of plant resources in Dhurkot rural municipality, Gulmi district Nepal

Rachana Bhandari, Bijay Pandeya and Balkrishna Ghimire

Correspondence

Rachana Bhandari, Bijay Pandeya and Balkrishna Ghimire*

Faculty of Forestry, Agriculture and Forestry University, Hetauda, Makawanpur, Nepal

*Corresponding Author: bkghimire@afu.edu.np

Ethnobotany Research and Applications 25:22 (2023) - http://dx.doi.org/10.32859/era.25.22.1-19
Manuscript received: 19/11/2022 – Revised manuscript received: 20/02/2023 - Published: 21/02/2023

Research

Abstract

Background. Despite easy access to modern medicines, people are still using plant-based medicine for their primary healthcare needs. People, particularly in the rural area are more dependent on herbal medicines. This study aims to explore the essential plants used in medicine locally and their uses on different ailments and diseases in Dhurkot Rural Municipality of Gulmi district, a western district of Nepal.

Methodology. The study includes several visits to different community forests, interviews, and discussions with people at different time intervals from February to October 2021. Data were collected through Focus group discussion, transect walk, direct observation, and key informant interviews. Local indigenous healers, popularly known as "dhami", "pujari", "guru" and elderly people who know the uses of medicinal and aromatic plants helped us in collecting information about the utilization of plants as medicines.

Results. Altogether 67 plant species belonging to 39 families and 64 genera were used by the people for their primary healthcare needs to treat different health problems. We found that the leaves are the most used parts of the plant followed by barks. During preference ranking among 484 individuals and focus group discussion people showed a preference for *Cinnamomum tamala* (Lauraceae) followed by *Phyllanthus emblica* (Phyllanthaceae), *Zanthoxylam armatum* (Rutaceae). Herbs are dominant among the plant forms used followed by trees, shrubs, and climbers.

Conclusion. We conclude that people in this area still depend on plant-based medicine for their primary health care needs. Many people seek traditional remedies when they suffer from various common health problems. Besides this, abundance of medicinal plants in the region are declining due to various anthropogenic factors, infrastructure development, and climate change. Thus, appropriate conservation and management approaches along with proper identification and cultivation of important medicinal and aromatic plants are urgently required in the study area.

Keywords: Ethnobotany, indigenous healers, focus group discussion, traditional medicines.

Background

Plants that have therapeutic potential and have been proven successful in the well-being of people are generally considered Medicinal plants (World Bank 2018). While on the other hand, indigenous knowledge is the expertise that local people have about the plants around their locality.

The understanding of the medicinal value and healing properties of plants has been transmitted within and among the public over centuries (Silva *et al.* 2010). Nepal is rich in plant, animal, and cultural diversity, despite being a small country occupying only 0.1% of the global area (MoFSC 2014). The existing checklist of Nepal records some 6,000 species of flowering plants (Source: floraofnepal.org). Out of them 1,792 to 2,331 species of medicinal and aromatic plants (MAPs) are traditionally used by locals as medicines (Baral, Kurmi 2006, Rokaya *et al.* 2010). The diverse culture, religion, and beliefs of Nepali people have been building a solid foundation for traditional herbal medicine in Nepal. It continues in different methods among ethnic groups in their ritual or ceremonial applications, spiritual practices, and self-healing performances. Different ethnic groups have been using traditional and indigenous knowledge for generations under local laws, customs, and traditions to cure different diseases (Malla *et al.* 2014). Indigenous knowledge not only identifies but also provides the system of management of natural resources (Koirala, Khaniya 2009).

People living in remote areas highly depend on different plants for their basic needs and mobilize the plant resources according to their knowledge and requirements (Joshi *et al.* 2011). The village people, mostly women, are involved in the maintenance, and preservation as well as promotion of the local crop species, collecting and using plant-based food for daily nutrition (Rawal *et al.* 2020). The knowledge of medicinal plant conservation and its sustainable use has developed a linkage between promoting environmental conservation and indigenous knowledge (Cameron 2008). Nepal is considered a storehouse of ethnomedicinal plants. It is estimated that about 83% of the total population live in hill and mountain regions and have poor access to modern medicines thus still depend upon the traditional system of treatment for their basic health care system (CBS 2007, Ignacimuthu *et.al.* 2006, Sathiyaraj *et al.* 2015, UNEP 2012, Upreti *et al.* 2010). In addition, people residing in remote areas do not know the scientific use of these medicinal plants however, they have been traditionally using these plants for ages as per their beliefs and thoughts. Nepal is home to many plants with medicinal and aromatic values as it is rich in biodiversity due to its unique geographical features and highly diverse climatic condition. Among these plants, some are used as traditional medicines while some are still not explored scientifically for their medicinal values (Subba, Paudel 2016). Systematic and scientific studies of traditional medicinal plants have provided many valuable drugs in modern medicines (Thakur *et al.* 2014). Therefore, taking into consideration, the documentation of important medicinal plants for further conservation is highly desirable before they become extinct from nature. Moreover, valuable plant information from different parts of the nation needs to be systematically collected and documented for future generations, apart from conserving these vital plant resources of high economic and social value. Despite the amazing geographical setting and fascinating floral diversity ethnobotanical reports from the Gulmi district are very limited and few published reports are mainly focused on the Magar community (Acharya 2012, Khanal *et al.* 2020). However, ethnobotanical studies targeting all communities in the district are lacking. We hypothesized that people in Dhurkot area are rich in ethnomedicinal knowledge and ample information on diversified medicinal plants from that area is expected. Therefore, the present study aims to: i) explore and document the ethnomedicinal plants in the Dhurkot Rural Municipality, ii) understand their mode of use in a different healing system based on the traditional knowledge of local people, and iii) identify the possible conservation measures of these important plants.

Materials and Methods

Study area

Dhurkot Rural municipality, which lies in 28°6′ to 28°10′ N and 83°15′ to 83°21′ E, is located in Gulmi district, Nepal. It is situated in Lumbini Province in the western part of the country with an area of 86.32 km^2 and includes 7 wards (Pipaldhara, Hadahade, Jaisithok, Bastu, Dhurkot Rajasthal, Nayagaun, and Wagla) (Fig. 1). . The altitude of the study area ranges from 350 to 2000 m above sea level which represents the tropical to subtropical climate. The annual average rainfall ranges from 620 to 1400 mm while the mean maximum and minimum temperature measures 39.5°C and 19°C, respectively. The summer average temperature ranges from 29 to 33°C and the winter average temperature ranges from 19°C-23°C. Within the Dhurkot rural municipality, 7004 households are managing 59 CFs covering an area of 2146.82 ha. (District Forest Office, Gulmi 2020).

The total population with seven wards of the rural municipality is 22, 454 (CBS 2012). The major ethnic groups residing are Brahmin, Chhetri, Kami, Damai, and Magar. People grow paddy, maize, millet, wheat, and barley as the main crop plants. The place is also famous for coffee and orange where people also rear livestock like buffalo, goat, and cow, for their own needs for instant milk and milk products, meat, and manure for the agricultural field. People use both traditional as well as modern health care needs as there is a primary health post in each ward and a hospital in this rural municipality.

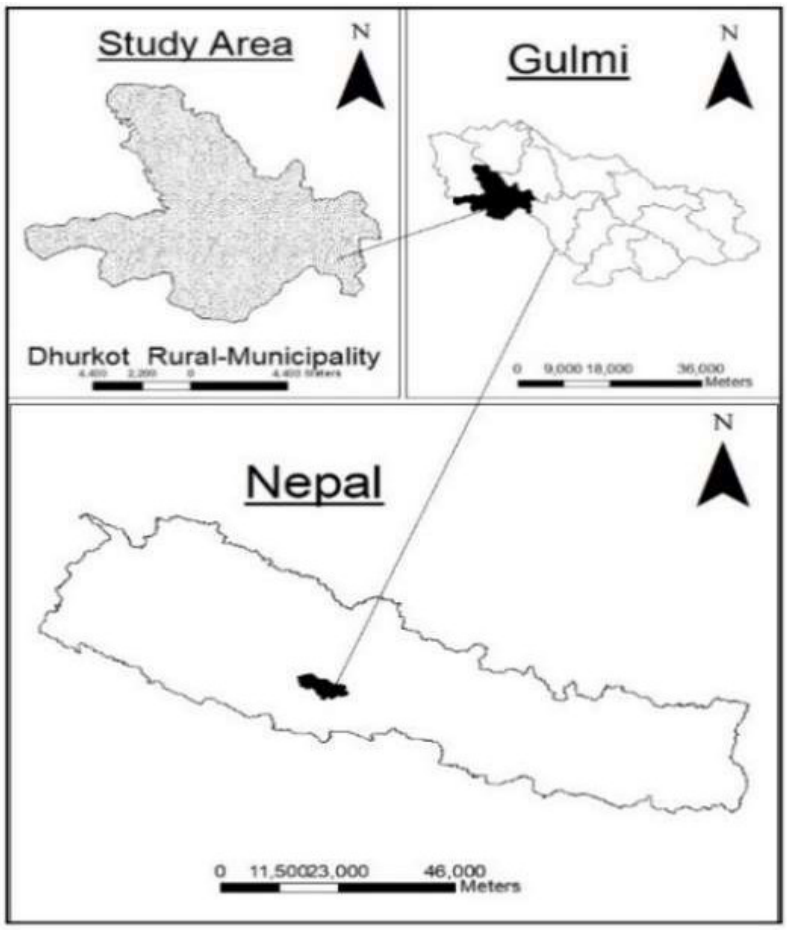

Figure 1. Map of the study area.

Data collection

This study covered all seven wards of Dhurkot rural municipality, Gulmi. The data were collected from February 2021 to October 2021. We used a questionnaire survey, focus group discussion, semi-structured interviews, key informant interviews, and field surveys for the data collection. During the study period, the study area was visited four times, and data were collected during the first visit, all the representatives of community forests (three from each community forest) of each ward were called to the ward office, and we interacted with them about the major species found in forests and recorded them. During the second visit, we visited the community forests considering the first-round information as baseline data. We collected data by transect walk with locals who helped us to identify some species by their vernacular names. All the species were recorded with their uses and unidentified species were collected and later brought to elder people who are living there for a long time and had traditional knowledge of plant use.Our third visit was at the household level gathering information from locals and doing a household survey. It took us almost the whole month of July to gather information from all seven wards. The number of households was determined as per the population of the ward where at least 50 households were taken for the questionnaire. Among the 4539 households in the municipality, we surveyed 428 households (about 9.42%). Nayagaun being the most populated ward with 818 households, we surveyed 98 households while for the rest six wards a total of 55 households per ward were surveyed. The participants were chosen to represent both genders, different professions and age groups. We prepared a set of questionnaires asking about the available species around their home, the local name of the species, which species they prefer more, which part of the medicinal plant they use and how. For the KII informant interview, we choose the chairperson and secretary of each ward, two teachers of local schools, three elderly people reputed as *'dhami/guru'* of the locality, and four common peoples. A total of 77 KIIs representing 11 from each ward were selected. During the study, we included all the age groups between (20-40 years), (40-60 years) and above 60 years (Figure 2). Among them, people above 60 years who had more knowledge of the traditional use of the plants were more interested in sharing knowledge and no doubt they have knowledge about the medicinal plants available in the local forest and surroundings. During the study period, every individual involved in the interaction was asked to rank the species according to their preferences in traditional medicines.

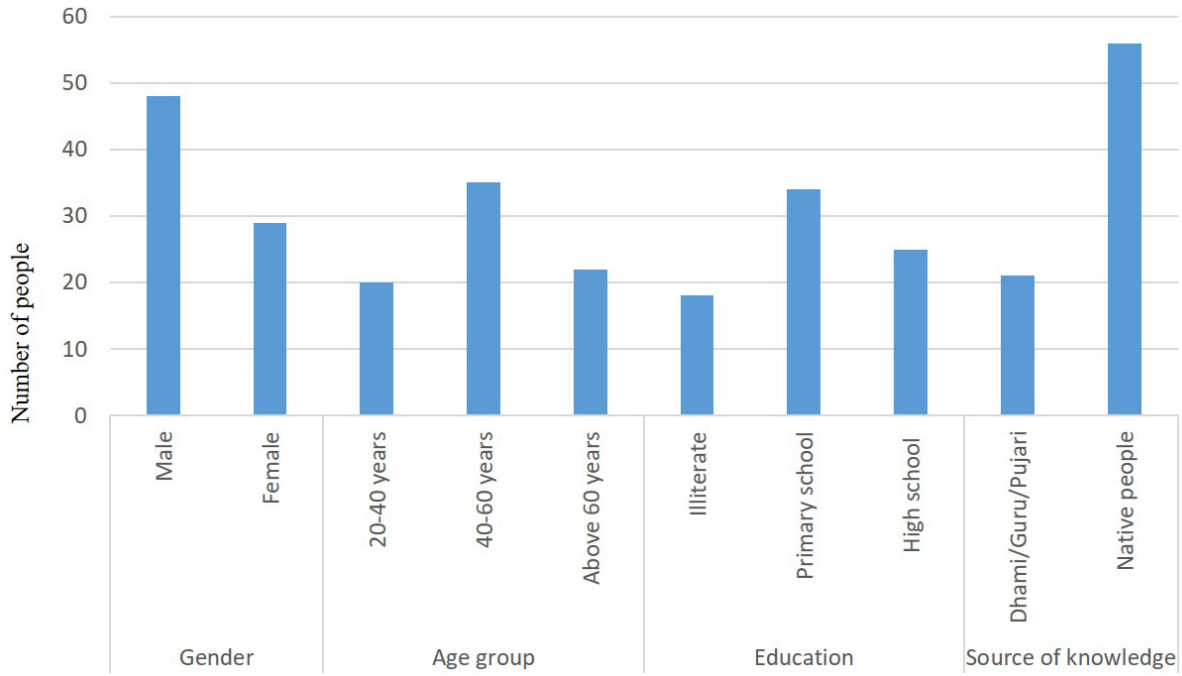

Figure 2. Demographic data of informants.

The plants were identified by their local vernacular names with the help of elderly people who has in-depth knowledge of traditional medicines and local plants. Cross-checking was also done for the specimen including its uses and later verified if a similar answer was recorded from multiple persons (3-5 individuals). The ones that remained unknown were identified with the help of published papers, flora, and related taxonomical literature (Hara *et al.*, 1978, 1982; Hara and Williams, 1979; Polunin and Stainton, 1984; Press *et al.*, 2000). The herbarium specimens were made accordingly. Voucher specimens were deposited at the Faculty of Forestry, Agriculture and Forestry University, Hetauda, Nepal.

Data analysis

The collected data were entered in MS Office Excel 2013 to analyze the information regarding plant rankings (family, genus, and species), parts used, preference of the locals, and plant forms. Data were expressed in terms of number and percentage. Graphs and pi-charts were made from the qualitative data.

Results

Our study found 67 species belonging to 39 families and 64 genera which are being used for curing various diseases in this area (Table 1). Among 39 families Poaceae is the dominant family with seven spp. are being used followed by Rutaceae, Asteraceae, and Lamiaceae with three species) whereas Solanaceae, Moraceae, Zingerberaceae, Fabaceae and Amaryllidaceae have two species each used for different purposes. The rest of the species represent the sole family. Table 1 shows the local name, scientific name, family, form of use, habit, and uses along with its parts. The uses are highly based on the local people's knowledge and methods of using plants as traditional medicines. The data is presented in Table 1. Plants are ranked according to the alphabetical order of their respective families and the spp. having the same families are ordered according to the alphabetical order of their scientific names.

Plants based on their parts used

To collect the information household survey was carried out by choosing 50-60 households as per the population of the ward and the transportation feasibility to reach the people. For the focal group discussion, we gathered the representative of all community forests of each ward, and the species found in the community forests were recorded from the discussion. It was found that every part of the plants is being used by the locals depending on the species. Most of the plant species had multiple uses for their parts and are used to treat multiple diseases. Among them, leaves are the most common parts being used (i.e., 29.55% of the total plants) followed by barks, whole plants, fruits, and roots (Figure 3). Besides this, underground bulbs and rhizomes were also used.

Table 1. List of the plant species found in the study area, their botanical name, family, common name, vernacular name, and medicinal uses.

Botanical Name (Voucher number)	Family	Common name	Vernacular Name	Habit	Habitat	Parts used	Form of use/mode of application	Uses
Justicia adhatoda L. (RB-045)	Acanthacaee	Malabar Nut	Asuro	Shrub	Wild	Leaves	Paste, decoction/oral	Leaves after boiling used for cough, asthma, and bronchitis,
Acorus calamus L. (RB-012)	Acoraceae	Flagroot	Bojho	Herb	Wild/Farmland	Root \	Juice/oral	Root or rhizome is used for sore throat, body pain, asthma, high blood pressure, constipation.
Achyranthes aspera L. (RB-010)	Amaranthaceae	Chaff flower	Datiwan	Herb	Wild	Twigs\ root	Juice, chewing/oral	Twigs used as toothbrush, used in religious purpose.
Allium cepa L. (RB-015)	Amaryllidaceae	Onion	Pyaaj	Herb	Farmland	Bulb\leaves	Decoction/oral, topical	Leaves and underground bulbs used as food on daily basis, used as an antioxidant.
Allium sativum L. (RB-016)	Amaryllidaceae	Garlic	Lasun	Herb	Farmland	Bulb\leaves	Decoction, Juice/oral, topical	Bulbs used in food, in gastritis, diarrhea, and stomach disorders.
Rhus javanica L. (RB-014)	Anacardiaceae	Nutgall tree	Bhakiamilo	Tree	Wild	Fruit	Powder, paste/oral, inhalation	Fruit and its powdered form are used during diarrhea and to cure when blood is seen during diarrhea.
Centella asiatica (L.) Urb. (RB-035)	Apiaceae	Asiatic pennywort	Topre jhar\ ghodtapre	Herb	Wild	whole plant	Juice/oral	Plant is used for stomachache, blood purifier, as a tonic and increase memory power.
Coriandrum sativum L. (RB-023)	Apiaceae	Corriander	Dhaniya	Herb	Farmland	Leaves\ seeds	Vegetable, powder form /oral	Leaves and seed used in cooking and believed to help in digestion.
Foeniculum vulgare Mill. (RB-021)	Apiaceae	Common fennel	Sampho	Herb	Farmland	Leaves\ seeds	Vegetable, powder form/oral	Used during cooking and the seeds after grinding and mixing with rice is served during fractures and during post pregnancy.
Calotropis gigantea (L.) W.T. Aiton (RB-001)	Apocynaceae	Giant calotrope	Aank	Shrub	Wild	Leaves	Latex/topical, oral	Leaves are used to treat muscular spasm, muscle tears, used to cure blood clotting. Latex is used to cure toothache and cavities.
Colocasia esculanta (L.) Schott (RB-034)	Araceae	Taro plant	Karkalo	Herb	Farmland	whole plant	Vegetable, decoction/ oral	Leaves used as vegetable and underground stem (corm) and petiole after cutting and dried are used to make "masyaura" which can be stored for long period of time for vegetable.
Phoenix humilis (L.) Royle (RB-067)	Arecaceae	Mountain date palm	Thakal	Shrub	Wild	leaves\fruit	Buds can be chewed/oral, chewing	Leaves as an astringent, intestinal troubles. Fruits are used in treatment of bowel disease.
Asparagus racemosus Willd. (RB-003)	Asparagaceae	Asparagus	Kurilo	Shrub	Wild	Root	Juice, decoction/oral	Roots used for acidity, fever, bark has antibacterial and antifungal property
Aloe vera (L.) Burm. f. (RB-005)	Asphodelaceae	Aloevera	Ghiu kumari	Herb	Farmland	Leaves	Gel/topical	Gel from the leaves used to cure burns and boils
Ageratum conyzoides (L.) L. (RB-017)	Asteraceae	Goat weed	Gandhe jhar	Herb	Wild	Leaves	Juice/topical	Local method to stop bleeding from wounds during cut.
Artemisia vulgaris C.B. Clarke (RB-004)	Asteraceae	Mugwort	Titepaati	Herb	Wild	Leaves	Juice, paste, decoction/oral, topical	Leaves has antifungal, antibacterial, antiparasitic used as an eye wash and culinary herb

Ageratina adenophora (Spreng.) R.M. King & H. Rob (RB-011)	Asteraceae	Crofton weed	Banmara	Shrub	Wild	Leaves	Juice/topical	Juice of leaves used to stop blood during cut, wound healing.
Marsdenia tenacissima (Roxb.) Moon (RB-009)	Asclepiadaceae	Rajmahal hemp	*Bilajor*	Climber	Wild/Farmland	Root/Leaves	Paste, small pieces of leaves/oral	Bark of root is used during fractures and body ache and leaves mixed with flour is used to make bread for the same purpose.
Berberis asiatica Roxb ex. DC. (RB-055)	Berberidaceae	Barberry	Chutro	shrub	Wild	bark \root	Juice/oral, topical	Juice of bark used in eye disease. barks and roots used as natural dye(yellow)
Brassica alba (L.) Rabenh. (RB-060)	Brassicaceae	White Mustard	Tori	Herb	Farmland	Seeds\leaves	Oil, vegetable/oral, topical	Oil produced after squeezing of seeds is used during earache whereas leaves used as vegetable.
Terminalia chebula Retz. (RB- 026)	Combretaceae	Myroballan	Harro	Tree	Wild	Fruit	Decoction /chewing/oral, inhalation	Fruit used for cough. Sometimes used for heart disease, and in Ayurveda.
Cuscuta reflexa Roxb. (RB-075)	Convolvulaceae	Dodder	Aaakashbeli	Climber	Wild	Whole plant	Juice/oral	Whole plant which occurs as climber is used as juice used in treating jaundice.
Momordia charantia L. (RB-002)	Cucurbitaceae	Bitterguard	Karela	Climber	Farmland	Fruit	Vegetable, decoction, juice/oral	Fruit used by high blood pressure patient as vegetable and also used as juice.
Dioscorea bulbifera L. Schott (RB-032)	Dioscoreaceae	Potato yam	Tarul	Climber	Farmland	Tubers	Decoction/oral, topical	Underground tubers are used as vegetables and also eaten after boiling. Also bulbils are used to treat piles and diarrhea
Rhododendron arboretum Sm. (RB-0049)	Ericaceae	Rhododendron	Gurans	Tree	Wild	Flowers	Juice/oral	Juice of flower is used to treat diarrhea, dysentery.
Bauhinia variegate L. (RB-048)	Fabaceae	Orchid Tree	Koiralo	Tree	Farmland	Flower\bark	Juice, decoction/oral	Bark is tonic, appetizer, astringent and anti-helminthic. Flowers also used for making pickle at local level.
Trigonella foenum-graecum L. (RB-078)	Fabaceae	Fenugreek	Methi	Herb	Farmland	Seeds	Decoction/oral, inhalation	Seeds used during gastritis, and soaked seeds with water is drank during summer used during cooking.
Juglans regia L. (RB-046)	Juglandaceae	Walnut	Okhar	Tree	Farmland	Fruit	Paste of fruit peel/oral, topical	Nutritious also helpful for diabetes patients. Peels of fruit used in fungal infection.
Mentha arvensis L. (RB-008)	Lamiaceae	Wild mint	Babari	Herb	Wild/Farmland	Leaves\stem twigs	Decoction/oral	Leaves used during sore throat and also during stomachache.
Mentha spicata L. (RB-007)	Lamiaceae	Mint	Pudina	Herb	Farmland	whole plant	Paste, juice/oral	Leaves are used for throat infection, indigestion. Raw leaves or juice of leaves in an empty stomach increase the appetite.
Ocimum tenuiflorum Burm. f. (RB-040)	Lamiaceae	Holy basil	Tulsi	Herb	Farmland	Leaves\stem twigs	Decoction/oral	Leaves and stem in headache, common cold, cough and bronchitis.
Pogostemon benghalensis (Gaertn.) G.L. Webster (RB-066)	Lamiaceae	Bengal shrub	Rudilo	Herb	Wild/Farmland	Leaves	Juice, decoction/oral	The leaves after boiling with water is used during sore throat and common cold.
Unidentifieid (RB-065)	Lamiaceae		Sanjivini	Herb	Wild/Farmland	Leaves	Decoction	Leaves used in sore throat, common cold, and stomachache

Cinnamomum tamala (Buch.Ham.) T. Nees& Nees (RB-042)	Lauraceae	Bayleaf	Tejpaat	Tree	Wild	Leaves\bark	Powder, decoction/oral	Leaves and bark used in food for better taste and smell. Contain vitamin A and folic acid.
Bombax ceiba L. (RB-038)	Malvaceae	Simal	Simal	Tree	Wild	Bark \root\flower	Decoction/oral	Bark, flower, roots used in dysentery and stomach disorders.
Azadirachta indica A. Juss. (RB-047)	Meliaceae	Neem	Neem	Tree	Wild	Leaves	Paste, powder, decoction/oral, topical	Leaf paste and powder is used to treat skin related problems, leaf decoction is helpful for stomach disorders and fever.
Tinospora cordifolia (Willd.) Miers (RB-029)	Menispermaceae	Heart leaved moonseed	Gurjo	Vine	Wild	Leaves\twigs	Juice of stem, decoction/oral	Powder or decoction of leaf and small twigs is used as blood purifier and also helpful for stomach disorders.
Artocarpus heterophyllus Lam. (RB-053	Moraceae	Jack fruit	Rukh katahar	Tree	Farmland	Stem\fruit	Latex/oral, topical	Latex of stem is used during swelling and ripe fruits are eaten whereas unripe fruits are used as vegetables.
Artocarpus lakoocha Wall. ex Roxb. (RB-051)	Moraceae	Monkey Jack	Badahar	Tree	Farmland	Stem\fruit	Latex, powder/oral, topical	Stem sap and bark powders used as antiseptic and applied to pimples and to cracked skin, also used in constipation
Ficus benghalensis L. (RB-039)	Moraceae	Banyan tree	Bar	Tree	Wild	Stem\leaves	Latex/topical	The latex of stem is used in toothache whereas leaves used in religious purpose.
Myrica esculenta Buch. -Ham. ex D. Don (RB-030)	Myricaceae	Box byrtle	Kaphal	Tree	Wild/Farmland	Bark	Decoction, paste/oral, topical	Bark boiled with water used in diarrhea, dysentery. Powdered bark with oil used in rheumatic and joint pain
Psidium guajava L. (RB-050)	Myrtaceae	Guava	Belauti\amba	Tree	Wild/Farmland	Leaves\Stem	Decoction/oral	Leaves used during Diarrhea, Dysentery, Menstrual disorders, stomachache, sore throat, ulcers, toothache, childbirth, lung problems, vomiting, bacterial infections, blood cleansing, wounds and as an antiseptic.
Nephrolepis cordifolia L. C. Pers (RB-018)	Nephrolepidaceae	Tuberous sword fern	Paani amala	Fern	Wild/Farmland	Underground part	Decoction/oral	Underground berries are used in jaundice and diabetes.
Oxalis acetosella L. (RB-061)	Oxalidaceae	crepping sorrel	Chariamilo	Herb	Wild/Farmland	whole plant	Juice, decoction/oral, topical	Leaf powdered mixed with water is applied in wound of snakebite. Juice of leaf and stem is used to improve digestive system, fever as well as in piles.
Phyllanthus emblica L. (RB-064)	Phyllanthaceae	Indian goose berry	Amala	Tree	Wild/Farmland	Fruit	Chewing, powder/oral, topical	Fruit rich in vitamin "c", boost immunity power, blood purifier, beneficial for skin and hair, helpful for reducing the chance of stone.
Cynodon dactylon (L.) Pers. (RB-041)	Poaceae	Bermuda grass	Dubo	Grass	Wild/Farmland	whole plant	Juice/oral, topical	Juice after grinding and squeezing is used in diarrhea, dysentery and its garland used in marriage and religious works.
Hordeum vulgare L. (RB-056)	Poaceae	Barley	Jahu	Grass	Farmland	Seed	Flour/oral	Flour used as good source of protein and is believed to reduce high cholesterol level.
Pennisetum glaucum (L.) R. Br. (RB-059)	Poaceae	Millet	*Kodo*	Grass	Farmland	Seed	Flour/oral	Millet flour and its bread are used during cold as it is believed it absorbs cold and treat cough.
Triticum aestivum L. (RB-057)	Poaceae	Wheat	Gahu	Grass	Farmland	Seed	Flour/oral	Wheat flour used in diabetes, used to make bread.

Oryza sativa L. (RB-062)	Poaceae	Paddy	Dhaan	Grass	Farmland	Seed	Rice/oral, inhalation	Used in everyday life as food and good source of carbohydrates. The seed after roasting is used during coughs and cold.
Saccharum officinalum L. (RB-071)	Poaceae	Sugarcane	Ukhu	Grass	Farmland	Stem	Juice/oral	Juice used by diabetic patients, as energy booster.
Zea mays L. (RB-069)	Poaceae	Maize	Makai	Grass	Farmland	Seed	Flour/oral	Source of carbohydrate and used as an important food by diabetes patients.
Cheilanthes tenuifolia (Burm. f.) Sw. (RB-044)	Pteridaceae	Lip fern	Dudh sinki	Fern	Wild	whole plant	Paste/oral	Used for acidity, and as a tonic.
Rubus ellipticus Sm. (RB-033)	Rosaceae	Himalayan raspberry	Aiselu	Shrub	Wild	Root, fruit	Juice/oral	Roots used to treat stomach pain, headache, and fruits as an anti-oxidant.
Aegle marmelos (L.) Correa (RB-013)	Rutaceae	Golden fruit	Bel	Tree	Wild/Farmland	Fruit	Juice/oral	Used in stomach disorders, juice is preferred by people for health benefits
Citrus limon (L.) Osbek (RB-052)	Rutaceae	Lemon	Kagati	Tree	Farmland	Fruit	Juice/oral	Contains vitamin -C and used for skin diseases and the lemon juice with water is widely used during summer.
Zanthoxylum armatum DC. (RB-006)	Rutaceae	Nepalese peper	Timur	Shrub	Farmland	Fruit	Juice, decoction/oral	Fruit used as spices, used in stomachache, joint pain, cough, cold, toothache, Also improve digestive system. Fruits are crushed and rubbed on the leg which acts as leech guard.
Sapindus mukorossi Geartn. (RB-063)	Sapindaceae	Indian soapberry	Ritha	Tree	Wild	Fruit	Seed/oral, topical	Used as soap\ detergent, cough.
Diploknema butyracea (Roxb.) H.J. Lam (RB-068)	Sapotaceae	Butter tree	Chiuri	Tree	Farmland	Fruit	Oil/oral, topical	Fruits used for making ghee, oil used for headache, skin burn, acnes.
Lycopersicion esculentum Mill. (RB-073)	Solanaceae	Tomato	Golveda	Climber	Farmland	Fruit	Juice, paste/oral, topical	Fruits used as vegetables as well as cut fruit is used during burns.
Nicotiana tabacum L. (RB-054)	Solanaceae	Cultivated tobacco	Kacho paat	Herb	Farmland	Leaves	Paste, juice/inhalation, oral	Dry leaf powder is used as tobacco
Solanum melongena L. (RB-028)	Solanaceae	Egg plant	Bhanta	Herb	Farmland	Fruit	Decoction/oral	Boiled fruit has antioxidant property and usis ed during fever.
Schima wallichi (DC.) Korth. (RB-074)	Theaceae	Needle wood tree	Chilaune	Tree	Wild	Bark	Decoction/oral	Bark used as an antipyretic, antiseptic, anti-helminthic and wound healing agent.
Daphne papyreceae Wall. ex G.Don (RB-081)	Thymelaeaceae	Nepalese paper plant	Lokta, Baruwa	Shrub	Wild	Root	Juice	Used in stomachache
Urtica dioca L. (RB-022)	Urticaceae	Common Nettle	Sisno	Herb	Wild/Farmland	Leaves\Root	Decoction, root Juice/oral	Leaves used as food after cooking, contains iron, vitamin A and C, potassium manganese and calcium.
Curcuma longa L. (RB-020)	Zingiberaceae	Turmeric	Haldedo	Herb	Farmland	Rhizome	Decoction/oral	Its underground rhizome used in stomach disorder along with water, used during common cold, sore throat.
Zingiber officinale Roscoe (RB-019)	Zingiberaceae	Zinger	Aduwa	Herb	Farmland	Rhizome	Decoction, chewing/oral	Rhizome used during common cold, stomachache and used in foods for flavor.

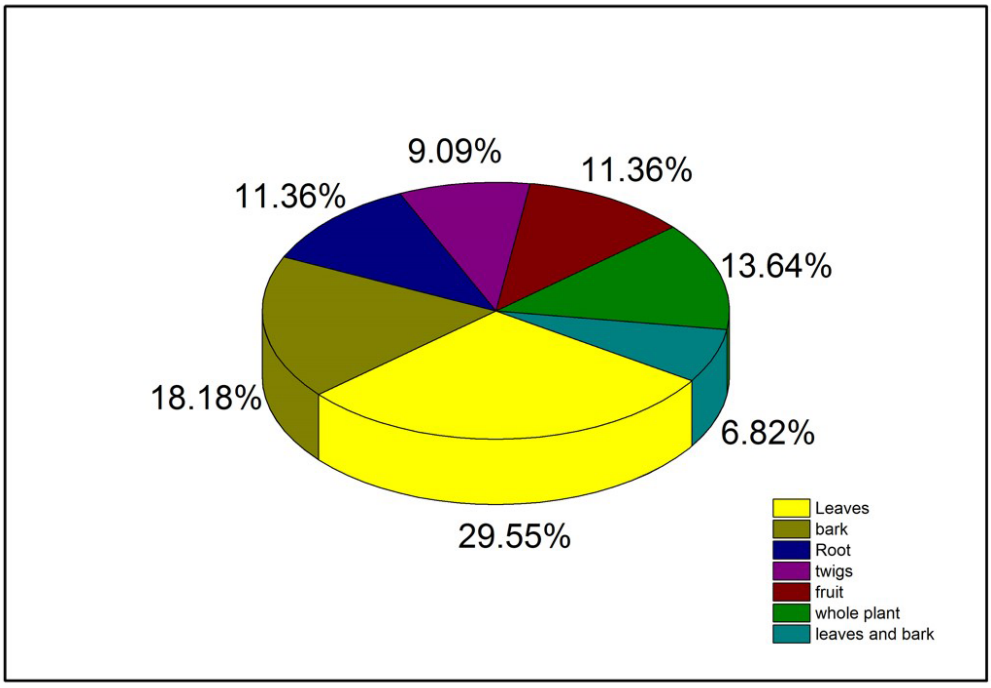

Figure 3. Distribution of plants based on their parts used.

Preference ranking by the locals

Among the 484 individuals who were involved in the preference ranking, most of them chose *Cinnamomum talama*, followed by *Oryza sativa*, *Phyllanthus emblica, and Zanthoxylam armatum* (Figure 4). Leaves and bark of *C. tamala* are used in food for better taste and smell. Our informants believed that fruits of *P. emblica* boost immunity power, purify blood, beneficial for skin and hair, and also help reduce the chances of stones. Similarly, *Z. armatum* provides a multipurpose medicine, and fruit of this species are used as spices in food and pickle (popularly known as Ttimur ko chhop' in the local language). It is also used in stomach aches, joint pain, and altitude sickness, as an ingredient of toothpaste, soap, and perfume. People in the study area also thought that consumption of *Z. armatum* fruits improves the digestive system. As *O. sativa* is consumed daily as a staple food, however, the medicinal value of this plant cannot be ignored (Table 1, 2).

Plants growth forms used by locals

During the study, we found that all forms of the plants are being used for medicinal purposes (Figure 5). Among them, herbs are the most preferred growth form (36%) followed by trees (27%) and grass (15%). Similarly, ferns with only 2% followed by climbers (7%) are the least growth form of the plants used in traditional medicine in the study area.

Mode of plant forms used as medicine

The result indicated that medicinal plants are mostly used in juice, decoction, paste, and powdered form (Figure 6). Some plants are used in form of the latex and flour while some are directly chewable, and few are consumed in pickled form. Concerning the mode of application, about 50% of the plants are being consumed orally in different forms either cooked or uncooked while about 25% of the plants are used in both modes, oral and topical (Table 1). Only four plants (*Ageratum conizoides*, *Ageretina adenophora, Aloe vera,* and *Ficus bengalensis*) are used in the topical mode for curing wounds, burns, and swollen body parts.

Table 2. List of plant species and their parts used for specific disease in study area.

Diseases	**Species name**	**Parts used**
Gastrointestinal diseases	*Allium sativum*	Bulb\leaves
	Rhus javanica	Fruit
	Centella asiatica	whole plant
	Coriandrum sativum	Leaves\seeds
	Phoenix humilis	leaves\fruit
	Dioscorea bulbifera	Tubers
	Rhododendron arboretum	Flowers
	Trigonella foenum-graecum	Fruit
	Mentha arvensis	Leaves\stem twigs
	Mentha spicata	whole plant
	Bombax ceiba	Bark \root\flower
	Azadirachta indica	Leaves
	Psidium guajava	Leaves\Stem
	Cynodon dactylon	whole plant
	Rubus ellipticus	Root
	Aegle marmelos	Fruit
	Zanthoxylum armatum	Fruit
	Curcuma longa	Rhizome
	Zingiber officinale	Rhizome
	Myrica esculenta	Bark
	Tinospora cordifolia	leaves/Twigs
	Oxalis acetosella	whole plant
Respiratory Diseases	*Justicia adhatoda*	Leaves
	Acorus calamus	Root \ leaves
	Terminalia chebula	Fruit
	Ocimum tenuiflorum	Leaves\stem twigs
	Pogostemon benghalensis	Leaves
	Pennisetum glaucum	Seed
	Oryza sativa	Seed
	Sapindus mukorossi	Fruit
	Unidentified (sanjivani)	Leaves
Skin Diseases	*Asparagus racemosus*	Root
	Aloe vera	Leaves
	Artemisia vulgaris	Leaves
	Artocarpus lakoocha	Stem\fruit
	Schima wallichi	Bark
	Citrus limon	Fruit
Myalgia/ Body ache	*Foeniculum vulgare*	Leaves\seeds
	Calotropis gigantea	Leaves
	Marsdenia tenacissima	Leaves
	Diploknema butyracea	Fruit
Cardio Diseases	*Momordia charantia*	Fruit
	Phyllanthus emblica	Fruit
	Hordeum vulgare	Seed
Blood Clotting	*Allium cepa*	Bulb\leaves
	Colocasia esculanta	whole plant
	Ageratum conyzoides	Leaves
	Ageratina adenophora	Leaves
Jaundice/ Diabetes	*Cuscuta reflexa*	Whole plant
	Nephrolepis cordifolia	Underground part
	Saccharum officinalum	Stem
	Zea mays	Seed
Multi Vitamin	*Urtica dioca*	Leaves\Root
	Juglans regia	Fruit

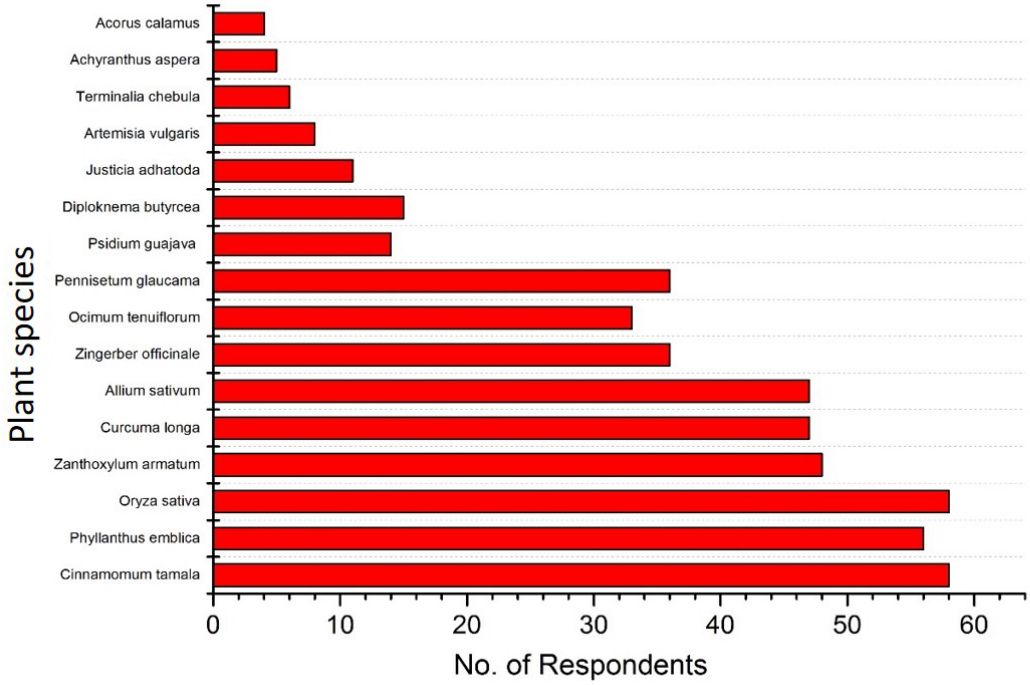

Figure 4. Ranking of plant species based on their preference.

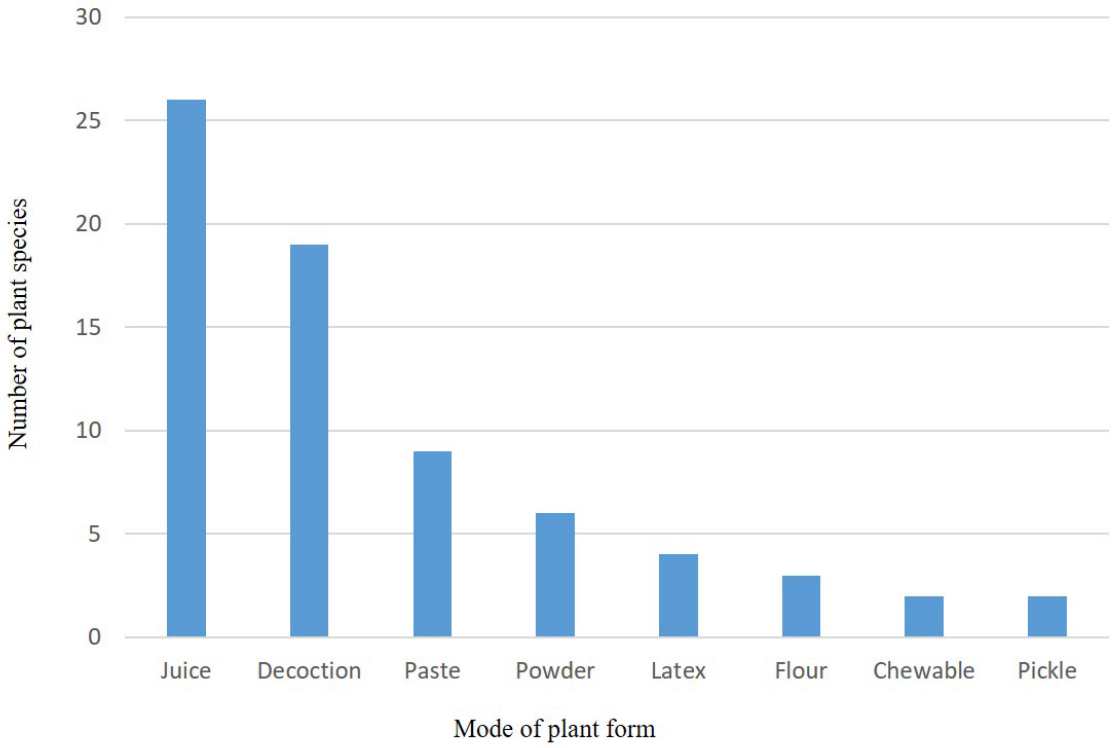

Figure 5. Mode of plant form used by locals for different diseases.

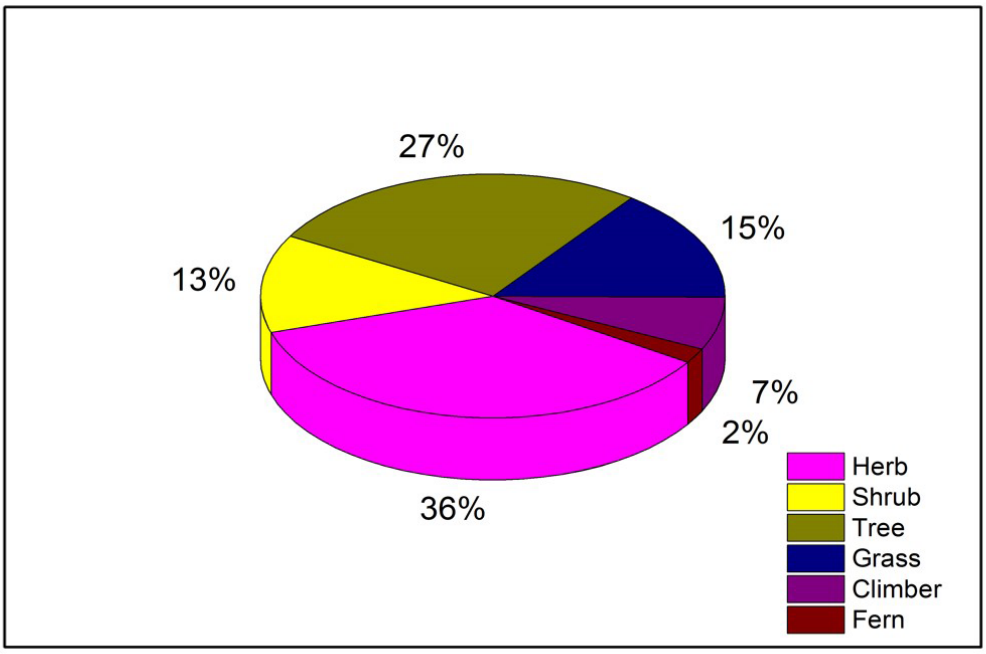

Figure 6. Mode of plant forms used as medicine.

Discussion

We found that altogether 67 species belonging to 39 families and 64 genera are ethnomedicinally useful in the study area. The study area lies in the mid hill region of western Nepal, representing a tropical to subtropical climate. Some of the recent studies in the same range of climatic conditions in the country found little low diversity of the medicinal plants although there is some disparity in the coverage area of the study (Khanal *et al.* 2020, Adhikari *et al.* 2021, Poudel *et al.* 2021). Adhikari *et al.* (2021) reported 56 plants belonging to 36 families in Bharat Pokhari Kaski while Poudel *et al.* (2021) found 52 species belonging to 32 families and 48 genera in the Arghakhachi district. In addition, Acharya (2012) documented 161 species belonging to 87 families and 144 genera from Resunga hill which are used by the Magar community of Badagaun VDC (now a part of Musikot Municipality). However, in their report, Khanal *et al.* (2020) reported only 31 species from 25 families that are used by the Magar community used for preparing different polyhedral formulations for the treatment of 24 human ailments in the Gulmi district. It has been suggested that there is a positive correlation between plant use/knowledge and plant density, diversity, and habitat diversity (Vandebroek *et al.* 2004; Bennett *et al.* 1992). If the area is rich in plant diversity the use of plants is also heterogeneous and if the area is less diverse (abundant), the use of plants is also homogenous (Begossi 1996). Thus, a higher number of ethnomedicinal plants found in Resunga hill was associated with the area rich in biodiversity as this forest is very rich in biodiversity with great variation in vegetation housing sub-tropical to lower temperate regions (Sharma *et al.* 2018). Also, there could be an alternative explanation that the people in the study have extensive knowledge of how to use plants as a traditional medicine against different diseases.

It was found that more than one-third of the total useful plants reported were herbs in our study area. The herbs were followed by trees, grass, shrubs, and climbers, and only a few fern species are being used by people. This is an agreement with Acharya (2012) who found 39% of herbs with medicinal value in Resunga hill that is used by the Magar community of Badagaun VDC, Gulmi. However, the dominance of herbs in ethnomedicine is not limited to our study area only but was found to be the most dominant growth forms over trees, shrubs, and climbers and are being frequently used in Himalayan folk medicine (Mall, Chetri 2009, Uprety *et al.* 2010, Rokaya *et al.* 2010, Kunwar 2017, Luitel *et al.* 2014, Hasan *et al.* 2013, O'Neill, Rana 2016, Rokaya *et al.* 2014, Shrestha *et al.* 2003, Shrestha, Dhillions 2003, Singh 2013, Singh *et al.* 2012, Abbas *et al.* 2017, Singh *et al.* 2017, Thapa 2010, Acharya 2012, Chekole 2017, Maroyi 2017, Yaseen 2015, Umair *et al.* 2019). It might be the reason that herbs are easily accessible in the ground for collection, storage, and transportation. In addition, they have shorter lifecycles which make them relatively easy to cultivate, and can easily fulfill the demand if needed in higher quantity (Bekalo *et al.*

2009). More importantly, herbs are supposed to contain higher amounts of secondary metabolites for their life strategies (Stepp, Moerman 2001). Coley *et al.* (1985) demonstrated a positive relationship between short-living plants and reliance on qualitative compounds as they are opportunistic and rapidly colonize an area. Further support for the relationship between lifespan and type of defense is provided by the fact that all over the world, alkaloids are twice more likely to appear in annuals than perennials (Levin 1976). Therefore, the preferable selection and wide use of herbaceous plants depend on their phytochemical profile, natural habitat, and their accessibility for collection (Adhikari *et al.* 2019). Usually, all portions of the plants were found to be useful for medicinal purposes. Among the choice of the healer above ground parts including whole plants were frequently used. The preference in selecting parts of plants could be related to their availability during the year and also to the concentration of active chemical compounds. In our study area, the parts preferred the most by the people include leaves followed by barks, whole plants, fruits, roots, and rhizomes. The finding of this study resembles previous reports on ethnobotanical studies in different indigenous communities in the country, for instance, Magar in Gulmi district (Acharya 2012), Chepang in Chitwan district (Rijal 2008), Rai and Tamang in Sunsari district (Deokota, Chhetri 2009), Tamang in Rasuwa district (Upreti *et al.* 2010), Tharu and Magar in Rupendehi district (Singh *et al.* 2012), and Tamang in Makawanpur district (Luitel *et al.* 2014). Nevertheless, there are several reports describing the underground part, the root is preferably used as a medicine in most cases (Rokaya *et al.* 2010, Hasan *et al.* 2013, O'Neill, Rana 2016, Kunwar *et al.* 2010, Kunwar, Adhikari 2003, Rokaya *et al.* 2014, Shrestha *et al.* 2016, Shrestha, Dhillion 2003, Burlakoti, Kunwar 2008, Singh *et al.* 2017, Thapa 2012). Both roots and leaves have their value for the plants, as root contains a greater amount of active principles, in comparison with other parts (Bhattarai *et al.* 2006), while leaves have a greater role in the plant defense system and possess a higher concentration of bioactive secondary metabolites (Bhattarai *et al.* 2009, Srithi, Balslev 2009, Umair *et al.* 2019). Therefore, the best choice of leaves for the preparation of indigenous medicine recipes may be due to their highest healing power, enriched secondary metabolites, and easy availability in the surrounding areas (Verpoorte 1998, Verpoorte, Memelink 2002, Bibi *et al.* 2014).

The plant parts are used to prepare various forms of healing which can be applied to cure different human diseases and health problems (Table 2). We found that plant juice (26 species, 38.8%) was the most commonly used form followed by decoction (19 species, 28.35%), paste (9 species, 13.4%), powder (6 species, 8.96%), latex (4 species, 5.9%), flour (3 species, 4.4%), chewable (2 species, 2.9%), and pickle (2 species, 2.9%). This is an agreement with Ambu *et al.* (2020) in the Kavreplanchok district who found that 36.27% of medicinal plants were used in form of juice. Before that Burlakoti, Kunwar (2008) also reported juice as the most common form of healing followed by decoction, paste, and powder in western Nepal. The most preferred form the juice could be due to the simplicity of preparation and an excellent way of getting vitamins and minerals from the plant (Ambu *et al.* 2020). It may also be due to the presence of a greater amount of active principles extracted in juice as compared to other dosage forms (Yasen *et al.* 2015). Most of the preparation was given orally to cure human ailments and some are topically used for skin diseases, burns, and swellings. Similar results were observed in various ethnic communities in Nepal and some neighboring countries as well (Bhattarai *et al.* 2005, Upreti *et al.* 2010, Singh *et al.* 2012, Kunwar *et al.* 2013, Lulekal *et al.* 2013, Luitel *et al.* 2014).

The plants both from wild and farmlands were medicinally used in the study area (Table 1). Most of the ailments were prepared from fresh plant materials when needed. Altogether 30 (44.77%) species were found to grow on farmlands. These plants were either purposely cultivated by our respondents or unintentionally grown in the farmland of the respondents. Similarly, 24 (35.82%) species were exclusively found in the wild and respondents collected them from there and prepare doses and used them. The remaining species were found in both habitats. These species were not actually cultivated by the respondents but are purposefully or accidentally bring them to farmland from the wild. Rice (*Oryza sativa*) and Cinnamomum (*Cinnamomum tamala*) were the most preferred species of our informants. After that they choose *Phyllanthus emblica*, *Zanthoxylum armatum*, *Curcuma longa*, *Allium sativa*, and *Zanzibar officinale* the most. *Oryza sativa* is a multipurpose plant as rice is the staple food of the informants and the principal supplement of carbohydrates. Rice flour is used to prepare 'roti' in feasts, festivals, and other special occasions, and grains after roasting were used during coughs and colds. Interestingly, our informants choose rice as the most usable plant because looking across the previous studies, we could not find this plant as the most preferred plant in ethnobotanical studies in Nepal (Malla, Chetri 2009, Uprety *et al.* 2010, Rokaya *et al.* 2010, Kunwar 2017, Luitel *et al.* 2014, Hasan *et al.* 2013, O'Neill Rana 2016, Rokaya *et al.* 2014, Shrestha *et al.* 2003, Shrestha, Dhillions 2003, Singh 2013, Singh *et al.* 2012, Abbas *et al.* 201,; Singh *et al.* 2017, Thapa 2010, Acharya 2012, Chekole 2017, Maroyi 2017, Yaseen 2015, Umair *et al.* 2019). The second choice of our informants was *Cinnamomum tamala*. According to them the leaves and bark which contain vitamin A and folic acid is used as spices or food applications for better taste and smell. Although informants were not aware of the fact, the leaves

of this plant exhibit significant biological activity due to their active constituents and thus the leaves are recommended in traditional medicinal for several ailments. In Ayurveda, the leaf is considered to have heating and alexiteric properties and is considered useful in scabies, disease of the anus and rectum, piles, heart troubles, ozaena, and bad taste (Sharma *et al.* 2014). Considering this, the leaves and bark of this multipurpose plant have been used to cure several health problems including intestinal disorders, gastritis, diarrhea and dysentery, sexual incompatibility, and toothache in different parts of Nepal (Joshi *et al.* 2011, Acharya 2012, Hasan *et al.* 2013, Luitel *et al.* 2014, Shrestha *et al.* 2016, Adhikari *et al.* 2019, 2021). Similarly, in Punjab India, leaves of *C. tamala* are used to treat rheumatism, colic trouble, and diarrhea, and for suppression of lochia after childbirth, and the bark is considered useful in the treatment of gonorrhea (Sharma *et al.* 2014).

According to the informants, the fruits of *Phyllanthus emblica* (Phyllantaceae) help in the immune system, purifies the blood, beneficial for skin and hair, and also helpful in reducing the chances of kidney stones. Fresh fruits can be chewed directly, or they can be stored in form of the powder prepared from dry fruits. However, the medicinal value of this species is different in western Terai as people use bark juice for dysentery, constipation, and body aches while fruit decoction is given orally in shore throat (Singh *et al.* 2012). Similarly, people of Nawalparasi, Kabhreplanchok, Tamang community of Makawanpur, and Baram community of Gorkha consumed fruit as expectorants in case of cough and sore throat, heart pain, constipation, diarrhea, gastritis (Bhattrai *et al.* 2009, Luitel *et al.* 2014; Tamang, Shedai 2016). The exceptional diversity in the mode of utilization and healing ailments by the people of different communities indicated that this species may carry a great opportunity for bioprospecting and bioactivity determination.

Another highly preferred species by our informants was *Zanthoxylum armatum*. This is not a surprise though because this species has been extensively used as traditional medicine by various indigenous and ethnic communities. In our study area, the fruits were used as spices in preparing soup and pickles. It helps with a stomach aches, joint pain, cough, colds, and toothache, and also improves the digestive system. Fresh fruits are crushed and rubbed on the leg which acts as a leech guard. Adhikari *et al.* (2019, 2021) found that the juice and paste of fruit are used in snakebites, and scabies, and for the treatment of food poisoning in the Kaski district which was not reported by our informants. The application of different parts of this species for similar category diseases as of our informants is confirmed by other studies on the folk medicine of Nepal. The fruits and seeds of *Z. armatum* are used to cure cholera, and toothache and as leech repellant (Shrestha 1985, 1988, Manandhar 1987, Joshi, Edington 1990, Joshi, Joshi 2000, Balami 2004). In addition, the bark, thorns, and fruits are also used in fish poisoning (Kunwar *et al.* 2009, 2013, Joshi 2004, Malla *et al.* 2014).

Allium sativa, *Zanzibar officinale*, and *Curcuma longa*, which are locally known as 'lasun, adua, and besar respectively, were the principal ingredients of the spices. Informants ranked these plants in their preference list because these spices were consumed on daily basis and were easy to access as they were cultivated in the kitchen garden. Apart from the spices bulb and leaves of *A. sativum* were used to cure gastritis, diarrhea, and stomach disorder. Similar uses of these plants have been recorded from other parts of Nepal as well as other countries (Adhikari *et al.* 2019, Abbasi *et al.* 2010, Mayori *et al.* 2017, Thapa 2012, Jayaprasad *et al.* 2012, Malla, Chetri 2009). In addition to this, Adhikari *et al.* (2019) also reported that a paste of *A. sativum* bulb is applied to snakebite in the Kaski district. Likewise, *C. longa,* which is reported to be used in stomach disordered, common cold, and sore throat in our study area was also reported as being used in fever, sinusitis, sore throat, and common cold (Adhikari *et al.* 2010, 2019, Kunwar *et al.* 2010, Singh 2013, Singh *et al.* 2012, 2017, Thapa 2012, Lama *et al.* 2010). Apart from spices ingredients, *Z. officinale* was used to heal the common cold and stomachache. However, the same plant has also been used for vomiting and snake bites in Kaski (Adhikari *et al.* 2019), appetizer and stomach disorder in Tamil Nadu India (Jayaprasad *et al.* 2012), diarrhea (leaf juice) in Nawalparasi (Bhattrai, Chaudhary 2010), headache in eastern Nepal (Shrestha *et al.* 2016), indigestion, constipation, and bronchial infection in western terai (Singh *et al.* 2013). Moreover, it has been suggested that *Z. officinale* contains gingerol as an active ingredient, which possesses cholinergic M3 and 5-HT3 receptor-blocking effects thereby decreasing gastric emptying time and leading to the prevention of nausea and vomiting (Giacosa *et al.* 2015).

Our informants reported that the root or rhizome of the *Acorus calamus*, which was among the most preferred plants, can be used for sore throat, body pain, asthma, high blood pressure, and constipation. When looking across the literature, similar uses of this plant have also been recorded from other regions of the country, for instance, Kaski (Adhikari *et al.* 2019), Rasuwa (Uprety *et al.* 2010), Rupandehi (Acharya, Acharya 2009, Shing *et al.* 2012), Humla (Rokaya *et al.* 2010), Macchegaun (Joshi *et al.* 2011), Makawanpur (Hasan *et al.* 2013), Gulmi (Acharya 2012), Dolpa (Kunwar 2005), Nawalparasi (Bhattarai *et al.* 2009), and Ghandruk (Adhikari 2010) [31]. This indicated that *A.*

calamus has a good potential for bioprospecting as the predominant compounds like α-asarone, β-asarone, eugenol, and calamine present in rhizomes and leaves are responsible for the expression of potent bioactivities (Sharma *et al.* 2020). In addition, a total of 145 constituents have been isolated and identified from this herb, and evidence is suggested that its various extracts and active components are possibly useful in some metabolic and neurological disorders (Sharma *et al.* 2020, and references therein). According to our informants, the pulp of *Aloe vera* was applied to burns and boils. This has also been practiced in Machhapuchhre rural municipality Kaski (Adhikari *et al.* 2019), Panchase, Kaski (Bhattarai *et al.* 2011), Machhegaun, Kathmandu (Joshi *et al.* 2011), and the Rudraprayag district of the neighboring country India (Yaseen *et al.* 2015). However, several reports are indicating the different uses of this species, like diabetes in the Panchase village of the Kaski district (Bhattarai *et al.* 2011), fever and cough in the Makawanpur district of Nepal (Hasan *et al.* 2013), menstruation cramps, intestinal worms, and constipation in the Badgaun village of the Gulmi district (Acharya 2012), and rheumatism, constipation, and backache in Pakistan (Abbas *et al.* 2017).

The overall comparison of our reports with previous studies on traditional uses of some ethnomedicinal plants suggested the considerable variation in their application within Nepal and also some neighboring countries, for instance, India, Pakistan, and Bangladesh. In our study area, some ethnomedicinal plants were exclusively new in terms of healing practice for particular health disordered or modes of application for treatment. The discrepancy in ethnomedicinal uses of these plants may be due to the diversity in the traditional knowledge of the people and the availability and dominance of plant species in the specific geographical location. We also found that all the local indigenous healers called "dhami", "pujari", and "guru" and elderly people have strong faith in ethnomedicines although they were less conscious about the documentation and preservation of such ethnomedicinal plants. Furthermore, some of the reported plants from our study area were already recommended for their active phytochemical constituents having related biological activities with traditional medicinal practices and treatment by our informants. Therefore, such plant species which contain active metabolites and are scientifically proven to be important for the different diseases are suggested for further study on their possibilities of potential bioprospecting.

Conclusion

This study revealed that the local traditional healers of our study area are rich in ethnomedicinal knowledge. Along with modern medicines people of this area still depend on plant-based medicine for their primary health care needs. As a result, we found that many people seek traditional remedies when they suffer from various common health problems such as headaches, body aches, constipation, indigestion, cold, fever, diarrhea, dysentery, boils, wounds, skin diseases, etc. Nepal has great possibilities for the farming of medicinal plants as essential sources of sustainable livelihood. Although the modern system of remedies like allopathy, and surgery is common in practice, many people today still have to rely on plant resources for their medical needs. Medicinal and aromatic plants can play an essential role in the support of livelihood improvement of rural people in Nepal. Therefore, proper farming and cultivation of medicinal plants which have wide ethnobotanical use and bioprospecting potential could be done. In addition, medicinal plants with high value can be further investigated for essential metabolites which can draw the attention of future research, health practitioners, pharmaceutical industries and policy makers.

Declarations

Conflict of Interest: Authors have no conflict of interest.
Consent for publications: Not applicable.
Data Availability: Data available on request from the authors.
Funding: Authors have not received any funding during this research.
Author Contribution: R.B, B.P and B.G. conceived of the idea. R.B and B.P conducted the experiment and collected data. R.B and B.G. write the first draft. All authors have read and agreed to submit the final version of this manuscript.

Acknowledgements

We would like to thank the chairman of Dhurkot Rural Municipality, Mr. Bhupal Pokhrel who facilitated us during our fieldwork. Special thanks to Yubraj Bhandari for his continuous support during fieldwork. Our sincere gratitude to all the members, elders, traditional healers, and the members of community forest user groups who shared their valuable knowledge with us throughout this period. Thank you to the chairman of all the respective wards for facilitating on our data collection process.

Literature Cited

Abbas Z, Khan SM, Alam J, Khan, SW,, Abbasi AM. 2017. Medicinal plants used byinhabitants of the Shigar Valley, Baltistan region of Karakorum range-Pakistan. Journal of Ethnobiology and Ethnomedicine 13(1):1-15.

Abbasi AM, Khan MA, Ahmed M,, Zafar M. 2010. Herbal medicines used to cure various ailments by the inhabitants of Abbottabad district, North-West Frontier Province, Pakistan.

Acharya KP, Acharya R. 2010. Eating from the wild: indigenous knowledge on wild edible plants in Parroha VDC of Rupandehi district, Central Nepal. International Journal of Social Forestry 3(1):28-48.

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.

Adhikari YP, Fischer A. 2010. Trend analysis and purpose of use of some important plant and animal species of Ghandruk VDC, Nepal. Our Nature 8(1):122-130.

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

Ambu G, Chaudhary RP, Mariotti M, Cornara L. 2020. Traditional uses of medicinal plants by ethnic people in the Kavrepalanchok district, Central Nepal. Plants 9(6):759.

Balami NP. 2004. Ethnomedicinal uses of plants among the Newar community of Pharping village of Kathmandu district, Nepal. Tribhuvan University Journal 24(1):13-19.

Baral, SR,, Kurmi, PP. 2006. *Compendium of medicinal plants in Nepal*. Rachana Sharma.

Begossi A. 1996. Use of ecological methods in ethnobotany: diversity indices. Economic Botany 50(3):280-289.

Bekalo TH, Woodmatas SD, Woldemariam ZA. 2009. An ethnobotanical study of medicinal plants used by local people in the lowlands of Konta Special Woreda, southern nations, nationalities and peoples regional state, Ethiopia. Journal of Ethnobiology and Ethnomedicine 5:26. doi: 10.1186/1746-4269-5-26

Bennett BC. 1992. Plants and people of the Amazonian rainforests. BioScience 42(8):599-607.

Bhattarai KR, Måren IE, Chaudhary RP. 2011. Medicinal plant knowledge of the Panchase region in the middle hills of the Nepalese Himalayas. Banko Janakari 21(2):31-39.

Bhattarai S, Chaudhary RP, Taylor, RS. 2006. Ethnomedicinal plants used by the people of Manang district, central Nepal. Journal of Ethnobiology and Ethnomedicine 2(1):1-8.

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

Burlakoti C, Kunwar RM. 2008. Folk herbal medicines of Mahakali watershed Area, Nepal. Medicinal plants in Nepal: An Anthology of Contemporary Research 187-193.

Cameron MM. 2009. Modern desires, knowledge control, and physician resistance: Regulating Ayurvedic medicine in Nepal. Asian Medicine 4:86-112.

CBS. 2007. Population Profile of Nepal; Central Bureau of Statistics: Kathmandu, Nepal.

CBS. 2012. Population Profile of Nepal; Central Bureau of Statistics: Kathmandu, Nepal.Chekole G. 2017. Ethnobotanical study of medicinal plants used against human ailments in Gubalafto District, Northern Ethiopia. Journal of Ethnobiology and Ethnomedicine 13(1):1-29.

Chhetri VT, Shrestha S, Thapa S, Timilsina S. 2021. Status and Role of Medicinal and Aromatic Plants (MAPs) in Nepalese Livelihood. International Journal of Environment 10(1):112–136. doi: 10.3126/ije.v10i1.38405.

Coley PD, Bryant JP, Chapin FS. 1985. Resource availability and plant anti-herbivore defense. Science 230:895-899.

Dangol D, Maharjan K, Maharjan S, Acharya A. 2017. Wild edible plants of Nepal. Conservation and Utilization of Agricultural Plant Genetic Resources in Nepal. Proceedings of 2nd National Workshop, 22-23 May 2017, Dhulikhel; NAGRC, FDD, DoA and MoAD; Kathmandu, Nepal.

Das BD, Paudel N, Paudel M, Khadka MK, Dhakal S, KC A. 2021. Ethnobotanical knowledge of Kewrat community of Morang district, eastern Nepal. Ethnobotany Research and Applications 21:1-11.

District Forest Office, Gulmi (2020). Annual Report. DFO Gulmi.

Ghimire SK. 2008. Medicinal plants in the Nepal Himalaya: Current issues, sustainable harvesting, knowledge gaps and research priorities. Medicinal Plants in Nepal: An Anthology of Contemporary Research, 25-42.

Giacosa A, Morazzoni P, Bombardelli E, Riva A, Bianchi Porro G, Rondanelli M. 2015. Can nausea and vomiting be treated with ginger extract? European Review of Medical and Pharmacological Science 19(7):1291-6.

Gurung S, Subedi S. 2021. Ethnobotanical application of medicinal plants by the Gurung community of Siddhalek rural municipality, Dhading, Nepal. Asian Journal of Pharmacognosy 4(3):13-21.

Hasan MK, Gatto P, Jha PK. 2013. Traditional uses of wild medicinal plants and their management practices in Nepal-A study in Makawanpur district. International Journal of Medicinal and Aromatic Plants 3(1):102-112.

Ignacimuthu S, Ayyanar M, Sankara Sivaraman K. 2006 Ethnobotanical investigations among tribes in Madurai District of Tamil Nadu (India). Journal of Ethnobiology and Ethnomedicine 2:25-30

Jayaprasad B, Thamayandhi D, Sharavanan PS. 2012. Traditionally using antidiabetic medicinal plants in Tamil Nadu. International Journal of Research in Pharmaceutical and Biosciences 2(1):1-8.

Joshi AR, Edington JM. 1990. The use of medicinal plants by two village communities in the central development region of Nepal. Economic Botany 44(1):71-83.

Joshi AR, Joshi K. 2000. Indigenous knowledge and uses of medicinal plants by local communities of the Kali Gandaki Watershed Area, Nepal. Journal of Ethnopharmacology 73(1-2):175-183.

Joshi B, Sah GP, Basnet BB, Bhatt MR, Sharma D, Subedi K, Pandey J, Malla R. 2011 Phytochemical extraction and antimicrobial properties of different medicinal plants: *Ocimum sanctum* (Tulsi), *Eugenia caryophyllata* (Clove), *Achyranthes bidentata* (Datiwan) and *Azadirachta indica* (Neem). Journal of Microbiology and Antimicrobials 3(1):1-7.

Joshi K, Joshi R, Joshi AR. 2011. Indigenous knowledge and uses of medicinal plants in Macchegaun, Nepal. Indian Journal of Traditional Knowledge 10(2):281-286.

Khanal DP, Raut B, Magar YT. 2020. Traditional Healing Practices Using Herbal Dosage Forms and Other Agents by Magar Community of Gulmi District, Nepal. Journal of Manmohan Memorial Institute of Health Sciences 6(1):20-38. doi: 10.3126/jmmihs.v6i1.30533

Koirala RR, Khaniya BN. 2009. Present status of traditional medicines and medicinal, aromatic pants related resources, organizations in Nepal. Nepal Health Research Council.

Kumar M, Rawat S, Nagar B, Kumar A, Pala NA, Bhat JA, Bussmann RW, Cabral-Pinto M, Kunwar R. 2021. Implementation of the Use of Ethnomedicinal Plants for Curing Diseases in the Indian Himalayas and Its Role in Sustainability of Livelihoods and Socioeconomic Development. *International Journal of Environmental Research and Public Health* 18(4):1509. doi: 10.3390/ijerph18041509

Kumar L, Mazumder A, Das S and Chand S. 2021. *Rubus ellipticus*: A Phyto-nutraceutical with medicinal importance. International Journal of Pharmaceutical Research 13(02).

Kunwar RM, Adhikari N. 2005. Ethnomedicine of Dolpa district, Nepal: the plants, their vernacular names and uses. Lyonia 8:43–9.

Kunwar BB. 2017. Plants struggling to receive proper identity at Bhadaure Tamagi of Kaski district, Nepal. Trop. Plant Res. 4, 286-296.

Kunwar RM, Bussmann RW. 2008. Ethnobotany in the Nepal Himalaya. Journal of Ethnobiology and Ethnomedicine 4(1):1-8.

Kunwar RM, Fadiman M, Cameron M, Bussmann RW, Thapa-Magar KB, Rimal B, Sapkota P. 2018. Cross-cultural comparison of plant use knowledge in Baitadi and Darchula districts, Nepal Himalaya. Journal of Ethnobiology and Ethnomedicine 14(1):1-17.

Kunwar RM, Shrestha KP, Bussmann RW. 2010. Traditional herbal medicine in Far-west Nepal: a pharmacological appraisal. Journal of Ethnobiology and Ethnomedicine 6(1):1-18.

Kunwar RM, Burlakoti C, Chowdhary CL, Bussmann RW. 2010. Medicinal plants in farwest Nepal: Indigenous uses and pharmacological validity. Medicinal and Aromatic Plant Science Biotechnology 4:28-42

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.

Kurmi PP, Baral SR. 2004. Ethnomedical uses of plants from Salyan District, Nepal. Banko Janakari 14(2):35-39.

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

Levin DA. 1976. Alkaloid-bearing plants: an ecogeographic perspective. Am. Naturalist 110:261–284.

Luitel DR, Rokaya MB, Timsina B, Münzbergová Z. 2014. Medicinal plants used by the Tamang community in the Makawanpur district of central Nepal. Journal of Ethnobiology and Ethnomedicine 10(1):1-11.

Malla B, Chhetri RB. 2009. Indigenous knowledge on ethnobotanical plants of Kavrepalanchowk district. Kathmandu University Journal of Science, Engineering and Technology 5(2):96-109.

Malla B, Gauchan DP, Chhetri RB. 2014. Medico-ethnobotanical investigations in Parbat district of Western Nepal. Journal of Medicinal Plants Research 8(2):95-108.

Manandhar NP. 1987. Traditional medicinal plants used by tribals of Lamjung District, Nepal. International Journal of Crude Drug Research 25(4):236-240.

Maroyi A. 2017. Diversity of use and local knowledge of wild and cultivated plants in the Eastern Cape province, South Africa. Journal of Ethnobiology and Ethnomedicine 13(1):1-16.

O'Neill AR, Rana SK. 2016. An ethnobotanical analysis of parasitic plants (Parijibi) in the Nepal Himalaya. Journal of Ethnobiology and Ethnomedicine 12(1):1-15.

Paudel N, Adhikari DC, Das BD. 2018. Some medicinal plants uses in ethnical group from Biratnagar, Eastern, Nepal. American Academic Scientific Research Journal for Engineering, Technology, and Sciences 41(1):233-239.

Poudel B, Bhandari J, Poudel A, Gautam D. 2021. Ethnomedicinal use of common garden species in Arghakhanchi district, Western Nepal. Asian Journal of Pharmacognocy 4:31-65.

Prabakaran R, Kumar TS, Rao MV. 2013. Role of non-timber forest products in the livelihood of Malayali tribe of Chitteri hills of Southern Eastern Ghats, Tamil Nadu, India. Journal of Applied Pharmaceutical Science 3(5):056-060.

Rai SK, Subedi S, Mishra S. 2004. Utilization pattern of medicinal plants in Thumpakhar, Village Development Committee, Sindhupalchok, Nepal. Botanica Orientalis 4(1):75-78.

Rijal A. 2008. Living knowledge of the healing plants: Ethno-phytotherapy in the Chepang communities from the Mid-Hills of Nepal. Journal of Ethnobiology and Ethnomedicine 4(1):1-10.

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.

Rokaya MB, Uprety Y, Poudel RC, Timsina B, Münzbergová Z, Asselin H, Tiwari A, Shrestha SS, Sigdel SR. 2014. Traditional uses of medicinal plants in gastrointestinal disorders in Nepal. Journal of Ethnopharmacology 158:221-229.

Sathiyaraj G, Muthukumar T, Ravindran KC. 2015. Ethnomedicinal importance of fern and fern allies traditionally used by tribal people of Palani Hills (Kodaikanal), Western Ghats, South India. Journal of Medicinal Herbs and Ethnomedicine 1:4-9.

Sharma V, Rao LJM. 2014. An overview on chemical composition, bioactivity and processing of leaves of *Cinnamomum tamala*. Critical Reviews in Food Science and Nutrition 54(4):433-448.

Sharma V, Sharma R, Gautam DS, Kuca K, Nepovimova E, Martins N. 2020. Role of Vacha (*Acorus calamus* L.) in neurological and metabolic disorders: evidence from ethnopharmacology, phytochemistry, pharmacology and clinical study. Journal of Clinical Medicine 9(4):1176.

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. Research note: contribution to the ethnobotany of the Palpa area. Contribution to Nepalese Studies, Centre for Nepal and Asian Studies (CNAS), Tribhuvan University (TU), 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(1):81-96.

Silva NCC, Fernandes Júnior A. 2010. Biological properties of medicinal plants: a review of their antimicrobial activity. Journal of Venomous Animals and Toxins Including Tropical Diseases 16:402-413.

Singh AG. 2013. Medicinal plants as a source of antipyretic agent in Terai region of Western Nepal. International Journal of Applied Sciences and Biotechnology 1(3):118-126.

Singh AG, Kumar A, Tewari DD. 2012. An ethnobotanical survey of medicinal plants used in Terai Forest of western Nepal. Journal of Ethnobiology and Ethnomedicine 8(1):1-15.

Singh A, Nautiyal MC, Kunwar RM, Bussmann RW. 2017. Ethnomedicinal plants used by local inhabitants of Jakholi block, Rudraprayag district, western Himalaya, India. Journal of Ethnobiology and Ethnomedicine 13(1):1-29.

Singh AG, Gautam LP, Tewari DD. 2011. Folk uses of some medicinal plants of Dobhan VDC of Palpa District, western Nepal. Journal of Phytology 3:62-67

Srithi K, Balslev H, Wangpakapattanawong P, Srisanga P Trisonthi C. 2009. Medicinal plant knowledge and its erosion among the Mien (Yao) in northern Thailand. Journal of Ethnopharmacology 123(2):335-342.

Stepp JR, Moerman DE. 2001. The importance of weeds in ethnopharmacology. Journal of Ethnopharmacology 75:19–23.

Subba B, Paudel RR. 2014. Phytochemical constituents and bioactivity of different plants from Gulmi district of Nepal. World Journal of Pharmacy and Pharmaceutical Science 3(9):1107-1116.

Tamang R, Sedai DR. 2016. Documentation of Ethnomedicinal Knowledge on Plant Resources Used by Baram Community in Arupokhari VDC, Gorkha District, Central Nepal. Bulletin of Department of Plant Resources 38:60-64

Thakur KS, Kumar M, Bawa R, Bussmann RW. 2014. Ethnobotanical study of herbaceous flora along an altitudinal gradient in Bharmour Forest Division, District Chamba of Himachal Pradesh, India. Evidence-Based Complementary and Alternative Medicine, 2014.

Thapa S. 2012. Medico-ethnobotany of Magar community in Salija VDC of Parbat district, central Nepal. Our Nature 10(1):176-190.

Tropical Plants Database, Ken Fern. tropical.theferns.info.

Umair M, Altaf M, Bussmann RW, Abbasi AM. 2019. Ethnomedicinal uses of the local flora in Chenab riverine area, Punjab province Pakistan. Journal of Ethnobiology and Ethnomedicine 15(1):1-31.

UNEP. 2012. Green Economy Sectorial Study: Biotrade-Harnessing the Potential for Transitioning to a Green Economy-The Case of Medicinal and Aromatic Plants in Nepal; United Nations Environment Programme: Nairobi, Kenya.

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):1-10.

Uprety Y, Poudel RC, Gurung J, Chettri N, Chaudhary RP. 2016. Traditional use and management of NTFPs in Kangchenjunga Landscape: implications for conservation and livelihoods. Journal of Ethnobiology and Ethnomedicine 12:19. doi: 10.1186/s13002- 016-0089-8.

Vandebroek I, Van Damme P, Van Puyvelde L, Arrazola S, De Kimpe N. 2004. A comparison of traditional healers' medicinal plant knowledge in the Bolivian Andes and Amazon. Social Science and Medicine 59(4):837-849.

Yaseen G, Ahmad M, Zafar M, Sultana S, Kayani S, Cetto AA, Shaheen S. 2015. Traditional management of diabetes in Pakistan: ethnobotanical investigation from traditional health practitioners. Journal of Ethnopharmacology 174:91-117.