ETHNOBOTANY IN THE KAILASH SACRED LANDSCAPE, NEPAL:
IMPLICATIONS FOR CONSERVATION THROUGH INTERACTIONS OF PLANTS, PEOPLE, CULTURE AND GEOGRAPHY

by

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This dissertation was prepared under the direction of the candidate's dissertation advisors, Dr. Maria Fadiman, Department of Geosciences and Dr. Mary Cameron, Department of Anthropology, and has been approved by the members of his supervisory committee. It was submitted to the faculty of the Charles E. Schmidt College of Science and was accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

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ABSTRACT

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Little is known about the vegetation, forests, useful plants and their patterns of use at the gradients of climate, geography and culture in Baitadi and Darchula districts, far western Nepal. The interactions among plants-people-places were analyzed using data from phyto-sociological studies, community interviews, and literature. Ecological sampling, participant observation, semi-structured interviews, and informal discussions were held between February and September 2017. We compared plant collection, use and management of two culturally distinct groups (Baitadi and Darchula), who inhabit different physiographic regions, yet share the same ecological landscape, environmental resources and livelihood challenges. We hypothesized that the salient (visible, apparent and accessible) plants and places are likely to be more frequently foraged than the non-salient ones. We also hypothesized that the elderly, native and traditional healers living in rural and remote physiographic conditions possess more diverse and detailed knowledge of plant use and conservation than young, non-native and non-healer people. A total of 18 forest types including eight from the study districts showed that the study area is rich in forests and plants. A total of 975 plant species including 82 new species records and 23 new use reports to Baitadi and Darchula districts were recorded. There were 305 (31%) useful plant species including 122 useful reported in the present study. The people of study area showed a large repertoire of knowledge that helps them execute different strategies of plant use suited to

their environment and geography. The knowledge of plant use follows a pattern according to ecological conditions (availability) as well as the cultural significance (transhumance, settlement) of the landscape. However, the latter prevails. Predominate foraging by the agro-pastoral communities from the remote undisturbed forests for quality products and medicines in Darchula district was divergent from the collections from ruderal areas in Baitadi district by generalist collectors for ritual purposes. The extensive usage of plants for socio-economic reasons, livelihood and rituals indicates that the plants and culture are inseparable. Conservation measures with acknowledgement of human, cultural, geographical and environmental variables, are therefore encouraged for sustainable management of the natural resources and traditional knowledge of the Baitadi and Darchula districts.

DEDICATION

To my father, Ram B. Kunwar and my mother, Bel K. Kunwar, for their ceaseless support and unconditional love. Your actions, words and motivation inspired me achieve my goals.

To the people of the rural, remote and rugged Kailash Sacred Landscape, Nepal, who struggle for livelihood by adopting and adapting traditional agro-pastoral, livestock grazing, animal husbandry, collection and trade of medicinal plants and trade of woolen woven products.

To my wife, Laxmi Mahat, who constantly supported me for years. Your love and support to my life is unrivaled.

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ABBREVIATIONS

AD	Anno Domini
Av	Average
B	Baitadi
BS	Bikram Sambat (Nepali calendar)
CBD	Convention on Biological Diversity
CCA	Canonical Correspondence Analysis
CF	Community Forest
D	Darchula
DFO	District Forest Office
DNPWC	Department of National Parks and Wildlife Conservation
DoF	Department of Forest
EAH	Ecological Apparency Hypothesis
EDG	Elevational Diversity Gradient
FAO	Food and Agriculture Organization
FAU	Florida Atlantic University
FiC	Informant Consensus Factor
FL	Fidelity Level
ft	Feet
FW	Far Western
GLM	Generalized Linear Model
GoN	Government of Nepal
ha	Hectare
IAS	Index of Agreement on Species
IASc	Index of Agreement on Species consensus

ICIMOD	International Center for Integrated Mountain Development
IRB	Institutional Review Board
IVI	Importance Value Index
KSL	Kailash Sacred Landscape
m asl	meter above sea level
MUR	Medicinal Use Report
MUV	Medicinal Use Value
NSF	National Science Foundation
NTFPs	Non Timber Forest Products
OFT	Optimum Foraging Theory
OUR	Other Use Report
OUV	Other Use Value
RA	Relative Abundance
RD	Relative Density
RF	Relative Frequency
Syn	Synonym
TUV	Total Use Value
UNCED	United Nations Conference on Environment and Development
UUR	Unique Use Report
UV	Use Value

INTRODUCTION

Bio-geography and Culture

Nepal is a small landlocked country occupying 0.1 % of the earth. The country lies along the slopes of the Himalayan mountain between China and India between 80°04' – 88°12' E and 26°22' - 30°27' N. It has a land area of 147,181 km^2 spanning 800-850 km from east to west, and 144-240 km north to south. Physiographically, it has the largest elevational gradient in the world (Li & Feng, 2015), extending from tropical alluvial plains as low as 59 meters above sea level (m asl) in the lowland Tarai through hilly zones of 1,500-3,000 m asl to the alpine-nival earth's highest peak Mt. Everest (*Sagarmatha* in Nepali) at 8,848 m asl over a vertical span of 150-200 km (Hagen, 1969). Within this vertical span, there are three distinct physiographical regions: lowland Tarai (< 700 m asl), hill (700-3,000 m asl) and mountain (3,000-8,848 m asl) (IUCN, 2000). There are 71 mountains of over 6,000 m asl in Nepal among which Mt. Api (7,132 m asl), Mt. Api-West (*Byash*) (7,100 m asl), Mt. Saipal (7,031 m asl), Mt. Jethi Bahurani (6,850 m asl) and Mt. Om (6,191 m asl) are stretched in Nepal Kailash region.

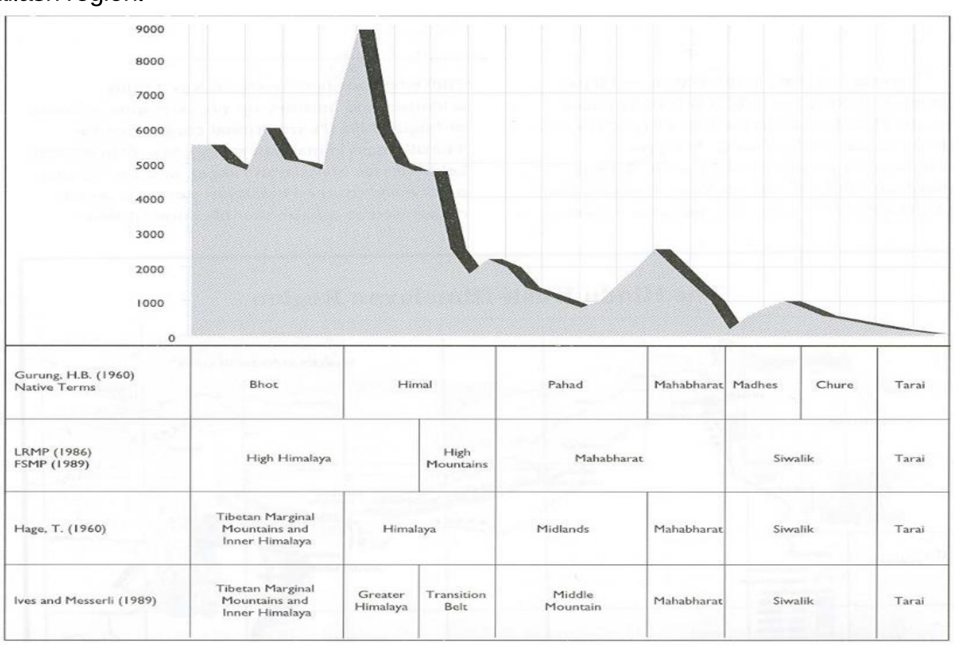

Figure 1.1 Physiographic regions of Nepal (Shrestha et al., 2002)

Biogeographically, Nepal lies between Palearctic and Paleotrophic realms (Bhuju et al., 2007). This diverse terrain nurtures over 10,000 species of flowering plants (Bhattarai et al., 2011), including about 2,500 useful species (Ghimire, 2008; Rokaya et al., 2010). Besides diverse biogeography, the country is inhabited by a total population of 26,494,504 comprising over 125 castes and ethnic groups (GoN, 2011). About 70% of the population live in rural mountains and mid-hills with a fragile and remote physiography and low economic productivity (Abington, 1992) (Figure 1.2). This situation creates the necessity for a strong human-environment-culture relationship and a notable environment-poverty nexus. Human communities that inhabit rural, remote, rugged and biodiverse environments adopt diverse livelihood strategies (Ladio & Lozada, 2004) such as utilizing different ethno-ecological environments (Thomas et al., 2008). Use of locally available plants is the most common in a place constrained by geo-ecological environments (Manzardo et al., 1976). Studies indicate that human communities that inhabit ecosystems rich in species also use a high number of locally available species (Salick et al., 1999; Ladio & Lozada, 2004).

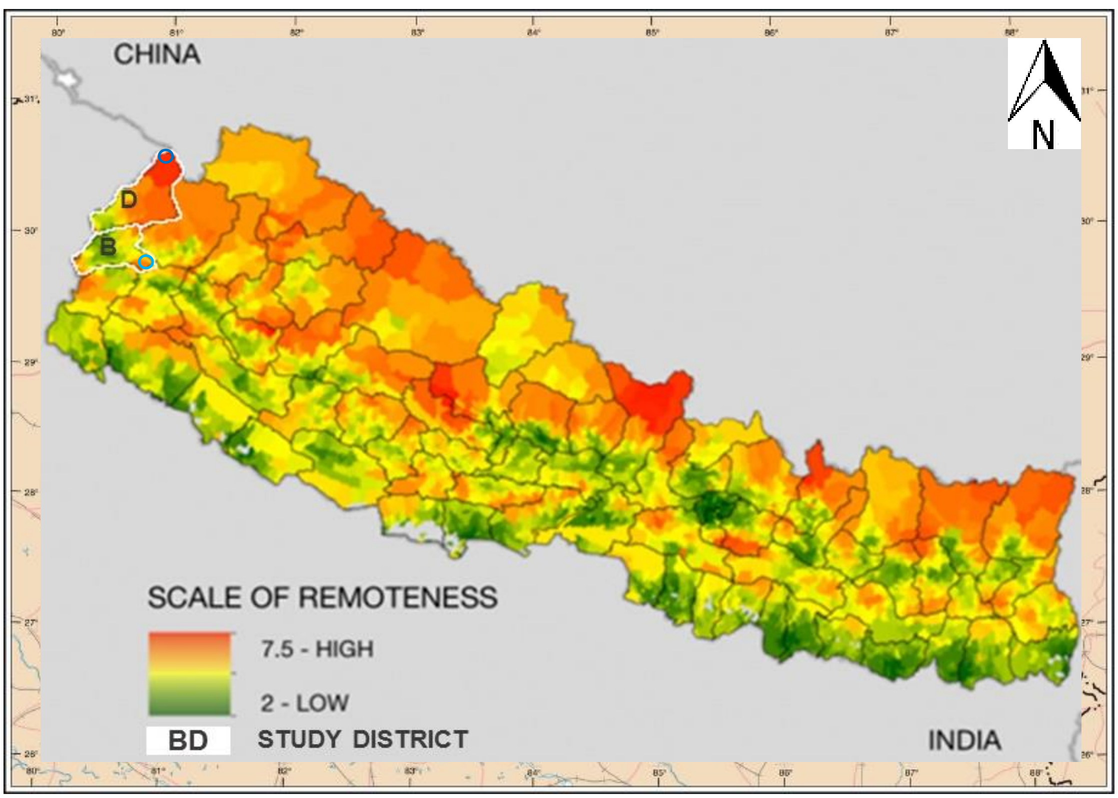

Figure 1.2 District-wise remoteness index of Nepal (blue circles are study sites)
Source: http://aiddata.org/blog/quantifying-remoteness-a-scale-of-accessibility-across-nepal

The knowledge of plant use in the Nepal Himalaya dates back to the 6,500 years old text of *Rigveda* (Malla & Shakya, 1984) which records the use of 67 plants and is the oldest text known in the world regarding plant use. Later, *Ayurveda* (the foundation of science of life and the art of healing in Hindu culture and corpus of traditional medicine, written about 3-5 thousand years ago) describes the uses of 1,200 Himalayan plants for wellbeing of humans and the environment. Early settlers (Aryans) advancing into the western parts of Nepal in 1100 AD are considered the initial group in the region to employ different strategies of forest plant use for their subsistence, economy and healthcare (Pandey, 1989; Shrestha, 2001). The long history of contact of a community with nature infers a tradition and culture that integrate a high number of indigenous medicinal plants for local livelihood (Prance, 1972). The geo-ecological constraints, rich biodiversity, socio-culture and the long history of tradition accounts for the use of large numbers of locally available plants and their products (Bhattarai, 1992; Manandhar, 2002). The use of plants seems more pertinent in the premises of prevalent poverty and changing land-use, socio-culture and climatic variables.

Theoretical Concepts of Ethnobotany

The term ethnobotany was probably first coined as a term in 1895 by one of Florida's early botanists, John W. Harshberger. He described ethnobotany as the study of the interaction between people, plants, and culture (Harshberger, 1896). It refers to studies that explore the reciprocal relationship among plants, people and traditions (Cotton, 1996). Ethnobotany, in general, refers to the study of the processes and patterns of utilization of plants for a variety of humans needs such as medicine, food, fodder, fiber, and goods required for their material culture, aesthetics, rituals and amenities (Martin, 1995). The study of ethnobotany, thus, may go far in explaining and predicting patterns and processes of the plant people relationship through the use of ecological theories, methods and analyses applied to questions within ethnoecology and ethnobotany (Albuquerque & Lucena, 2005). Thus ethnobotany is an interdisciplinary science, involving knowledge and use of plants and their ecology in the context of their cultural, social and economic significance. It is the study of interactions between people and plants at spatial, temporal, historical and cross-cultural scales, particularly the role of plants in human culture, how humans have used and modified plants, and how they represent them in their systems of knowledge (Austin, 2004). The combination of these premises has transformed the importance and significance of ethnobotany, placing the discipline in a privileged position in the search for solutions to complex social, environmental and climatic problems (Bussmann, 2002; Alexiades, 2003; Albuquerque & Lucena, 2005; Quave & Pieroni, 2015; Bussmann, 2017).

Ecological Theories and Ethnobotany - A lack of ecological knowledge hinders conservation initiatives in sustainable use and management of useful plant species, especially in the face of anthropogenic threats such as overuse and changes of land-use and climate (McGeoch et al., 2008). Half of a century ago, MacArthur & Pianka (1966) proposed optimal foraging theory (OFT) which expected that the most productive areas with a high availability of plant resources (areas with higher energy) would have a larger amount of extraction events and would be more locally recognized. In an ethnobotanical context, this could be indicated by higher frequencies of plant use reports (Soldati & Albuquerque, 2012). To test this adapted hypothesis, Phillips & Gentry (1993a, 1993b) developed a quantitative measure of plant use, called use value (UV), that attempts to measure the relative importance of a species to a human population based on ecology, diversity and distribution of plants. They stated that the local availability of a resource is linked to its relative importance to a given community. In "ecological apparency hypothesis" (EAH) (Rhoades & Cates, 1976; Feeny, 1976), the "apparent" plants are more susceptible for foraging, expected to feature more strongly in local botanical knowledge, i.e., the largest, most dominant, and most frequent plants should have the highest "use values", not because they are necessarily intrinsically more useful, but simply because they are more available or visible to a human community (Phillips & Gentry 1993a, 1993b). The apparent plants are woody, those easily visible due to their size (trees, shrubs, and large herbs) or life cycle characteristics (perennials) (Albuquerque & Lucena, 2005). Higher use values of apparent plants could partly be a reflection of higher abundance in a given area and thus are more likely to be favored for collection than those that are rarely encountered (Giday et al., 2003). The positive correlation between the accessibility/availability and usefulness of plants has been demonstrated repeatedly (Phillips & Gentry, 1993b; Alexiades, 1996; Salick et al., 1999; Ladio & Lozada 2004; Lucena et al., 2007; Thomas et al., 2009; Ribeiro et al., 2014; Albuquerque et al., 2015) (Figure 1.3).

The premises of preference for accessible sites and species is rooted in OFT and EAH (Greg-Smith, 1983; Pyke, 1984). The OFT presents cost-benefit trade-offs in foragers' choices. Ethnobotanical research reveals the required costs (time to access the distance and time to manage the produce) (Soldati & Albuquerque, 2012), and procured benefits (Ladio & Lozada, 2004). Collecting plants in close proximity proves to be less important to quality (Harlan, 1992) and to have more importance to time and accessibility, grounds for both EAH and OFT (Thomas et al., 2009). It is often hypothesized that there exists a positive correlation between plant use/knowledge and plant density, diversity and habitat diversity (Bennett, 1992; Begossi, 1996; Milliken & Albert, 1997; Vandebroek et al., 2004). If the area is biodiverse, the use of plants is heterogeneous and if the area is less diverse (abundant), the use of plants is homogenous (Begossi, 1996).

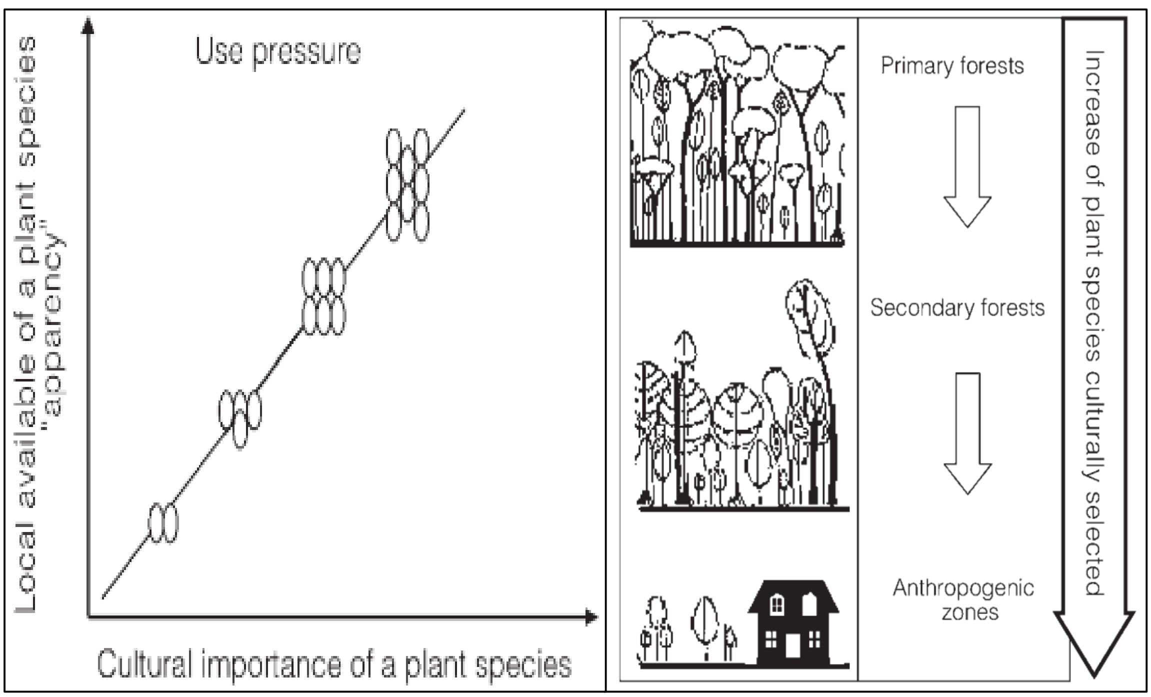

Figure 1.3 Plant species collection based on ecological availability (abundance) (left); plant species collection based on proximity (Source: Albuquerque & Lucena, 2005) (right)

Analogous to ecological apparency hypothesis, Moerman (1979) proposed a theory of non-random medicinal plant selection and suggested that there will be higher number of medicinal (useful) plant species in a family that has a larger number of species. Plant families that have more species in general will be expected to have more useful, including more medicinal species. It is also assumed that the number of species in a site should correlate with the number of plants collected and used by a culture if random selection of plants is the underlying mechanism (Kindscher et al., 2013). However, from a chemical viewpoint, the more apparent plants (perennials and trees) tend to invest more in physical alterations whereas the obscure (nonapparent) plants (typically herbs) constitute a qualitative strategy and become more chemically active (Stepp & Moerman, 2001; Alencar et al., 2009). Quality and pharmacological properties are also considered essential in collection and use of plants (Kohn, 1992; Gertsch, 2012). Thus the role of ecological processes and patterns in determining and responding to human use of plants is important (Salick, 1995).

Ethnobotany at Cultural Premise - Plants are known and used by local populations for food, feed, medicine, rituals, cosmologies, spiritual and magical practices, songs, and narratives since the beginning of human civilization. The knowledge and practices associated with these applications vary within any culture by abundance of biological species, quality of species, geographical origin, nativity, settlement, family size, livelihood assets, ethnicity, religion, occupation, educational background, social status, relations, income, economy, age, and gender (Phillips & Gentry, 1993a; Byg & Baslev, 2001; Cameron, 1996; Fadiman, 2005; Reyes-Garcia et al., 2006; Voeks, 2007; Toledo et al., 2007; Cetinkaya, 2009; Thomas et al., 2009; Salick et al., 2014; Paniagua-Zambrana et al., 2014; Soldati et al., 2016, Atreya et al., 2018). The important cultural factors that might influence local use-systems (Ellen, 2009) are mediated through language (Maffi, 2005; Saslis-Lagoudakis et al., 2014), human cognition and cultural history (Leonti & Casu, 2013), beliefs, religion (Pieroni et al., 2011), taboos (Labeyrie et al., 2014), human behavior, and social and economic constraints (Pelto et al., 1989) as well as health care and development (Shengji et al., 2002).

Research Relevance and Purpose

By combining cultural and ecological data, the analysis of ethnobotany places importance of forests/vegetation with people and *vice versa* (Anderson & Posey, 1989). The understanding of ethnobotany dynamics is essential for studies that investigate the local context of biodiversity management and conservation (Albuquerque, 2005). Such studies can enhance our understanding of human-environment interactions (Benz et al., 2000) and help design more efficient management ways to conserve plant-people-culture relationships (Balick, 2009).

Contextualizing and Conceptualizing

Variables such as population density, urbanization, migration, and labor mobility may change the number of species extracted for use from the surrounding vegetation (Gray et al., 2008). Studies have demonstrated that ethnobotanical knowledge increases with an individual's age and length of residence (Muller et al., 2015). Constrained livelihood options, exacerbated by changes in lifestyle as a result of globalization, population growth, and ongoing land-use and climate change, have led to socio-acculturation in the areas around the world. This in turn, threatens sustainability of mountain communities, altering the integrity of plants, people and conservation (Zomer et al., 2013). Cultural variables seem more essential in explaining community knowledge of collection and plant use in addition to the sustainability of plant resources. In the absence of a continuous cultural interaction, indigenous use-systems and knowledge have been weakened (Turner & Clifton, 2009). Thus understanding the factors (Figure 1.4) that influence the construction of local knowledge about the management of natural resources is essential (Albuquerque, 2005).

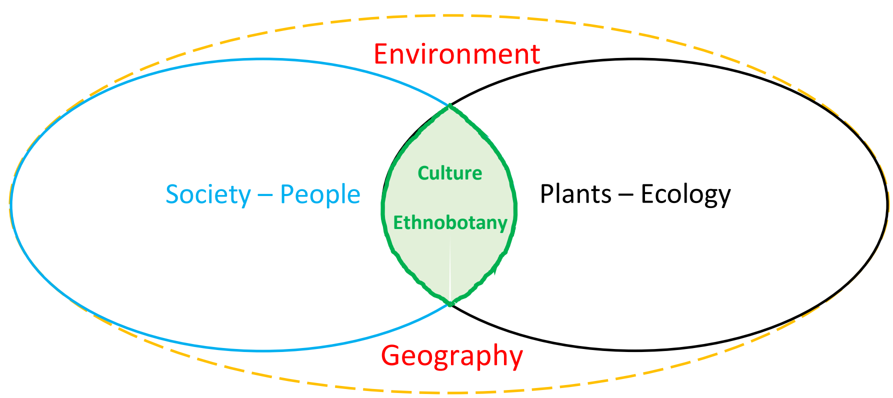

Figure 1.4 Conceptual model of interaction of plants and people through human tradition and culture

For the design of appropriate conservation and management plans, quantitative information of plant ecology is required (van Andel, 2000). There are some studies deducing the negative effects of land-use change on diversity and distribution of useful medicinal plants, resulting in changed collection sites (Anyinam, 1995; Alves & Rosa, 2007). Thus, the studies integrating diversity and distribution of useful plants, tradition of collection, uses and conservation amidst the changes of land-use, culture and climate are worthwhile. Therefore, ethnobotanical research in combination with quantitative ecological methods, physiography, land-use and climate change and peoples' culture, has gained considerable importance over the decades (Prance et al., 1987; Phillips et al., 1994; Bennett, 2005; Toledo et al., 2009; Salick et al., 2014; Popovic et al., 2016). Understanding diversity, distribution and extent of use of plants is a basis for designing and implementing a sound resource management and utilization system in a sustainable manner (Han et al., 2011). Culture and conservation can be complementary once an understanding of the complexities of a sacred landscape and the accompanying knowledge and principles of resource utilization are appraised (Phillips, 1996). There is a wide recognition that ethnobotanical knowledge contributes both conservation and sustainable use of biological diversity (CBD, 1993).

In this connection, this study helps develop baseline data on ethnobotanical and ecological knowledge in Kailash Sacred Landscape, Far West Nepal through the: (1) preparation of a plant database with free-list and herbarium specimens of all useful plants encountered during the study; (2) assessment of quantitative, qualitative and ecological and distribution records of ethnobotanical useful plants; (3) analyses of distribution of plant use knowledge at spatial and cross-cultural scales; (4) examination of the interdependencies of forests, plants, people and culture, and (5) evaluation of plant usefulness with cross-cutting themes of culture, geography, landuse and climate change for the sustainable management of traditional knowledge and conservation of these resources. Human dimensions of climate change are of great consequence in the high altitude areas like KSL, Nepal where the habitats are rapidly changing and especially important to indigenous populations as collection grounds for medicinal plants, as grazing lands for cattle, and as sacred areas for pilgrims and indigenous people.

Biodiversity will not be conserved without understanding how humans interact with the natural environment. If human-environmental interactions are to be considered a basis for major change in the Himalayas (Gurung et al., 2012), and if improving the knowledge base of Himalayan ecosystems and socio-economic activities is the goal for biodiversity conservation in the mountains (UNCED, 1992; ICIMOD, 2012), then studies that link ecological diversity of plants, the way the people use the plants and the causative factors associated with these changes are critical (Salick et al., 2009). However, little is known about the vegetation, forest, ecology, plant use, ethnobotanical patterns, geography and culture of Kailash Sacred Landscape, Nepal (DNPWC, 2008; Chaudhary et. al., 2010). Both the Far Western Nepal and KSL are underrepresented in research (Heim & Gansser, 1939; Manzardo et al., 1976; Fisher, 1991; Xu et al., 2009; Eriksson et al., 2009; Elliott, 2012) because of their limited accessibility and underfunding.

In this context, this study provides a new and substantive record of ecologically and ethnobotanically important plants and their indigenous uses and conservation in two districts of Kailash Sacred Landscape Nepal. Working at the intersection of ethnobotany, ecology, culture and indigenous knowledge, this study explores how dynamics and patterns of plant resources and indigenous knowledge are interrelated at spatio-temporal and cross-cultural scales within the changing contexts of socio-culture, land-use and climate.

Research Hypotheses, Goals and Objectives

The study of how plant resources and indigenous knowledge are patterned at spatio-temporal and cross-cultural scales within the changing contexts of socio-culture, land-use and climate was carried out by testing the following the hypotheses:

- Given a heterogeneous Kailash Sacred Landscape, Nepal offering different biodiversity, geography, and land-uses, the distribution and richness of plants and their collection, use and management traditions vary at the gradients of ecology, climate and land-use.
- The salient (apparent and ecologically abundant and available) plants and plant taxa with higher species richness are likely to be more frequently foraged by people.
- The selection and access to foraging sites and collection of plants are regulated by their proximity and accessibility. Cost and benefit trade-offs appear to affect selection and collection.

- The elders and traditional healers native to rural, remote and higher elevation areas possess more diverse and detailed knowledge of plant identification, collection, use and conservation than youngers, non-native and non-healers.
- In the changing contexts of socio-culture, land-use and climate, the ethnobotany of the area is adaptive and substitutes are being introduced in the limitation of indigenous species, habitats and culture.
- The study area is rich in biodiversity and plant use knowledge; however, it is effaced by ongoing changes on land-use and socio-cultural practices.

The overall aim of this dissertation is to advance the understanding of the different dimensions of plant use within the context of availability of plants, accessibility of places and adaptability of practices/socio-cultural traditions of people living in two remotely located and biodiverse districts Baitadi and Darchula of Kailash, Nepal. The objectives of this study are to:

1. Inventory the vegetation and forest types of the area and study their interdependencies and interactions with the environmental and socio-cultural variables.
2. Catalogue the plants (general, useful, medicinal) and assess their ecological, cultural and conservation values at spatio-temporal scales to see whether there is an association between the useful/general plants and their usefulness with their accessibility, availability and distribution.
3. Study the ecology, ethnography and geography of KSL Nepal and evaluate their interactions for sustainable management of plants and indigenous ethnobotanical knowledge.
4. Assess the knowledge of useful and medicinal plants of people across socio-economic variables (education, occupation, land and livestock ownership, and food availability) and culture (gender, age, ethnicity, length of residence, settlement, language spoken, household size, and livelihood) to determine if they influence the knowledge of plant use.

Limitations of Study

The fieldwork for this study was scheduled in spring and summer, 2017 after getting IRB from FAU in Fall 2016. Preparations were made in January and local level consents were obtained in February 2017. Fieldwork was started in late February. Being located at 500 miles north-west from the Kathmandu and border west to India and north to China, the study area still has limited access to modern amenities as Manzardo et al. (1976) described. Local people remain busy for transhumance, seasonal migration, summer grazing and agro-pastoral activities. The people of Darchula live six months in Byash village (study site, > 3000 m asl) (in the warmer summer months (May-October)) and then descend and live in the lowlands (*Khalanga*) for the rest of the year. The village is covered by snow in winter (November-February). Again the access roads to Byash village are frequently interrupted and even closed at the Nepal side in the spring because of frequent landslides along the Mahakali River. In the case of emergency, people use the alternative access roads of India.

Since Baitadi district is on the way to Darchula and it has relatively easier access, the fieldwork of forest quadrat sampling and semi-structured interviews was carried out in Baitadi in February-April, 2017. Quadrat sampling in relatively undisturbed forests of Baitadi and Darchula was possible only after getting consent and field support from local forest user groups. Darchula was visited only after April when the snow receded and local people ascended to the higher elevations and reached to Byash village. Nonetheless, the interview was further limited because the villagers had departed in May to the alpine pastures (> 3,600 m) to collect one of the high value medicinal plants, Himalayan caterpillar fungus, Organic Gold (*Ophiocordyceps sinensis* (Berk.) G.H.Sung) and remained busy in processing and selling the products *in situ.*

Thus, the geo-ecological constraints and busy schedule paired with limited accessibility and accommodation were major factors in Kailash Sacred landscape Nepal affecting intensive research (Heim & Gansser, 1939; Manzardo, 1977; Fisher, 1991; Eriksson et al., 2009). Another study limitation was due to the selective sampling of study participants (traditional healers, elders and medicinal plant collectors and traders). The participants of both districts speak local dialects (Byashi-Rang in Darchula and Doteli/Baitadeli in Baitadi), which are slightly different from the mother language Nepali. One local assistant and one research associate in each district accompanied both fieldworks of quadrat samplings and community consultations.

Kailash Sacred Landscape, Nepal

The Kailash Sacred Landscape (KSL) is a tri-national trans-boundary landscape comprised of parts of the southwestern Tibetan Autonomous Region of China, and adjacent pieces of northern India and northwestern Nepal (Chaudhary et al., 2010; Uddin et al., 2015a). At its heart, high upon the Tibetan plateau, lies the holy Mt. *Kailash* (6,638 m asl) and sacred lake *Mansarowar*, considered a sacred pilgrimage site by over a billion people practicing five religions: Hinduism, Buddhism, Jainism, Sikhism and Bon for several millennia (Zomer et al., 2013). The KSL, Nepal occupies 42% of the total KSL, which covers four mountain districts (Darchula, Humla, Baitadi and Bajhang) in the Far Western part of the country. It is a historically, geo-politically, ecologically, and culturally interconnected transboundary landscape across Nepal, India and China. This is also one of the most underdeveloped regions of Nepal and faces numerous conservation and development challenges because of the harsh climate, poor accessibility, marginality and poverty. Baitadi and Darchula, the study districts (29º 22' N to 30 º 15' N / 80 º 15' E to 81 º 45' E and altitudinal span 457 to 7,132 m asl) are located at the westernmost end of the country represent Far Western Nepal bordering India and China. They are located about 500 miles west to Kathmandu.

The legacy of sacredness has been shown to have a major effect on culture, conservation, ecology and environment due to the associated special precautions and restrictions on use (Khumbongmayum et al., 2005). As a result of limited human activity due to sociocultural taboos and prohibitions, sacred places are associated with the old-growth vegetation and many ecologically and socially valuable plant species (Ramakrishnan, 1996). A major international conservation organization located in Nepal, ICIMOD, has designated KSL’s conservation across all the countries’ regions it encompasses, a priority. Despite the importance of the KSL, Nepal in terms of biodiversity and the ecosystem services, the density, diversity and distribution of plants and their associated knowledge across the gradients of land-use, climate and socio-culture is poorly monitored (Xu et al., 2009; Eriksson et al., 2009; Elliott, 2012).

Climate: Temperature and Rainfall - Climate in the KSL is primarily governed by the monsoon in the southern part (Greater and Lesser Himalayan Zones), by the rain shadow zone (cold desert conditions) over the crest of Trans-Himalayan zone and by continental and Central Asian climatic influences on the Tibetan Plateau (Zomer & Oli, 2011). The KSL has an average maximum temperature 18.6 º C and the minimum temperature 7.7 º C. Average rainfall is 2,129 mm, with nearly 80% of the total annual rainfall falling during the four months of monsoons from

June to September (Chaudhary et al., 2010). The temperature data of Baitadi and Darchula districts between 1982 and 2016 showed that the average maximum temperature is 19.9 º C and minimum temperature is 13.2 º C (Figure 1.5) which is higher than cited by Chaudhary et al. (2010). The average rainfall of the area (1,750 mm) was within the range reported by Chaudhary et al. (2010) and annually results in a loss of productivity (Bhandari, 2013). Among the three climate indicators of each district, the rainfall of Darchula was found to be increasing over time and the rest were insignificantly increasing indicating that the area is being less influenced by some climate variables. The bio-climate of Baitadi and Darchula districts ranges from tropical in the Baitadi district to alpine in the higher reaches of the mountainous Darchula district (Lilleso et al., 2005; Chaudhary et al., 2010).

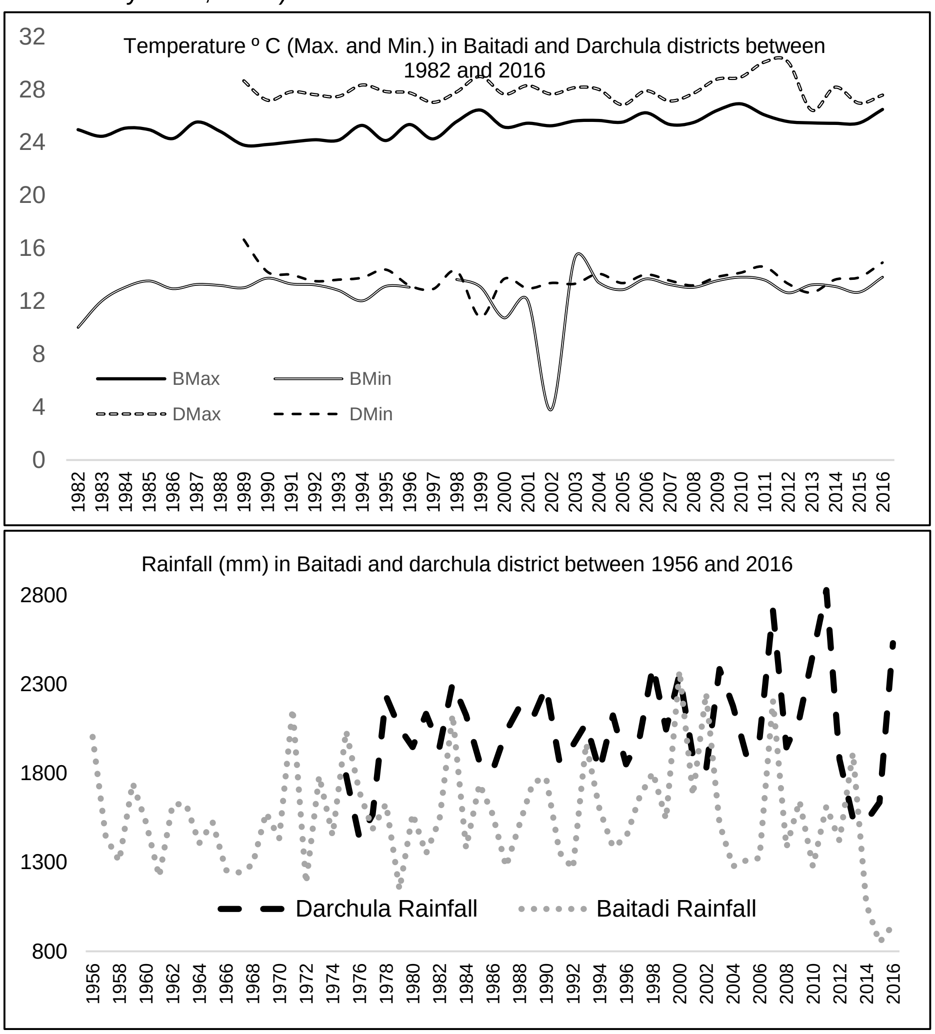

Figure 1.5 Climate (Temperature and rainfall) data of study area (1956-2016) (Data Source: Department of Hydrology and Metereology, Babar Mahal, Kathmandu)

Land-Use Land Cover (LULC) - The transition from an alpine cold semi-desert type snow-capped trans-Himalayan zone to the tropical humid forest ecosystems in the tropical lowlands through terrace agricultural farming at midhills represent the country's major land cover. Much of the area of the districts consists of dry, steep, semi-arid and rugged terrain and only 7-21% of the area is suitable for farming (Kunwar et al., 2012). Land-use of the districts is predominantly forest, pasture and agriculture. Furthermore, the districts are dominated by human habitation in the southern regions as a result their forest patches are more fragmented. The community managed forest (CF) cover is found highest (69%) in Baitadi district followed by 34% in Darchula (Table 1.1).

Table 1.1 Land-use change in Baitadi and Darchula districts

	Baitadi (151,900)					Darchula (232,200 ha)				
	Forest	Shrub land	Grazing land	Cultv. land	Others	Forest	Shrub land	Grass land	Cultv. land	Others
LRMP (1978/79)	60,785	17,920	19,199	51,624	2,372	72,978	6,555	61,214	25,012	66,400
Department of survey/GoN (1998/2001)	61,292	30,573	10,792	44,480	4,763	75,578	17,988	52,987	20,115	65,492
CBS (2013)	72,020	27,751	5,162	46,368	1,599	58,177	31,218	27,335	32,902	81,568
Present study (2018)	80,833	14,276	8,481	45,710	2,600	76,195	17,105	49,898	18,725	70,277

The districts studied are located in the southern parts of the KSL, Nepal, and are considered important for growing amaranth (Joshi, 1981; Balick & Cox, 1996) and relict hemp cultures (Clarke, 2007). In the face of the present-day spread of a market economy and the barring of hemp cultivation in 1973, it is now no longer a source of rural livelihood (Clarke, 2007). The limited livelihood options, together with modern changes in lifestyle as a result of globalization, droughts and erratic weather patterns, threaten the sustainability of these mountain communities, the landscape and their biodiversity (Cameron, 1996; Zomer et al., 2013). The fragile nature of the districts, coupled with excessive resource harvesting and land-use change pose a danger to the forest ecosystems landscape, with implications for biodiversity and people (Uddin et al., 2015a).

Forest Types - Nepal's current forest policy and legislation classifies the country's forests mainly according to tenure over the land as government-managed, community-managed, leasehold, religious, private and protected forest (Acharya, 2002). Government-managed forests are *de facto* open access, which invites unsustainable and illicit activities (GoN/MoFSC, 2014).

Forests, together with shrub lands, cover the majority of the country's land 40.36% (GoN/DFRS, 2015) followed by 29.83% agriculture land. Patch and edge forests constitute 23.4% of national forest cover (Uddin et al., 2015b) and always seem to have the proximate biotic and anthropogenic interferences over the forests.

TISC (2000) classified 37 types of vegetation/forests in Nepal and at least 18 major types are expected to be found in Baitadi and Darchula districts (Chaudhary et al., 2010) (Appendix A). However, only eight types of forest were reported by Zomer at al. (2013) and five types (*Shorea robusta, Pinus roxburghii, Quercus* species*, P. wallichiana* and alpine scrub) by GoN (2015) from northern Darchula. Yet Darchula district is rich in forest types ranging from tropical humid hill Sal (*S. robusta*) forest to sub-tropical Chir pine *P. roxburghii* forest to alpine Nival pastures, meadows and Betula-Rhododendron scrub with a varied topography (Pant & Panta, 2004; Elliott, 2012; DFO, 2015). Between 1000-2000 m asl *P. roxburghii* is dominant and at 1500-2500 m asl *Quercus incana - Quercus lanuginosa* appeared the most. All the vegetation up to 2000 m asl was degraded by continual chopping for fodder and clearing for agriculture (Elliott, 2012). Above 2500 m asl *Quercus semecarpifolia* became dominant and then above 3000 m asl *Abies spectabilis, A. pindrow* interspersed with *P. wallichiana*, *Tsuga dumosa* and *Betula utilis*. Baitadi district is less diverse in forest types and only nine types were reported by Chaudhary et al., (2010). Only four forest types: Chir pine, Oak, Mixed Oak and mountain Oak forests were reported from Sigas protect forest, Baitadi, a study site of this current study (DFO, 2017).

Forest exploitation was severe before the 1970s (Robbe, 1954; Ekholm, 1975; Bajracharya, 1983) because the government forests of the districts were considered open commodity and harvesting of non-timber forest products (NTFPs) and medicinal plants was free or nominal fee based (Burlakoti & Kunwar, 2008). However, there were early forest management initiatives meant to arrest the degradation of government-managed forests. The indigenous forest management practices in Byash, Huti and Pipalchauri in Darchula district (Chand & Wilson, 1987) and Kotgaun, Salena and Binashaun in Baitadi district (Chhetri & Pandey, 1992) were the early accounts of community-based conservation initiatives helping derail the degradations and lead the community forestry programs in the districts. Now, the forests of the districts are relatively restored. However, they are worsened by invasive species and curtailed by changing land-use and climatic variables. Forest resources and alpine pastures complement the rural agricultural system, meeting fuel, fodder, timber and medicinal herb needs (Figure 1.6, 1.7).

Figure 1.6 Forest, land-use change and pastoral livelihood at Budhi, Darchula

Figure 1.7 Hemp, once a good complement for local livelihood is now becoming a weed because of unattended management.

Useful Plants - Baitadi and Darchula districts are rich in forest types as well as different plant species. There are 752 plants reported from Baitadi and Darchula district (Kanel et al., 2017), among them most are useful. Local people largely rely on these useful plants for subsistence especially during the times of famine. Earlier studies carried out at southern and lower parts of study area (Devkota & Karmacharya, 2003; Pant & Panta, 2004; Pant et al., 2005; DNPWC, 2008; Joshi, 2008; Burlakoti & Kunwar, 2008; Pal, 2009; Dadal, 2010; Kunwar et al., 2009, 2012, 2013, 2015, 2016; Aryal et al., 2018; Atreya et al., 2018) recorded over three-hundred ethnobotanically useful plants. The early record of trade of high value medicinal plants such as *Nardostachys grandiflora* DC.*, Swertia chirayita* (Roxb. ex Fleming) Karstrn, *Neopicrorhiza scrophulariflora* (Pennell) Hong, etc. dates back to 17th century (Regmi, 1971). However, the plants were bartered for grains in the districts for the centuries (Clarke, 2007) and the tradition was persistent until 1970s' (Toba, 1975). However, the Sino-Indian border conflict in 1962 and the law enforcement of barring hemp in 1973 heavily disrupted the traditional livelihood (Jianlin et al., 2002, Garbyal et al., 2005a). This led people to pursue nonindigenous economic portfolios such as commercial cultivation and trade of medicinal plants and off-farm activities.

A seventeen-year (1999-2016) overview on collection and trade data of medicinal plants from Baitadi and Darchula districts revealed a slight fluctuation in the number of species in trade over time (GoN, 2000-2016), however, the species turnover was changed and the amount traded was increased revealing that the medicinal plant resources have been collected based on market demand. The species common in tropical and ruderal areas such as *Curcuma angustifolia* Roxb.*, Acorus calamus* L., etc. were introduced over time (DFO, 2017) (Table 1.2). Medicinal plant species *Cinnamomum tamala* (Buch.-Ham) Nees, *Sapindus mukorossi* Gaertn. and *Zanthoxylum armatum* DC., indigenous to the study area, have long been traded in the largest volumes in both the study area and across Nepal. Between 100-178 medicinal plants and products are commercially traded in the country (Olsen, 1998; Bhattarai & Ghimire, 2006; Srivastava, 2009), 51 species are traded from Humla (Chaudhary et al., 2010) and 40-50 species from our study area. In particular, the high value and high altitude medicinal plants such as *Ophiocordyceps sinensis* (Berk.) G.H.Sung, *N. grandiflora, P. polyphylla* Sm.*, Valeriana jatamansii* Jones, etc. are sought most from the national forests and alpine meadows because of their high market price. Moreover, temperate-alpine plants *Abies pindrow* Royle, *Angelica archangelica* L., *Dactylorhiza hatagirea* (D.Don) Soo, *N. scrophulariflora*, *O. sinensis* etc. are frequently traded in Darchula (ANSAB, 2003) and tropical-temperate plants *Bergenia ciliata* (Haw.) Sternb., *Phyllanthus emblica* L., *S. chirayita*, *V. jatamansii*, etc. in hilly and lowlands Baitadi district (Bista & Webb, 2006) contributing rural livelihood.

Table 1.2 List of traded medicinal plant species and their quantity (kg) in Baitadi and Darchula

Vernacular name	Botanical name	English name	1999 AD 2055-56 BS	2008 AD 2064-65 BS	2016 AD 2072-73 BS
सिकाकाइँ	*Acacia concinna*	Sikakai	D- 200	-	-
बोझो	*Acorus calamus*	Sweet sage, Sweet flag	-	B- 600	B- 100
बन लसुन	*Allium wallichii*	Wild garlic	-	-	D- 40
सतावरी कुरिलो	*Asparagus racemosus*	Asparagus	BD-20,500	-	-
भोँला	*Bauhinia vahlii*	Bhorla	-	D- 1,000	D- 1,100
चुत्रो	*Berberia asiatica*	Barberry	BD-5,700	B- 11,300	B- 6,300
पाखनवेद	*Bergenia ciliata*	Rock foil	D-15,200	BD- 79,300	BD-101,900
तेजपात	*Cinnamomum tamala*	Bay leaf tree, Malabar tree	BD-105,000	BD- 128,000	B- 3,400
कचुर	*Curcuma angustifolia*	Zedoary	-	-	D- 846
भ्याकुर	*Dioscorea bulbifera*	Deltoid yam	BD-7,600	-	-
सोमलता	*Ephedra gerardiana*	Gerard's Jointfir	B-14,760	-	-
ओखर	*Juglans regia*	Walnut	D-5,200	-	-
धुपी	*Juniperus indica*	Juniper	-	D- 10,000	D- 165,000
भ्याउ	Lichen	Lichens	B-47,500	BD- 23,000	-
पावनको बोक्रा	*Machilus* species	Persea	-	B- 49,000	
दारुहल्दी	*Mahonia* species	Mahonia	D-8,400	-	-
सेतक चिनि जरा	*Polygonatum* species		BD-2,800	-	-
च्याउ	*Mushroom*	Morel, Mushroom	-	D- 86	D- 4,530
जटामसी	*Nardostachys grandiflora*	Spikenard	-	-	D- 3,350
कुट्की	*Neopicrorhiza scrophulariflora*	Picrorhiza	D-5,700	D- 3,700	D- 6,100
यार्सागुम्बा	*Ophiocordyceps sinensis*	Himalayan caterpillar fungus	-	D- 576	D- 1,019
सतुवा	*Paris polyphylla*	Love apple	-	D- 110	D- 8,000
काउलोको बोक्रा	*Persea odoratissima*	Fragrant bay tree	-	D- 20,000	BD- 22,100
अमला	*Phyllanthus emblica*	Gooseberry	-	BD- 5,200	BD- 22,300
अमलभेद	*Rheum australe*		D-100	-	-
रिठ्ठा	*Sapindus mukorossi*	Soap nut	BD-55,500	BD- 284,800	BD- 168,000
भुतकेस	*Selinum wallichianum*	Milk Parsley	D- 24,000	D- 100	-
चिराइतो	*Swertia chirayita*	Swertia, Chiretta	BD-3,600	BD- 4,000	D- 2,700
लोठसल्ला	*Taxus contorta*	Himalayan yew			
सुगन्धवाल	*Valeriana jatamansii*	Valerian	B- 9,300	B- 6,000	BD- 2,200
सिस्नु	*Urtica dioica*	Urtica, Stinging neetle	D-3,800	-	-
टिमुर	*Zanthoxylum armatum*	Prickly ash, Nepalese pepper	-	D- 1,520	-
अन्य	*Others*	Others	-	-	D- 5,700
# species in trade			**18**	**19**	**19**
Total amount traded (Kg)			**322,000**	**473,500**	**540,000**

Note: B = Baitadi district, D = Darchula district, BS= Bikram Sambat (Nepali Calendar)
Source: GoN, Hamro Ban volumes (2000-2016)

Livelihood - Because of the remote location, reliance on traditional medicine is associated with wild medicinal plants and on the harmonious existence of spirit and nature. Local people depend on nature for almost everything and believe that the mountains surrounding their habitations are the storehouses of a number of medicinal, edible and other useful plants (Heim & Gansser, 1939). Famine is frequent in the districts (UNWFP, 2006; Amatya, 2008) and collection of hay (grasses), fodder, forage and edible and medicinal plant is a common strategy to offset these hungry episodes. The local development indices are low, with frequent food, nutrition and health hygiene deficiencies and shortages of supplies for basic needs (Chaudhary et al., 2010).

The high dependency of Byashi people (Darchula) on the Himalayan highlands is neither of their own choosing nor is it the result of historic accident. A self-contained peasant economy based on pastures and animal husbandry could not be sustained by the natural resources of the valleys lying above the 3000 m asl and even below that level larger concentration of populations could grow only where the income from trade supplemented the yield from subsistence farming. The average land-holding is low and of poor quality and can only feed the family for three to four months a year (Manzardo, 1977).

The supplementary agriculture of Byash is based primarily on potato (*Solanum tuberosum* L.) and bitter buckwheat (*Fagopyrum tartaricum* (L.) Geartn.), though sweet buckwheat (*F. esculentum* Moench), naked barley (*Hordeum vulgare* L.), beans (*Phaseolus vulgaris* L.), mustard (*Brassica rapa* L.), small-grained wheat (Napal), etc. are grown. In addition to these, a cash crop radish is sliced, dried and taken to northern border Taklakot and Tibet to barter for salt. Collection, trade and bartering of medicinal plants such as Yartsagumba (*O. sinensis*), Jimbu (*Allium hypsistum* Stearn), Simme (*V. jatamansii*), Balaichan (*N. grandiflora*), Timur (*Zanthoxylum armatum*), and Satuwa (*Paris polyphylla*) is common. They are bartered for grains and traded at trans-boundary and low lands (Manzardo et al., 1976; Edwards, 1996). In order to ease living, pairing trade with pastoral livelihood is very common (Manzardo, 1977). The illegal trade via Taklakot (Nepal Tibet/China border) is also reported (WWG, 2007; Kanel et al., 2017; Pouliot et al., 2018).

Traditional trade and transhumance were disrupted when the trade routes were closed in 1962 because of the Sino-Indian border conflict (Jianlin et al., 2002, Garbyal et al., 2005b). This began contemporary sociocultural and economic transformation, as certain kinds of traditional knowledge began to decline and socio-acculturation and outmigration led people to pursue different economic opportunities for new survival challenges (Farooquee & Saxena, 1996; Bhatt, 2010). Thus, the traditional subsistence has undergone substantial change in the recent decades (Negi et al., 2017). Once the popular and livelihood friendly amaranth (Joshi, 1981; Balick & Cox, 1996) and hemp cultures (Clarke, 2007) are now limited in use. In the face of the present-day spread of market economy, there is a radical change in sociocultural behaviors and local biodiversity.

Socio-economy and Demography - The KSL area includes almost all of Pulan county in the TAR-China; most of Pithoragarh District and a small part of Bhageshwar District in India; and portions of Humla, Bajhang, Darchula and Baitadi districts in northwestern Nepal. Over a million people live in this landscape; however, most of the population resides in India and Nepal with extreme poverty, resulting in serious environmental challenges (Zomer & Oli, 2011). A large number of agro-pastoral and migratory pastoral communities depend heavily on bio-resources of the area for livestock grazing, high-value medicinal plants, agriculture, religion and other traditional rites. Population growth in the districts was lower than the national average (Table 1.3), becoming further reduced by outmigration. A continuous outmigration for menial work in India (Poertner et al., 2011) and a greater percentage of absentee population of 7.51%, higher than the national average of 7.23% (GoN, 2011), clearly indicated that population density is not a major problem in the districts however, the huge chunk of lands previously cultivated were left unattended and land-use change was manifested as a result of outmigration.

Table 1.3 Population change in Nepal and Baitadi and Darchula districts

Location	1981	1991	2001	2011	Households (2011)
Baitadi	179,136	200,716	234,418	250,898	45,167
% change		+1.20%	+1.67%	+0.70%	
Darchula	90,218	101,683	121,996	133,274	24,604
% change		+1.27%	+1.99	+0.92	
Nepal	15,022,839	18,491,097	23,151,423	26,494,504	5,427,302
Growth Rate (%)	2.62	2.10	2.24	1.35	

Ethnographic Setting - There are more than 30 ethnic groups in the study districts (GoN, 2011). Chhetri is the dominant group (about 60%) followed by Brahmin (about 20%) and *Dalit* (Lohar, Kami, Sarki 10%) and others 10%. There are more than 10 minority groups including the indigenous groups Byashi and Santhal in Darchula and Kusunda, Dom and Dhanuk in Baitadi (GoN, 2011). Brahmin, Chhetri and *Dalit* predominate in both districts.

The community of Baitadi district was composed of sedentary farmers and villagers including hill caste Chhetri, Brahmin and *Dalit* (Table1.4). Agriculture, business, medicinal plant collection and trade and traditional healing are the major occupations in Baitadi however, the former contributes the most (UNFCO, 2013). Baitadi district is renowned for sociocultural sacred peaks (Bhatta, 2003). Sacred forests are part of the cultural heritage that represent important spiritual sites (Wickramasinghe, 1997) and local people believe that their livelihood and cultural existence are greatly connected with local plants and the blessings of their deity (Chandrashekara & Sankar, 1998). Bista & Webb (2006) showed that 39% of the economically active population of Baitadi district collected and traded 23 high value plant species, which contributed up to 90% of the total household income. It was found that there are 351 medicinal plants in Baitadi (GoN/DOED, 2016) including 34 commercially important plants, all they contribute to improving the rural livelihoods (Rasul et al., 2012) and the species *Swertia chirayita, Zanthoxylum armatum*, *Sapindus mukorossi*, *Cinnamomum tamala*, etc. are considered for commercial cultivation (Acharya et al., 2015).

Table 1.4 Dominant ethnic groups in Baitadi and Darchula districts

Caste		Baitadi	Darchula	Total
Chhetri	Privileged	112,974 (48.2%)	73,254 (54.9%)	186,228 (50%)
Brahmin	Privileged	47,350 (20.2%)	22,531 (16.9%)	69,881 (20%)
Lohar, Kami	Unprivileged	25,181 (10.74%)	9,115 (6.83%)	34,296 (10%)
Thakuri	Privileged	19,284 (8.22%)	8,048 (6.03%)	27,332 (7%)
Sarki	Unprivileged	7,436 (3.17%)	2,194 (1.64%)	9,630 (2%)
Sanyasi	Unprivileged	3,766 (1.6%)	1,864 (1.4%)	5,630 (2%)
Dhanuk	Unprivileged	2,042 (0.8%)	-	2,042 (1%)
Byashi		-	946 (0.5%)	946 (1%)
Others		16,385 (6.98%)	15,322 (11.49)	31,707 (7%)
Total population		234,418	133,274	367,692
Total households		45,167	24,604	69,771

Byashi is a minority group with a population of about 4,000 in the country. About 500 live in Chyanrung, Byash village and about 500 in Rapla, Shitola and Khalanga (GoN, 2011). Byash village is located in the northernmost part of Darchula district in Far Western Nepal, lying north of Mt. Api and adjacent to both India and China. The area is composed of the uppermost valley of the Mahakali River, which constitutes the India-Nepal border. People living at the base of Mt. Byash (Mt. Api-West) (7,100 m asl) are called Byashi. It is believed that Saint *Ved Byash* used to meditate there at the lap of Mt. Byash. Byashi people are part of a group living throughout the Kumaon hills (Negi et al., 2017), as well as in Darchula, Humla and Bajhang districts of Nepal (Nawa, 2002). The corpus of rites from Kumaon Garhwal India to Darchula, Baitadi, Doti, Bajhang and up to Achham districts of Nepal is considered feudal from the cultural viewpoint (Oakley & Gairola, 1977). Before the Anglo-Nepalese war (Gurkha war) of 1814-16, the entirety of Kumaon Garhwal to Bairath (Baitadi), Doti was as Katyuri kingdom under Nepal administration (Kumar, 1967; Oakley & Gairola, 1977). There are a number of commemorative pillars erected in about 1200 AD in Dehimandu, Baitadi and adjoining areas as memories of victorious warriors of the region (Sharma, 1997).

Byashi women are proactive in both domestic and social functions. The village has long been ruled by elderly women (in 1936 observed by Heim & Gansser, 1939). The traditional dress of women is called *Chyungwala* while that of men called *Ranga Be Thulbu*. They are Bon-po (pre-Buddhist). Gabla is the major festival of Byashi Sauka. They are knowledgeable in carving wood and stone. Their houses are decorated with the fine wood-carved and reddish-brown painted windows and doors. They have kept their own cultures and traditions alive, while being influenced by both Tibetan Buddhism and Hinduism (Manzardo et al., 1976; Nawa, 2002). The plant Abies (*Himisin*) is frequently used for culture, fuel-wood, furniture and agricultural implements. It is a main source of fuelwood for heating and cooking. The village is covered by snow in winter. Transhumance (summer grazing, animal husbandry, agro-pastoral) and medicinal plant collection and trade in addition to the trade of hand-woven woolen garments are major livelihood strategies of Byashi people. Moreover, many of them pursue traditionally conducted trans-Himalayan trade during transhumance (Figure 1.8).

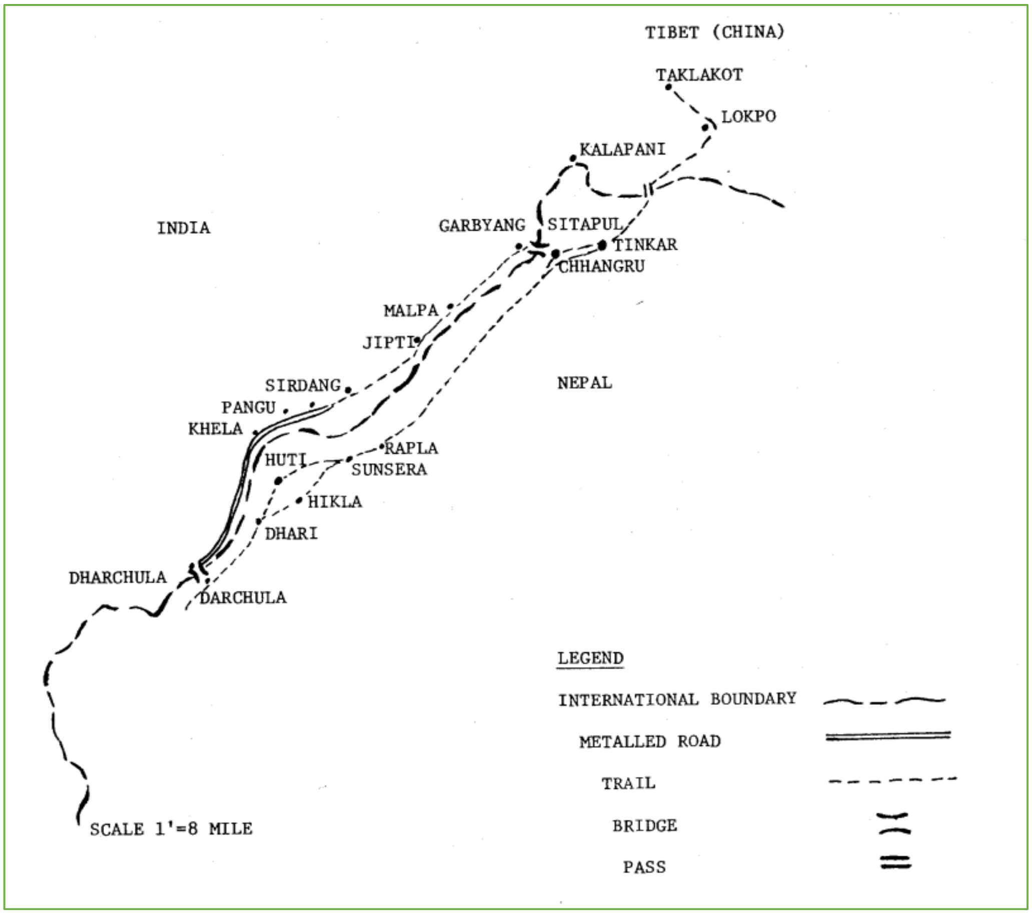

Figure 1.8 The transhumance route of Byashi people in Darchula district (Manzardo et al., 1976)

Many Byashi traditional healers worship plants and pray to them before collecting them, acknowledging the spiritual powers of the plants. They believe that plants become more potent when processed both spiritually and materially (Garbyal et al., 2007). However, traditional subsistence has undergone substantial change of late as a result of growing commercialization (Farooquee & Saxena, 1996). Byashi are called *Bhotia* in India

Materials and Methods

Informed consents - The field work for this study was conducted in spring and summer, 2017 as scheduled in IRB FAU (Appendix B). Both oral and written consents were obtained. Prior oral informed consent was obtained from all interview participants and written consents were obtained from the District Forest Offices and Department of National Parks and Wildlife Conservation, Kathmandu, Nepal (Appendix C 1,2).

Materials - Plant height and basal diameter of trees (diameter at breast height) was measured using a dendrometer (Criterion RD 1000). The elevation, slope and aspect in each 10 x 10 m quadrat were recorded using a global positioning system (Garmin ETrex 10).

Sampling and Data Collection - Along the elevational gradient from 1800-3665 m asl, 141 quadrats were established following stratified random sampling in Sigas forest of Baitadi and Byash forest of Darchula. For analysis of ecological data along the elevation (elevational diversity gradient - EDG), two to five (10 m x 10 m) quadrats were nested with equal space in a 100 m x 10 m transect. Transects were laid along the trails and contour ensuring different slopes, elevations and 50-200 m sides of trail based on topography. The quadrat size was 10 x 10 m for tree species, within which one 5 x 5 m quadrat was nested to record shrubs and two 1 x 1 m quadrats were laid to inventory herbs. The distribution of quadrats in each elevational zone was as follows: 17% (24) in 1800-2299 m asl, 30% (41) in 2300-2799 m asl, 44% (63) in 2800-3299 m asl and 9% (13) in > 3300 m asl (Figure 1.9). Of the total quadrats, 44 were laid in Baitadi and 97 in Darchula.

While laying out quadrats, environmental variables such as elevation from the center of each plot, aspect, slope, canopy cover, distance to road (human intervention), distance to nearest human settlement and agriculture field and disturbance gradient were recorded using checklist (Appendix D1). The canopy-cover of trees at each plot and abundance of trees, shrubs and herbs, as well as the girth of trees at breast height, disturbance index, geography, forest types, dominant species, distance, etc. were recorded. Canopy cover was visually estimated. Information regarding plant communities, forest types and useful plant species were supplemented by informal meetings with community members. Past forest management regimes and forest types were recalled and catalogued while carrying out informal interviews and reviewing literature. All the plant species recorded in each quadrat were identified up to the lowest taxon by using local indigenous knowledge and literature (Polunin & Stainton, 1984; Stainton, 1998).

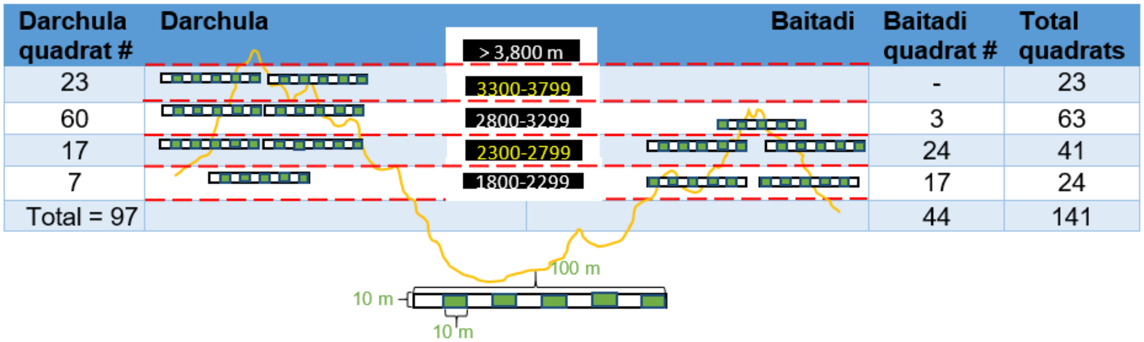

Figure 1.9 Layout of study transects and quadrats

Ethnography and Sample Communities - After ecological plots were inventoried, we collected ethnobotanical data through ethnographic studies and snowball sampling. Ethnographic information regarding the daily lives and behaviors of participants in collection, use and conservation of useful plants was collected through careful observations during participant-observation (Bernard, 1995). Guided tours, *walks-in-the-woods*, informal meetings at tea shops were important in recording the perceptions, behavior, aptitude and attitude of participants towards the collection, use and conservation of useful plants (Putnam, 1975; Bernard, 1995; Martin 1996; Alexiades, 1996). The ethnographic descriptive analysis followed, which integrates qualitative, quantitative, positivistic and interpretive approaches (Bernard, 1995).

The sample participants of the communities were selective, i.e. only traditional healers and medicinal plant collectors and elderly people with age 41 to 102 (67±14 yrs) were interviewed after obtaining oral prior informed consent. A total of 106 people were contacted for interview and 100 (68 men and 32 women) agreed to share ethnobotanical, demographic and socioeconomic information. There were 58 participants from Chhetri, 14 from Brahmin, 24 from Byashi and four from *Dalit*. There were 57 participants including 47 Chhetri, six Brahmin and four *Dalit* from nine villages (Chaukham - 14, Dhungad - 3, Gajari - 9, Siddeshwor - 1, Siddhapur - 4, Sigas - 8, Shikharpur - 6, Shivlinga - 10 and Thakalada - 2) of Baitadi district and 43 participants including 11 Chhetri, eight Brahmin and 24 Byashi from 12 villages (Bhagawati - 1, Byash - 13, Dhap - 1, Dhaulakot - 1, Hikila - 2, Kantai - 1, Khalanga - 8, Khar - 1, Rapla - 12, Shankarpur - 1, Sunsera - 1, Yerkot - 1) from Darchula district.

Ethnobotanical Survey - Ethnobotanical data needed to test the hypotheses were collected using semi-structured interviews (Martin 1995). These interviews were inventory based (Mutchnick & McCarthy, 1997) and carried out in three field visits each, the duration of each trip lasting about a month between February 2017 and September 2017. A male local assistant and a female research assistant in each district facilitated interviews. A two-page semi-structured questionnaire was developed in Nepali script prior to the start of fieldwork (Appendix D2).

The interview form (Albuquerque et al., 2014) included questions concerning the informants' knowledge about the three most important plants for their culture, primary health care and livelihood category, and then ranking each species within the categories (score 3 as most important, 2 as moderate and 1 as general) for a particular use (Gomez-Beloz, 2002). Interviews were supplemented with other investigative techniques, such as participant observation and guided tours (Albuquerque et al., 2014). Some participants were asked to take part in *walks-in-the-woods* to help record the voucher and geo-coordinates of useful species. While participating in the guided tours, voucher specimens of the species that could not be identified in the field were collected by participants and field assistants, and processed according to Balick (1996) and deposited at the plant laboratory and herbarium (KATH), Lalitpur, Nepal for future reference. Informal discussions were held during the evenings while staying with local communities, and sometimes with tea vendors. Tea-shops are excellent arenas for observing interactions between communities and discussion of open ended questions (Putnam, 1975). Experience of plant collection, uses and conservation was sought and noted while recording informally in order to add a historical dimension to better understand the knowledge of plant collection, use and conservation.

Ecological Data Analysis - The species data of each quadrat was used to calculate phytosociological parameters (frequency, density, abundance and their relative values (IVI) following Mueller-Dombois & Ellenberg (1974) and Shannon diversity index and species richness. The data was also employed to analyze the relationship between the abundance, diversity, distribution and density of plants and their use values (Galeano, 2000). Environmental variables, socio-economic variables and three species diversity indices were used to analyze interaction of diversity, distribution and density of plant species with environmental and socio-economic variables (Table 1.5). From the values of aspect (Ω), slope (β) and latitude (ϕ), RRI was calculated following the formula given by Oke (1987): $RRI = \cos(180° - \Omega).\ \sin\beta.\ \sin\phi + \cos\beta.\ \cos\phi$. The disturbance intensity was quantified subjectively by measuring frequency of open canopy (> 50%) and exotic species in quadrat and evaluated on a scale of 0 (no impact at all) to 2 (presence of both) adapted from Metz (1997) and Miehe et al. (2015). Use pressure was quantified by recording the frequency disturbances.

Table 1.5 Socio-economic and environmental variables and ecological indices used

Environmental and socioeconomic variables	Ecological indices
1. Elevation	1. Shannon-Weiner (H)
2. Aspect	2. Species Richness (S)
3. Slope	3. Pielou Evenness (E)
4. Solar radiation	4. Frequency (F)
5. Aridity	5. Density (D)
6. Precipitation	6. Abundance (A)
7. Evapo-transpiration	7. Importance Value Index (IVI)
8. Temperature	
9. Use pressure (Grazing, firing, cutting, trampling/trail)	
10. Disturbance index (Canopy cover and exotic species)	

Ethnobotanical Data Analysis - To demonstrate the relative importance of a species, use values (UV) calculated by two different techniques UVp - Phillips & Gentry (1993a) and UVL – Lawrence et al. (2005) were employed. The Use Value (UVp) for each species was calculated by dividing the sum of all reports of its use by the total number of people interviewed (Phillips & Gentry, 1993a). UVL was calculated based on rank score. UV by category (total, medicinal and non-medicinal (others)) of use for each species was calculated by dividing the total reports of the species in a particular category by the total number of people interviewed. Apparency was tested by using both availability and accessibility of plant species. The former was tested applying the ecological indices such as relative density, relative frequency, relative abundance, IVI, species richness and diversity index. For regression analysis, six variables of ecology (IVI, RF, RD, RA, species richness (S), diversity (H)) and ethnobotany (total use value by rank (TUVL), total use value by reports (TUV), medicinal use value (MUV) and other use reports (OUV) were used. Apparency was tested for species, families and use category using the Spearman correlation coefficient and simple regression analyses (Moerman, 1979; Bennett & Husby, 2008). The accessibility was tested by the use value of species with spatial units (forest/non-forest areas, nearby/transition/distant areas, hill/mountainous district, Himalayan endemic/Pan-Himalayan/broadly distributed).

To determine the influence of socioeconomic factors, three different indicators of knowledge were recorded and calculated: 1) use reports, representing the sum of all uses reported by an informant for all species known by that person, 2) useful species, representing the sum of all useful species an informant knew and 3) use value. For the purpose of this study, a single record of use from the interviews with the 100 participants was termed a “use-report.” The use-report reference for each mention of a plant use given by a participant (Treyvaud-Amiguet, 2005) was used to compare use-specific differences. The use reports related to health and healing were grouped into medicinal (MUR) and the others as non-medicinal were grouped into OUR. Other measures used to correlate plant knowledge with consensus included the unique use-reports (UUR) by a participant. The use reports were categorized into emic use types and later grouped into etic categories following the Economic Botany Data Collection Standard (Cook, 1995). Each category was classified according to its level of species redundancy: highly redundant (> 25% species of total species used for a particular category, redundant (25-5%), and not very redundant (number of species < 5%) adapted from Albuquerque & Oliveira (2007).

To identify the proportion of culturally important species in each study district, the Index of Agreement on Species (IAS) was calculated following Trotter & Logan (1986). IAS was corrected to Index of Agreement on Species consensus (IASc) for the number of participants who knew a use for the species (Vandebroek, 2010). We determined the proportion of plant species with an IASc value > 0.5; this value was chosen as an arbitrary cut-off point for culturally important species. The two main measures of "Plant knowledge" consisted of (1) the cumulative number of participants who reported a use for each plant species at the group (cultural) level and (2) the number of plant species used at the level of individual participant. Friedman et al. (1986) used Fidelity Level designed to highlight species that have high potential for a specific purpose. Thus the plants popularity for a particular use was computed in Fidelity Level (FL). The FL value was calculated to estimate the popularity of each species for a particular use. It is defined as the ratio of the total number of informants who suggested the use of a species for a particular use (Np) and the total number of informants (N) that cited the plants for any use and calculated as:

$$FL = (Np / N) \times 100$$

The frequency of citation of a specific use, that is, the number of individual use-reports (nur) for a type of use category, serves to establish the consensus across the respondents (Weckerle et al., 2018). The cultural consensus on a particular use category can help inform efficacy of a plant to that particular use category (Trotter & Logan, 1986; Berlin & Berlin, 2005; Heinrich et al., 2009). The informant consensus factors (FiC) was calculated as: nur – nspp.used/nur–1

where nur shows the number of use reports while nspp shows the number of species used Trotter & Logan, 1986). After analyzing the FiC values of both districts, a comparison was made to sort out consensus of plant uses across the two districts.

Cross-cultural Analysis - The socioeconomic data was grouped into nominal/categorical variable: (1) gender, (2) literacy, (3) occupation, (4) physiography, (5) ethnicity, (6) food availability, (7) languages spoken; and continuous variable: (1) age, (2) family size, (3) livestock size, (4) land size, (5) length of residence, (6) years of healing practice, (7) distance from home to forest and (8) distance from home to health post (Table 1.6). Cross-cultural analysis followed Quave & Pieroni (2015) and was made at (1) gender: male, female, (2) education: literate, nonliterate, (3) occupation: traditional healers, non-healers, (4) physiography: hill (Baitadi district), mountain (Darchula district) (5) food availability: < 6 months, > 6 months, (6) Language spoken: ≤ 2 languages spoken, more than 2 and (7) ethnic groups: privileged group (Chhetri and Brahmin), disadvantaged/minority group (Byashi and *Dalit*). The sampling effort was tested by a Jackknife 1st order richness estimator 100 permutation species-use curve performed in R. Species-use curve was drawn from the cumulative number of species mentioned as being used versus the number of informants interviewed (Kristensen & Baslev, 2003).

Table 1.6 Variables used in this study for analyses

Categorical variables (factors - number of respondents)		Continuous variables
1. Livelihood	Baitadi/sedentary (suburban, hill) (57)	1. Length of residence (year)
	Darchula/seminomadic (rural, mountain) (43)	2. Livestock owned (number)
2. Access to opportunity	Privileged (Brahmin, Chhetri) (72)	3. Land owned (area)
	Underprivileged (Byashi, *Dalit*) (28)	4. Home-health post distance (hour)
3. Gender	Male (68)	5. Home-forest distance (hour)
	Female (32)	6. Household size (number)
4. Occupation	Healers (77)	7. Healing practice (year)
	Non-healer (23)	8. Age (year)
5. Languages spoken	≤ 2 (81)	
	> 2 (19)	
6. Education	Nonliterate (51)	
	Literate (49)	
7. Food availability	≤ 6 months (72)	
	> 6 months (18)	

Statistical Analysis - Prior to statistical analysis, the data were tested for homogeneity of variance. Probability values of p <0.05 were considered to be statistically significant. Kruskal-Wallis test was used to evaluate the possible difference in data set (Sokal & Rholf, 1995). Statistical models were used to explore how socio-cultural variables interact among themselves and with the knowledge of plant collection, use and management intensity. Since our response variable is count variable, *Generalized Linear Regression* with *Poisson* or *Quasipoisson* error was analyzed to see the effect of settlement, length of residence, size of household, livestock, land, age and experience of participants against plant uses. Over-dispersion of data was tested before selecting final model looking residual deviance. Data showing residual deviance greater than the degree of freedom, thus *Poisson* logit (link) regression model was used. For categorical variables, *emmeans* (least square regression of means at logical scale) generalized linear model was used (Searle et al., 1980). A bootstrap-version of ward hierarchical clustering, based on presence/absence data and a canonical correspondence analysis (CCA) (ter Braak & Smilauer, 2002) were computed to identify plant communities and to analyze their relationships with environmental variables using *pvclust, ape, phylo* and *vegan* packages in R. Generalized Linear Model (GLM) up to second order (with family Poisson distribution) was used for regression of environmental variables and diversity indices. All the analyses were performed in R studio in R 3.4.1 (R Development Core Team 2017).

Related Studies

Kailash Sacred Landscape has been identified as one of the most under-studied areas in Nepal, thus the relationship of plants-people-places in this area is not well understood. The first account of plants and people of Kailash Nepal Darchula district was documented by Heim & Gansser in 1939. Adam Stainton travelled some of the route in 1965 and collected only a few plants as he headed west through Nepal on his way to collect plants in Kashmir, India. Before Adam Stainton, O Polunin and his team had visited Humla in 1952 for botanical exploration. Yet, there have been limited botanical explorations carried out in Baitadi and Darchula. An extensive exploration led by Hiroshi Ikeda (University of Tokyo) made in Darchula, Far Western Nepal in 2012 collected 1,181 samples from 383 genera of flowering plants and ferns.

Table 1.7 Botanical Explorations in KSL Nepal

Team members	Year	Districts/Areas
Polunin O, Sykes WR, Williams LHJ	1952	Humla
Stainton JDA	1965	Bajhang
Shrestha TB	1965	Bajhang
Malla SB	1968	Humla
Bista MS & Joshi DP	1972	Baitadi
Rajbhandari KR & Malla KJ	1980	Baitadi, Darchula
Malla SB & Sainju HK	1981	Baitadi
Sharma I, Joshi R, Uprety R & Pandey I	1981	Baitadi
Amatya M & Regmi PM	1982	Darchula
Shakya PR, Adhikari MK & Subedi MN	1984	Baitadi, Bajhang
Ikeda H, Elliott A	2012	Darchula
Pandey TR, Bhatta GD, Kandel DR, Basnet R	2017	Baitadi, Bajhang, Darchula, Humla
Rana HK, Sun H, Paudel A, Ghimire SK	2018	Baitadi, Bajhang, Darchula, Humla

The majority of the collections were from Poaceae and Asteraceae (Elliott, 2012; Pandey et al., 2017). The recent floral collection from Kailash, Nepal was made by Pandey et al. (2017) and a new plant species was reported by Rana et al. (2018) from Kailash, Nepal (Table 1.7). There are over 6,600 flowering plants including over 2,400 useful plants in Nepal reported until 2010 (Ghimire et al., 2008; Kunwar et al., 2010; Rokaya et al., 2010). All useful plants have been traditionally used in rural areas as a key resource for subsistence, household economy and primary health care (Singh et al., 1979; Malla & Shakya, 1984). The first scientific study of Nepalese useful and medicinal plants was made by Francis Buchnan in 1802-1803 from Kathmandu valley. The early studies were meant for inventory and documentation (D. Don, 1825; Wallich, 1826). The first ethnobotanical study in Nepal was carried out by ML Banerji in 1955. Since 1980, there are exhaustive numbers of ethnobotanical studies in Nepal (Table 1.8) as found worldwide (Bennett, 2005). The articles dealing with ethnobotany and herbal medicine in the world increased about 500%, from 376 (2001) to 2367 (2013) (Popovic et al., 2016) (Figure 1.10). The search of the term “ethnobotany” in NSF website (www.nsf.gov) yielded only two hits in 2001 (Bennett, 2005) but on April 06, 2018 yielded 22 hits. This shows that the project and research on ethnobotany is increasing. However, the Far Western Nepal is still under-studied and under-funded for ethnobotanical research (Table 1.9).

Table 1.8 Early Ethnobotanical Studies in Nepal

Year	Contributors	Study reference
1802–1803	Buchanan F	An account of Kingdom of Nepal
1825	D. Don	Prodromus Florae Nepalensis
1820-1826	Wallich N	Tentamen Flora Nepalensis Illustrate, London
1955	Banerji ML	Some edible and medicinal plants from east Nepal
1961	Pandey PR	Distribution of medicinal plants of Nepal
1964	Pandey BD	The Wealth of Medicinal Plants of Nepal
1968	Singh SC	Some wild plants of food value in Nepal
1970	Dhatta BB	Natural History and Economic Botany of Nepal. Government of Nepal
1975	Toba S	Plant Names in Khaling: A study in ethnobotany and village economy
1979	Sacherer J	The high altitude ethnobotany of Rolwaling Sherpa
1979	Singh et al.	Medicinal Plants of Nepal: Retrospects and Prospects
1980	Manandhar NP	Medicinal Plants of Nepal Himalaya
1984	Coburn B	Some Native Medicinal Plants of the Western Gurung.
1984	Malla SB & Shakya SR	Medicinal plants of Nepal
1989	Bhattarai N	Ethnobotanical studies in central Nepal: the ceremonial plants-food

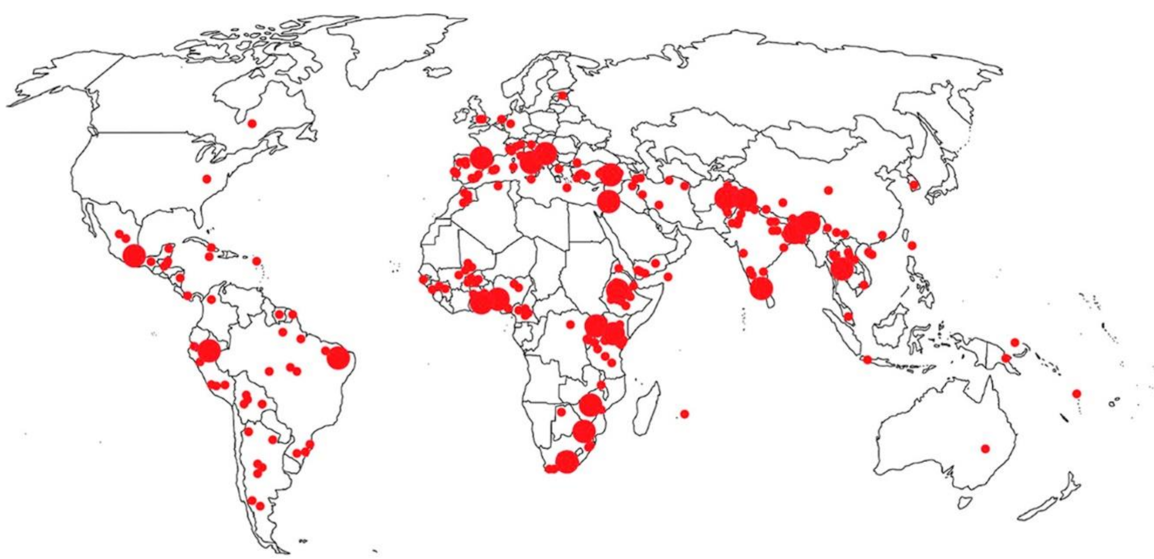

Figure 1.10 Ethnobotanical research between 2001 and 2013 (Popovic et al., 2016)

The use of plants in rural areas is primarily constituted by both theoretical and practical knowledge surrounding health, illness and sociocultural values (Bhasin, 2007). Relatively few of the useful species are cultivated, the great majority still provided by collection from the wild (Lange & Schippman, 1997). Use of non-indigenous species is consistent with the utilitarian redundancy hypothesis, which states that the use of functionally similar species can be a part of a strategy to maintain the resilience of local knowledge (Albuquerque, 2006). The most common and accessible species and habitats are more valued, supporting the ecological apparency hypothesis (Phillips &

Gentry, 1993a; Moerman, 1998; Thomas et al., 2009; Humphreys, 2014). It is often hypothesized that there exists a positive correlation between plant use/knowledge and plant density, diversity and habitat diversity (Bennett, 1992; Begossi, 1996; Milliken & Albert, 1997; Vandebroek et al., 2004). Thus, the role of ecological processes and patterns in determining and responding to human use of plants is becoming increasingly recognized in ethnobotany and ethnoecology (Salick, 1995).

Anthropogenic impacts and global climate change are one of the most critical issues concerning the conservation of forest ecosystems in developing countries (FAO, 2005). Due to changes in human population structure and sociocultural transformation, a considerable amount of indigenous knowledge about plant resource use is at risk of being lost. Agricultural lands, particularly in the hills and mountains, have been temporarily abandoned in recent years primarily due to outmigration in search of off-farm livelihoods and urbanization. The outmigration led the agricultural fields unattended and lack of labor (Maren et al., 2013) resulting in decreased productivity (Bhandari, 2013) and spread of weedy and non-indigenous species at ruderal areas. Spread and rampant growth of non-indigenous species are fueled by global warming and climate changes (Walther et al., 2002). An effect of climate change on forest and vegetation dynamics has been seen elsewhere (Maclean & Wilson, 2011) and we could also assume that the climate variables (e.g. temperature and rainfall) play an important role in changing population and distribution of useful plants in Baitadi and Darchula districts.

Overexploitation of wild populations and their habitats and lack of conservation programs are two interlocking problems facing sustainable management of plant resources. The traditional knowledge is effaced in the absence of a continuum of cultural interactions (Winter & McClatchey, 2008). A decrease of medicinal plants and associated indigenous knowledge can compel indigenous people to integrate newer strategies such as the introduction of non-indigenous resources into their lexicon (Bennett & Prance, 2000; Palmer, 2004) and to access secondary forests/disturbed/human derived landscape (Toledo et al., 1995; Salick et al., 1999).

Table 1.9 Ethnobotany and Ethnographical Studies in KSL, Nepal and Surrounding

Year	Contributors	Reference
1974	Rainhard J	The Raute: Notes on a Nomadic Hunting and Gathering Tribe of Nepal
1976	Manzardo et al.	The Byashi: an ethnographic note on a trading group in Far Western Nepal
1976	Bista DB	Encounter with the Raute: the last hunting nomads of Nepal
1977	Manzardo AE	Ecological constraints on trans-Himalayan trade in Nepal
1996	Cameron M	Medicinal plants of Bajhang
1998	Manandhar NP	Native phytotherapy among the Raute tribes of Dadeldhura district, Nepal
2002	Nawa K	Ethnonym Dialect of Byashi people
2003	Devkota & Karmacharya	Documentation in indigenous knowledge of medicinal plants in Gwallek, Baitadi
2003	Bhatta DD	Community approaches to natural resources management: Sacred and non-sacred landscapes
2004	Pant & Panta	Indigenous knowledge on medicinal plants in Bhagawati, Darchula
2005	Pant et al.	Wild edible plants of Lekham area, Darchula
2005	Lilleso et al.	Vegetation maps of Far Western Nepal
2006	Bista & Webb	NTFPs of Baitadi
2007	Clarke R	Hemp culture in Darchula
2007	Maharjan & Joshi	A Poverty Analysis in Baitadi District
2008	Burlakoti & Kunwar	Ethnobotany of Mahakali
2008	Joshi K	Ethnomedicine of Darchula
2008	Amatya G	Trade and socioeconomy of *Ophiocordyceps sinensis* in Darchula
2009	Kunwar et al.	Ethnopharmacology of Baitadi and Darchula districts
2009	Fortier J	Kings of the Forest: The Cultural Resilience of Himalayan Hunter-Gatherers
2009	Pal TB	A study on Yartsagumba collection in Darchula district of Nepal.
2010	Chaudhari et al.	Biodiversity of Kailash
2010	Kunwar et al.	Med plants and pharmacological validity
2010	Dadal AS	The role of non-timber forest products in income generating activities: A case study of Yartsagumba in Yerkot of Darchula District.
2011	Zomer & Oli	Landscape of Kailash
2012	Elliott A	Flora of Darchula
2012	Kunwar et al.	Underutilized plants in Far Western Nepal
2013	Kunwar et al.	Traditional medicines of Far Western Nepal
2013	Bhandari B	Effect of rainfall on crop yield in Darchula
2013	Zomer et al.	Environmental stratification of KSL and Projected Climate Change Impacts on Ecosystems and Productivity
2014	Pyakurel et al.	Commercially valued plants of Kailash
2014	Zomer et al.	Projected climate change impacts on spatial distribution of bioclimatic zones and ecoregions within the Kailash Sacred Landscape of China, India, Nepal
2015	Kunwar et al.	Medicinal plant dynamics in Far Western Nepal
2015a	Uddin et al.	The changing land cover and fragmenting forest on the Roof of the World: A case study in Nepal's Kailash Sacred Landscape
2016	Uprety et al.	NTFPs of Kailash Sacred landscape, Nepal
2016	Kunwar et al.	Landuse and Socioeconomic change, medicinal plant selection and biodiversity resilience
2017	Pyakurel et al.	Quantification of medicinal plant trade from Darchula District, Nepal
2018	Atreya et al.	Decline of traditional practices in Baitadi
2018	Aryal et al.	Wild edible plants of Khar, Darchula
2018	Pouliot et al.	Organic gold (*Ophiocordyceps sinensis*) in Darchula

Dissertation Layout

This dissertation consists of seven chapters. Chapters Three, Four, Five and Six are manuscripts currently published or submitted to journals. The current chapter, Chapter One introduces the background premises of the geography, culture and biodiversity of Nepal and Kailash Sacred Landscape and theories and concepts of plant utilization and conservation including the study contexts, concepts and constraints. I have framed the research questions, hypotheses, goals and objectives of this study and designed appropriate materials and methods. Little is known about the vegetation, forest, ecology, patterns of plant use, geography and culture of Kailash Sacred Landscape, Nepal because of its restricted access and the limited resources that are available for research. This chapter also describes climate, land-use, socio-economic situations, livelihood, demography, ethnography and useful plants of Kailash Sacred Landscape, Nepal (Baitadi and Darchula districts).

Overall research findings and discussion are outlined in Chapter Two. This chapter presents the results of the biodiversity, ecology, ethnobotany, culture and conservation of Baitadi and Darchula districts of KSL Nepal. Some detailed information not covered in the following chapters (the manuscript papers submitted to journals) are included in this chapter.

All of the papers published or submitted to journals are documented in Chapters Three through Six. Chapter Three is a manuscript submitted to Journal of Forestry Research. It describes types of forests and vegetation of Baitadi and Darchula districts and their interactions with socio-economic and environmental variables. This chapter also enumerates general and useful plants of the area and their distribution. Due to changes in land-use and socio-culture behaviors, forest degradation is expected to accelerate. More participatory forest conservation measures that incorporate human, cultural and environmental variables are recommended.

Detailed interpretations of the interdependencies of human, cultural and environmental variables are presented in Chapter Four. Since ecological apparency was not found to be the most important factor, social and cultural aspects help determine the nature of plant collection, use and aid in developing strategies for sustainable conservation. This manuscript submitted to

Journal of Mountain Science explores the strategies of how people use plant resources in the context of availability of plants, accessibility of site, and diversity of culture.

Chapter Five, a manuscript submitted to Ethnobiology and Ethnomedicine Journal seeks to better understand the human-nature interface and to measure the variability of plant use knowledge among cultures, through inter and intracultural analyses. Plant collection, use and management of two culturally distinct groups (Baitadi and Darchula) are compared at cross-cultural scales. The extensive usage of plants for socio-economic reasons, livelihood and rituals indicates that the plants and culture in KSL are inseparable.

Chapter Six, a published manuscript in The Florida Geographer Journal, describes the forest cover change in Darchula over a period between 1990 and 2016. The change in forest cover in the district is non-linear, albeit insignificant over time. The increased forest cover in conjunction with community based management systems have been jeopardized by the recent changes of socio-cultural practices and the climate.

Chapter Seven, the final chapter of the dissertation, summarizes the findings and suggests future directions for research. The chapter also highlights the future prospects of implications for conservation, resource sustainability and human well-being in the KSL, Nepal at the nexus of geo-ecological constraints, changing socio-cultural behaviors and climatic variables.

PLANT BIODIVERSITY, ETHNOBOTANY AND CONSERVATION

Plants and Useful Species

A total of 975 plant species including 82 new species recorded and 23 new use reports to Baitadi and Darchula districts were recorded (Appendix E) following field observations and review (flora literature – Chaudhary et al., 2010; Elliott, 2012; Uprety et al., 2016; Thapa, 2017; Pandey et al., 2017; and ethnobotany literature – Devkota & Karmacharya, 2003; Pant & Panta 2004; Panta et al., 2005; Burlakoti & Kunwar, 2008; Joshi, 2008; Kunwar et al., 2009, 2010, 2012, 2013, 2015, 2016; Aryal et al., 2018). There were 305 (31%) useful plant species including 122 useful reported in the present study. The 122 useful species represented from 48 herbs, 45 trees and 29 shrubs including 82 forest based species (60 recorded only in inventory quadrats and 19 recorded only in ethnobotanical survey) indicating that the contribution of forest in local livelihood in Baitadi and Darchula districts, Nepal is still important. The most frequently utilized plant parts were the leaf (25) followed by underground part (root/rhizome/bulb = 24), stem/wood (22) and flower/fruit (18) (Figure 2.1). In earlier studies (Kunwar et al., 2010), root/rhizome, leaf and fruits were frequently used in preparation of traditional herbal medicine.

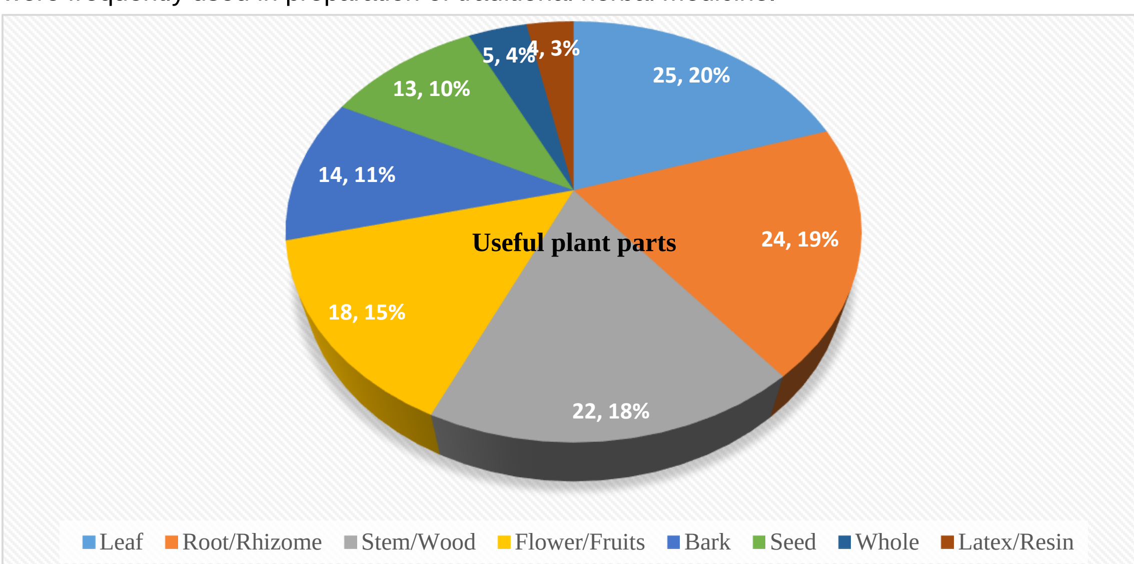

Figure 2.1 Useful plant parts

Use Reports and Consensus

A total of 1,434 use reports from 122 useful plant species were recorded from 100 participants. Each species was reported for 1- 10 use types and 1- 63 use reports. A total of 89 emic use types under 19 etic categories were treated by 122 useful plants (Appendix F). With 28.68% redundancy as the most in Darchula and 18.85% as the second most redundant in Baitadi district, digestive system disorder was the most redundant in study area: the highest numbers of species 49 (40.16%) were used followed by the species used for social use (42, 34.42%), inflammation (33 species, 27.04%) and ritual use (28 species, 22.95%). Social use (use for livelihood) was the most redundant in Baitadi district with 29.5% of total useful species used. There were only five categories as “not very redundant (< 5% species used)” and three categories (digestive disorder, social use and pain/inflammations) as the most redundant (> 25% species were used). A total of 49 species (40.16%) were used for digestive disorders. The preponderance of digestive system disorders in the study area was fomented by the food deficiency, consumption of wild foods, drinking untreated water, and conditions of poor general nutrition. Diarrhea and dysentery were the most common illness reported in the districts (DDO, 2010) and Far Western Nepal (GoN, 2011). Analysis of Fidelity Level (FL) showed that there were 27 useful species with 100% FL and 32 with > 90% FL (Appendix F).

The species with 90-100% FL are known as the most useful for one type of use category whereas the species with less than 100% FL are used for multiple uses, receiving less fidelity values. The species with 100% fidelity and reported by the highest number of participants are considered particularly efficient for that specific uses. The higher FL species are important in rural livelihoods because they could provide links to potential species for sustenance of culture and maintenance of health hygiene. Collecting plants with redundant utilities could offset the use pressure to the indigenous populations of living in restricted habitats and plants growing only in remote forests (Alencar et al., 2014). The opportunity to use functionally similar (secondary and versatile) species and habitats can help maintain the resilience of indigenous systems (Albuquerque & Oliveira, 2007). The plants with high fidelity could be candidate species for further evaluating their significance for their respective uses. The species with high IASc and fidelity are given in Table 2.1. The details of IASc, Fidelity and species importance for each use category is given in Chapter 5 and Appendix G.

Table 2.1 Use categories, use types and fidelity level (%) of 12 high IASc species

Use category (Abbreviation)	Use types	Plant species											
		Ber cil	Swe chi	Ang arc	Neo Scr	Dac hct	Par pol	Pru cer	Fic rel	Abi pin	Chr aci	Qer lan	Pol aby
Digestive – metabolism (Dig)	Diarrhea, dysentery, stomachache, nausea, anthelmintic, appendicitis, gastric, indigestion	*63.08*	*6.56*	*82.5*	*3.23*	*4.35*	*57.14*	-	-	-	-	3.33	
Infection (Inf)	TB, fever, typhoid, tetanus, leprosy, polio	*3.08*	*73.77*		*90.32*	*4.35*	*8.93*	-	-	-	-	-	
Pain/inflammation (Pai)	Cuts, wounds, burn, injury, analgesic, toothache, headache	*4.62*	*3.28*			*86.96*	*12.5*	-	-	-	-	6.67	
Respiratory (Res)	Pneumonia, cold, cough, larynx-sound	*6.15*	*13.11*	*7.5*	*6.45*			-	-	-	-	20	
Muskulo-skeletal (Mus)	Fracture, sprain, joint pain, backache, bath (rheumatism),	*1.54*		*2.5*				-	-	-	-	-	
Antipoison (Poi)	Snake bite, antidoting, scorpion sting, piscicidal, antileech, insecticidal						*16.07*	-	-	-	-	-	
Immune (Imm)	Immune, anticancer, nutrition, appetite, growth, tonic					*4.35*		-	-	-	-	-	
Endocrine (End)	Gall bladder, gall stone, diabetes	*21.54*						-	-	-	-	-	
Nervous (Ner)	Paralysis, memory longevity, epilepsy, dizziness, antidepressant						*3.57*	4.17	-	-	-	-	
Circulatory, Blood (Cir)	BP, heart disease, jaundice		*1.64*					-	-	-	-	-	
Skin (Ski)	Acne, scabies, foot problem, hair fall,							-	-	-	-	-	
Repro (Rep)	Lactation, fertility, conceive, abortion							-	-	-	-	-	
Genito-urinary (Gen)	Urine infection, hydrocele, piles,							-	-	-	-	-	-
Sensory (Sen)	Eye, ear complaints							-	-	-	-	-	-
Household Economy (Eco)	Dye, oil, resin		-	-								-	
Cultural (Rit)	Ritual, religious, evil spirits		-	-	-	-		79.17	100	2.86		-	-
Livestock (Liv)	Livestock health, veterinary		1.64	-	-	-	-	-	-	-	-	-	-
Social – materials (Soc)	Wood, fuel, fodder, forage, rope, bedding, agricultural implements		-	-	-	-	-	16.67	-	97.14	100	70	100
Food (Foo)	Vegetable, edible, spices	-	-	7.5	-	-	1.79	-	-	-	-	-	-

Note: Italicized data is fidelity value of plant species for medicinal uses, underlined value is fidelity value of plant species for socio-cultural values. Plant species names are abbreviated (Appendix H).

A nonexistent relation (p = 0.32) was already reported from adjoining villages of our study sites (Kunwar et al., 2015) and semi-arid and transhumance communities of Patagonia, Argentina (p = 0.34) (Lozada & Ladio, 2006). Earlier studies argue that the age group 65-75 holds a greater knowledge of plant use (Mahwasane & Boadua, 2013).

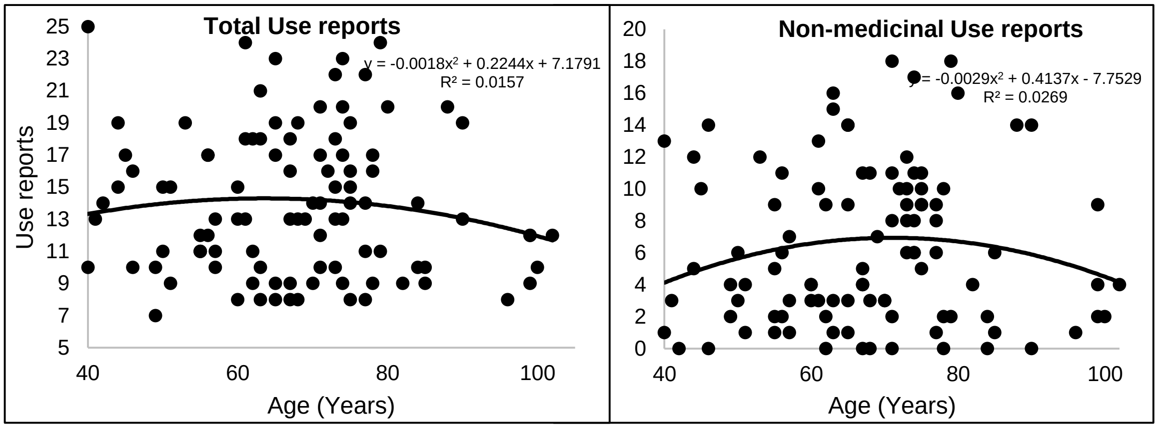

Figure 2.2 Correlation between age and number of use reports mentioned by participants

Conservation

Diverse livelihood strategies such as transhumance (summer grazing, animal husbandry, agro-pastoral) and medicinal plant collection and trade in geo-ecological constrained environment are a matter of survival (Haimendorf, 1975; Manzardo et al., 1976). A large number of communities of the districts depend heavily on remote forest areas for livelihood and rites. Culture of sustained utilization of local resources in the constrained environment through indigenous knowledge led them to sustain traditional and community based programs to offset the adversaries. A community based forestry program is one example, helping restore the forests important for locals' livelihood. A community granary, though rudimentary is still in place in Byash, Darchula for storing potatoes. A number of pit trenches are made under ground at an open place in the center of the village. The trenches are about 5 feet deep, have a 2 feet circular mouth and are caulked by birch bark and stems at the sides and top and covered by a large stone. The mouthpart is slightly elevated in order to avoid water stagnating (Figure 2.3). Thus, this is an example of how the local communities of the study area are rich in indigenous knowledge of how to adapt to the constrained environment and adopt local and culture-environment friendly strategies for wise use of local resources for sustained human-environment interactions.

There is a wide recognition that the contribution of traditional plant use knowledge aids in the conservation of biological diversity. In remote and rural areas like the study area where modern medicine is limited because of its high cost and long travel time, the application of local medicinal plants through traditional medicine is apparent (Figure 2.4). Traditional herbal medicine is the firstchoice among vilagers. The prevalence of folk medicine was atrributed by the limited number of biomedical health workers (one health worker for every 3,300 people in Baitadi and 1900 in Darchula) (DDO, 2010) than the traditional healers (one for every 100 people) in Nepal (Gillam, 1989; WRI, 2005) and the belief and long rooted tradition of using local and quality medicinal plants. The availability of quality medicinal plants also influenced the use.

However, most of the traditional knowledge of many important medicinal plant identification, collection, use and management has remained confined to the elders and traditional healers. The knowledge was kept secret and was parsimoniously transferred vertically to their own generations as found in surrounding areas (Uniyal & Shiva, 2005; Singh et al., 2014; Negi et al., 2017). Local traditional healers favor indigenous/endemic species found in remote wild habitats, self-crafted materials and self-processing to assure that they have the right materials, composition and procedure in place for their medicine. Widespread belief in the effectiveness of traditional therapies persisted and can be attributed to the generations-long uses and apprenticeship learning. However, the number of healers was decreasing rapidly (about 7% per annum) in KSL, Nepal (Kunwar et al., 2015), threatening the existence of tradtitional medicine. Unwillingness of the younger generation to practice traditional medicine, socio-acculturation and the passing away of the elder traditional healers without transferring detailed knowledge may also have posed serious implications for the lack of conservation of traditional knowledge, ultimately jeopardizing local biodiversity and livelihood. Indigenous knowledge of Kailash, Nepal area has played a key role in conserving biodiversity and culture of that area. Thus conservation of traditional knowledge before being effaced is an urgent necessity.

Figure 2.3 Community granary. Insets are garanary in close up and discussions at Byash

Figure 2.4 Discussion of plant use with a traditional healer Ganga D Bista, 84 at Dhap, Darchula

COMPOSITION AND CONSERVATION OF FORESTS AND VEGETATION IN KAILASH SACRED LANDSCAPE, NEPAL (SUBMITTED TO JOURNAL OF FORESTRY RESEARCH)

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Abstract

The Kailash Sacred Landscape, Nepal is a remote and rural biodiversity rich trans-boundary landscape. Little is known about its biodiversity and management. This study evaluates phytosociological vegetation patterns to identify the key variables influencing population and structure of plant species while analyzing the interdependencies between forest and vegetation and socioeconomic and environmental variables. Along an elevational gradient from 1800-3665 m asl, 141 quadrats were laid following a stratified random sampling. Species data were recorded from the nested quadrates. The distribution of forest species was determined using multivariate analysis with respect to ten subject variables. A total of 191 species from 166 genera and 87 families were recorded. We identified eight types of forests along an elevational diversity gradient: Laurel forest, Oak-Laurel forest, Oak-*Rhododendron* forest, Oak forest, Laurel-Alder-Maple forest, Fir forest, Fir-Blue pine forest and Blue pine forest, as result of a clustering dendrogram. The former three and latter three forest types were exclusively found in mid-hill Baitadi and mountainous Darchula district respectively, whereas the remaining two were interspersed in both districts. Based on the canonical correspondent and correlation analyses, the variables elevation, slope, temperature and aridity proved to be significant determining vegetation and species distribution. Species richness, heterogeneity, and evenness all showed significant relationships with elevation, aridity and precipitation ($p < 0.001$). Baitadi and Darchula districts were rich in both useful and general plant species and inherently connected with conservation, culture, physiography and indigenous management. The collection and use of plants was influenced by species richness and accessibility. Due to changes in land-use and socio-culture behaviors, forest degradation is expected to accelerate, urging more participatory forest conservation measures with acknowledgement of human, cultural and environmental variables for sustainable management.

Keywords: Phytosociological assessment; Environmental factors; Forest types; Aridity; Kailash Sacred Landscape; Nepal.

Introduction

A fossilized tooth of a Ramapithecus, found in 1980 in the Tinau (Butwal), Western Nepal Himalaya, dated to be the second oldest in the world, with 9.0- 9.5 million years (Munthe et al., 1983), substantiates prehistoric habitation of western Nepal (Pradhan, 1998). Humans are known to have been present throughout the Nepal Himalaya from paleolithic times (Corvinus, 1996, 2004). Wherever and whenever humans appear they changed their environments and burnt the forest for their livestock, as they considered treeless rangelands were easier to manage (Miehe et al., 2009). Early settlers (Aryans) advancing into the western parts of Nepal in 1100 AD are considered the first group employing different strategies of forest plant use for their subsistence, economy and healthcare (Chaturvedi, 1986; Khan et al., 2015). It is likely that human communities that inhabit high altitude arid Himalayas use a higher percentage of plant species (Salick et al., 1999; Thomas et al., 2009) and employ diverse strategies such as forest and pastureland management, transhumance and collection, use and trade of medicinal plants (Manzardo, 1977; Garbyal et al., 2007; Negi et al., 2017), influencing the structure and composition of forest and vegetation of the area (Anderson et al., 2005). Human dimensions of change are of great consequence in the Himalayas, where the habitats are especially important to the indigenous population as collection grounds for medicinal plants, grazing site for livestock, and as prayer grounds for pilgrims (Chandrasekhara & Sanker, 1998; Garbyal et al., 2005a). However, the role of human impact on vegetation patterns has been widely neglected (Miehe et al., 2009).

The pattern of forests and vegetation is also specific to the interactions of plant communities, population and environmental factors (Korner, 2007). Vegetation patterns are predicted by latitude, precipitation and soil characteristics (ter Steege et al., 2003). Topographic features of mountains such as slope orientation, aspect and elevation also play a major role in structuring vegetation composition due to variations in incoming solar radiation (Holland & Steyne, 1975). Gradients of forest type, canopy cover, management practice and disturbance influence species richness and vegetation (Bhattarai et al., 2004). Species richness and number of useful plants are positively associated in mountainous regions (Salick et al., 1999; Kunwar & Bussmann, 2008). Thus the environmental factors are also important in explaining plant species richness (Mc Vicar & Korner, 2012) as they ultimately affect forest and vegetation cover of an area. High altitude and mountain ecosystems are particularly sensitive to the environmental changes (Messerli & Ives, 1997).

Vegetation composition, structure and function are the most important ecological attributes of forests, which show variations in response to environmental as well as anthropogenic variables (Timilsina et al., 2007). However, studies dealing with the analyses of multiple variables in forest and vegetation ecology in the Baitadi and Darchula districts are scant and both the study area and Far Western Nepal are under-represented in research (Fisher, 1991; Eriksson et al., 2009; Elliott, 2012). For the design of appropriate conservation strategies, quantitative information is required on the diversity, population structure (density) and distribution patterns of plant species (van Andel, 2000). Studying biological and ecological effects of conservation of forest and flora with socio-cultural backgrounds guides the dynamics of people and nature, leading to greater understanding of social and ecological phenomena (Klamn, 1985; Anderson & Posey, 1989). This study analyzes forest and vegetation interdependencies and relationships with environmental variables with specific attention to be paid to useful plant species. Our objectives were (1) to identify the key variables influencing forests, vegetation and population of plant species, (2) to analyze the interdependencies among forest and vegetation characteristics and environmental and socio-economic variables in the Kailash Sacred Landscape, Nepal.

Material and Methods

Study Area and Site Description: The Kailash Sacred Landscape is a historically, ecologically, and culturally interconnected landscape within Nepal, India and China (Zomer et al., 2013). The bio-climate of the landscape includes hot and semi-arid regions in the southwest and lush green and humid valleys in the center. The northern area is covered by extensive mountain forests, moist alpine meadows, arid trans-Himalayan valleys, high altitude grasslands and steppes and permanent snow and ice fields (Zomer et al., 2013). High-altitude rangelands constitute nearly 27% of the geographical area within the KSL. These rangelands intergrade into sub-alpine forests towards lower elevations (<3,300 meter above sea level (m asl)); agricultural fields along flat river valleys; wetlands and the sub-nival zone (pioneer habitats) above 5,500 m asl. Almost 15% of the KSL area is classified as permanent snow or ice, 20% is estimated to be under some forms of forest cover and an additional 18% is bare or has uncultivated fallow land (FAO, 2010). In 2002, the land-use pattern of KSL was 24.3% forest, 8.6% shrub land, 17.1% grazing land, 8.6% cultivated land and other types of use was 41.3% (GoN, 2001). Because of the diverse geography, the KSL bestows with a rich array of natural resources and biological diversity (Eriksson et al., 2009; Zomer & Oli, 2011). Aridity and remoteness of the landscape isolate the region (Heim & Gansser 1939) and help enrich the unique biodiversity, human lifestyle and culture in the region (Pant, 1935; Manzardo, 1977; Elliott, 2012).

The KSL, Nepal is one of the most underdeveloped regions of Nepal and faces numerous conservation and development challenges resulting from the dry climate, poor accessibility and high level of poverty (Chaudhary et al., 2010). These manifest a high dependency on natural resources leading to overexploitation of the local resources (Roy et al., 2009). The KSL, Nepal covers four mountain and hilly districts (Darchula, Humla, Baitadi and Bajhang) in the Far West of the country. This study looks at the Baitadi and Darchula districts (29° 22' - 30° 15' N; 80° 15' - 81° 45' E) (Figure 3.1), which are important for their ecology and their role as historical, religious and tourist areas. Physiographically, Nepal has three regions: mountain >3,000 m, hill (700-3,000 m) and lowland-Tarai (60-700 m).

Our study area in the Baitadi district represents hill and Darchula includes mountain and trans-Himalayan ecosystems. Situated south of the landscape, the hilly region (*Pahad*) is highly populated and agriculture is the major form of livelihood. A large number of agro-pastoral and migratory pastoral communities of Darchula district depend heavily on bio-resources of mountain area for livestock grazing, high-value medicinal plants and religious rites. The fragile nature of the area, coupled with resource harvesting and land-use change poses a danger to the forested ecosystems in the landscape, with implications for biodiversity and people (Uddin et al., 2015b). These are the most remote northwestern border districts of Nepal to India and China. They range from 390 to 7,132 m asl. Situated south of the Mountain district Darchula, the hilly Baitadi district is mostly between 700 and 3,000 m asl and is highly populated with agriculture the major form of livelihood.

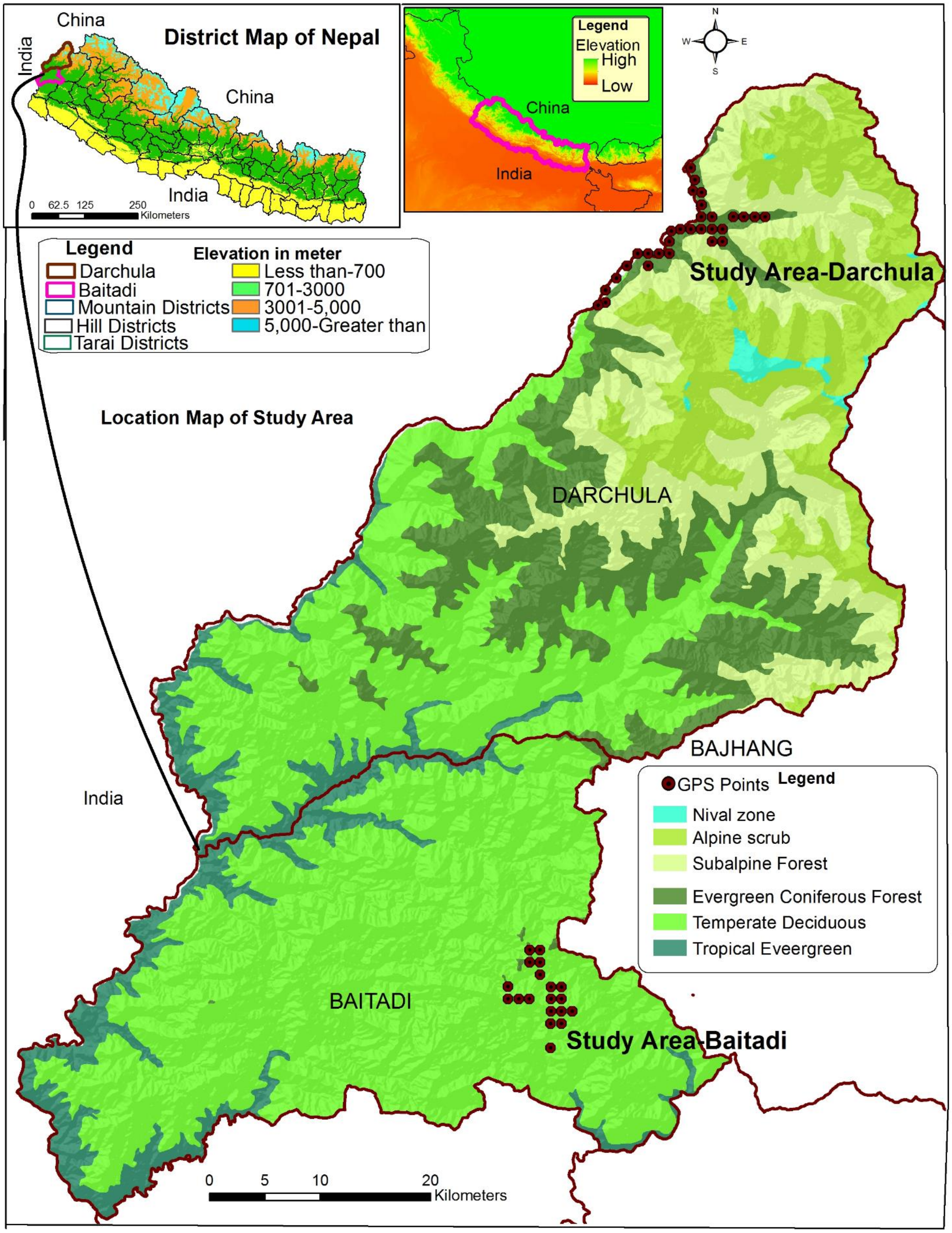

Figure 3.1 Study area showing study plots and forest types

Land distribution pattern is predominantly forest, pasture and agriculture. Furthermore, the districts are dominated by human habitation in the southern regions; as a result, their forest patches are more fragmented. The major caste groups of the study districts are Chhetri (>50%), Brahman (20%), Thakuri (7%), Kami (10%) and Sarki (8%). Kumahi Brahman were considered the first Aryans reaching Nepal in 1100 AD and settled in the western parts of the country. It is believed that they entered Far Western Nepal via the Urai pass in Bajhang district, the Lipu lekh in Darchula district and the Hilsa-Taklakot in Humla district (Shrestha, 2001). The pilgrimage transcends to holy Mt. Kailash and the adjacent lake *Mansarowar* via these routes are still used nowadays (Pandey, 1989).

Data Collection: Along the elevational gradient from 1800-3665 m asl, 141 quadrats were established following stratified random sampling. The distribution of quadrats in each elevational stratum was as follows: 17% (24) in 1800-2299 m asl, 30% (41) in 2300-2799 m asl, 44% (63) in 2800-3299 m asl and 9% (13) in > 3300 m asl. Of the total quadrats, 44 were laid in Baitadi and 97 in Darchula. Species data were recorded from nested quadrates. The quadrat size was 10 x 10 m for tree species, within which one 5 x 5 m quadrat was nested to record shrubs and two 1 x 1 m quadrats were laid to inventory herbs. The canopy-cover of each plot and abundance of trees, shrubs, and herbs, as well as the girth of trees at breast height, were measured. Plant height and basal diameter of trees (diameter at breast height) was measured using a dendrometer (Criterion RD 1000).

The elevation, slope and aspect in each 10 x 10 m quadrat were recorded using a global positioning system (Garmin ETrex 10). Canopy cover was visually estimated. The disturbance intensity was quantified subjectively by measuring frequency of open canopy (> 50%) and exotic species in the quadrats and evaluated on a scale of 0 (no impact at all) to 2 (presence of both) adapted from Metz (1997) and Miehe et al. (2015). Use-pressure was quantified by recording the frequency of firing, grazing, trampling trails and cutting/felling in the quadrats and scaled subjectively from 0 (no impact at all) to 4 (presence of all four factors). Additional data regarding distribution, use and management of plant communities and forest types were collected during informal meetings with communities.

Data Analysis: Density, frequency, basal area, abundance and their relative values were used for computing importance value index (IVI) following Mueller-Dombois & Ellenberg (1974). A canonical correspondence analysis (CCA) was conducted to identify plant communities (ter Braak & Smilauer, 2002) and to analyze their relationships with environmental variables, following Zhang et al. (2013). A fan shaped clustering dendrogram, based on presence/absence data, was elaborated to identify pattern and order of the sites using *ape* and *vegan* packages in R. In order to identify the cluster, the Euclidean distance was cut-off at > 20% following Gandiwa (2014) and Aigbokhan & Agianaku (2015). Three species diversity indices, for species richness (S), for species heterogeneity – Shannon-Weiner (H) and for species evenness – Pielou Evenness (E), were used to calculate diversity values as follows (Shannon & Wiener, 1949; Pielou, 1975):

$H' = - \sum pi \text{ Ln } pi$

where 'pi' represents the proportional abundance of the $\mathbf{I}^{th}$ species in the community.

$E = H'/\text{Ln } (S)$.

We used the value of nine variables (elevation, aspect, slope, solar radiation, aridity, precipitation, evapotranspiration, temperature and disturbance index) as environmental data and use-pressure as socioeconomic data of 141 quadrats for multivariate analysis for identifying the factors influencing the structure and composition of vegetation. The temperature and precipitation data were derived from Worldclim products (www.worldclim.org). We also calculated potential evapotranspiration following water balance model (Thornthwaite, 1948; Thornthwaite & Mather, 1955). Aridiy Index was estimated as the ratio of precipitation and potential evapotranspiration.

Results

Diversity and Distribution of Species: The patterns of species diversity were expressed as species richness and the Shannon-Wiener-Index was based on all 141 quadrats. Species richness varied from 8-34, the Shannon-Weiner index varied between 0.72 and 1.47 and the species evenness varied between 0.31 and 0.47. Tree density was less than 330 ha^{-}1. A total of 191 species from 166 genera and 87 families were recorded (Appendix H). Families Rosaceae, Asteraceae, Lauraceae, Ericaceae, Lamiaceae and Polygonaceae comprised of 19, 13, 6, 5, 5 and 5 species respectively. The genera with the highest number of species (4 each) were *Quercus*, *Rhododendron* and *Viburnum* and

3 each were *Ficus* and *Rubus*. The distribution of species was spatially varied. A total of 129 species from Baitadi and 126 from Darchula district with 63 common species was reported. There were 52 species of trees, 46 shrubs and 93 herbs including 60 useful species collected and utilized by local people for their livelihood. Twenty species out of 60 useful species were redundant in uses. We observed five useful species from Asteraceae and three from Rosaceae and Ericaceae each. Species *Abies pindrow* (Himalayan fir) and *Pinus wallichiana* (Blue pine) were the most frequent and densest with the highest IVI values (56.8 and 52.6 respectively). Species such as *Clematis montana* Buch.-Ham. ex DC*, Picris heiracoides* L.*, Polygonatum cirrhifolium* (Wall.) Royle*, Quercus semecarpifolia* Sm. and *Rumex nepalensis* Spreng. were distributed along the entire altitudinal range of study area (1,800~3,665 m) whereas *Toona serrata* (Royle) M. Roem (2,100-2,300 m)*, Taxus contorta* Griff. (2,500-3,000 m) and *Juniperus indica* Bertol. (3,500-4,100 m) were restricted within a narrow elevational range, affected the composition of forests.

Forest Types: Between 1,800 m asl and 3,665 m asl, we were able to report eight major types of forest along the elevational diversity gradient (EDG): Laurel forest, Oak-Laurel forest, Oak forest, Oak-*Rhododendron* forest, Laurel-Alder-Maple forest, Blue pine forest, Blue pine-Fir forest and Blue pine forest following a clustering fan shaped dendrogram (Table 3.1, Figure 3.2). This distinctly shows the ordination patterns for the eight clusters in the multidimensional space because of the differences in species richness and composition. Three clusters were exclusively present in each district and two were intermixed.

All forest types occurred under the ownership of national, protected and community forest systems. Other major forest types found in adjoining areas of study sites were tropical Sal (*Shorea robusta* Geartn.) forest along the Seti and Mahakali rivers of Baitadi, alpine Betula-Rhododendron scrub along tree line of Darchula, riverine forests below 1,000 m asl, etc. Between 1,000-2,000 m asl *Pinus roxburghii* Sarg. was dominant and at 1,500-2,500 m asl Oak forests appeared the most. Within 2,200-3,000 m asl, *Q. semecarpifolia* became dominant in Baitadi and *T. contorta* in Darchula district and then above 3,000 m asl *A. pindrow* interspersed with *P. wallichiana, Tsuga dumosa* (D.Don) Eichler and *Betula utilis* D.Don as moist temperate forest.

Table 3.1 Forest type, dominant species and their distribution

Plant community	Dominant species	Elevation range (field record) (m asl)	Number of quadrats (N=141)	District
Laurel	*Lindera neesiana, Ilex dipyrena, Quercus semecarpifolia*	1800-2500	11	Baitadi
Oak-Laurel	*Quercus semecarpifolia, Ilex dipyrena, Rhododendron arboreum*	1800-2700	4	Baitadi
Oak-*Rhododendron*	*Rhododendron arboreum, Quercus semecarpifolia, Lyonia ovalifolia*	2100-2400	5	Baitadi
Oak	*Quercus semecarpifolia, Berberis aristata, Lyonia ovalifolia*	2400-2800	9	Baitadi-Darchula
Laurel-Walnut-Alder-Maple	*Neolitsea pallens, Juglans regia, Acer campbelli, Alnus nepalensis*	1800-2600	35	Baitadi-Darchula
Blue pine – Fir forest	*Pinus wallichiana, Abies pindrow, Rosa sericea*	3000-3400	13	Darchula
Blue pine forest	*Pinus wallichiana, Berberis aristata, Abies pindrow*	3100-3400	23	Darchula
Fir forest	*Abies pindrow, Berberis aristata, Pinus wallichiana, Salix denticulata*	2700-3700	41	Darchula

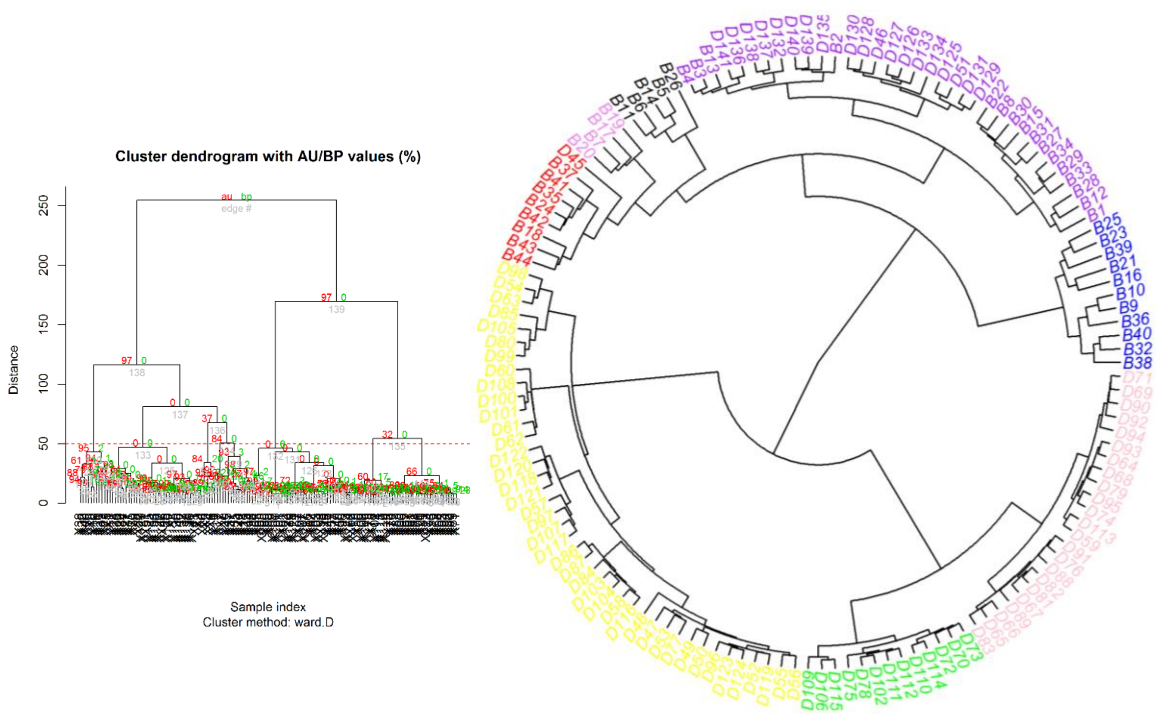

Figure 3.2 Ward and fan clustering dendrogram showing composition of forest types, sites and districts

Factors Influencing Forest and Vegetation: Canonical Correspondent Analysis ordination of 141 quadrats and 10 environmental and socio-economic variables was carried out to find out the major factor influence on the composition and structure of vegetation and forests (Figure 3.3; Appendix I). The Monte Carlo 999 permutation test indicated that the analysis was significant ($p < 0.01$). For the first 4 CCA axes, the eigenvalues were 0.0181, 0.0082, 0.0005 and 0.0001; the species–environment correlations were 0.665, 0.308, 0.018 and 0.003 and the cumulative percentage variance of species–environment relationship was 99.7%. The first CCA axis was significantly related to aridity, temperature, precipitation, evapotranspiration and elevation; and the second CCA axis to radiation, aspect, use pressure and disturbance (Table 3.2, Figure 3.3).

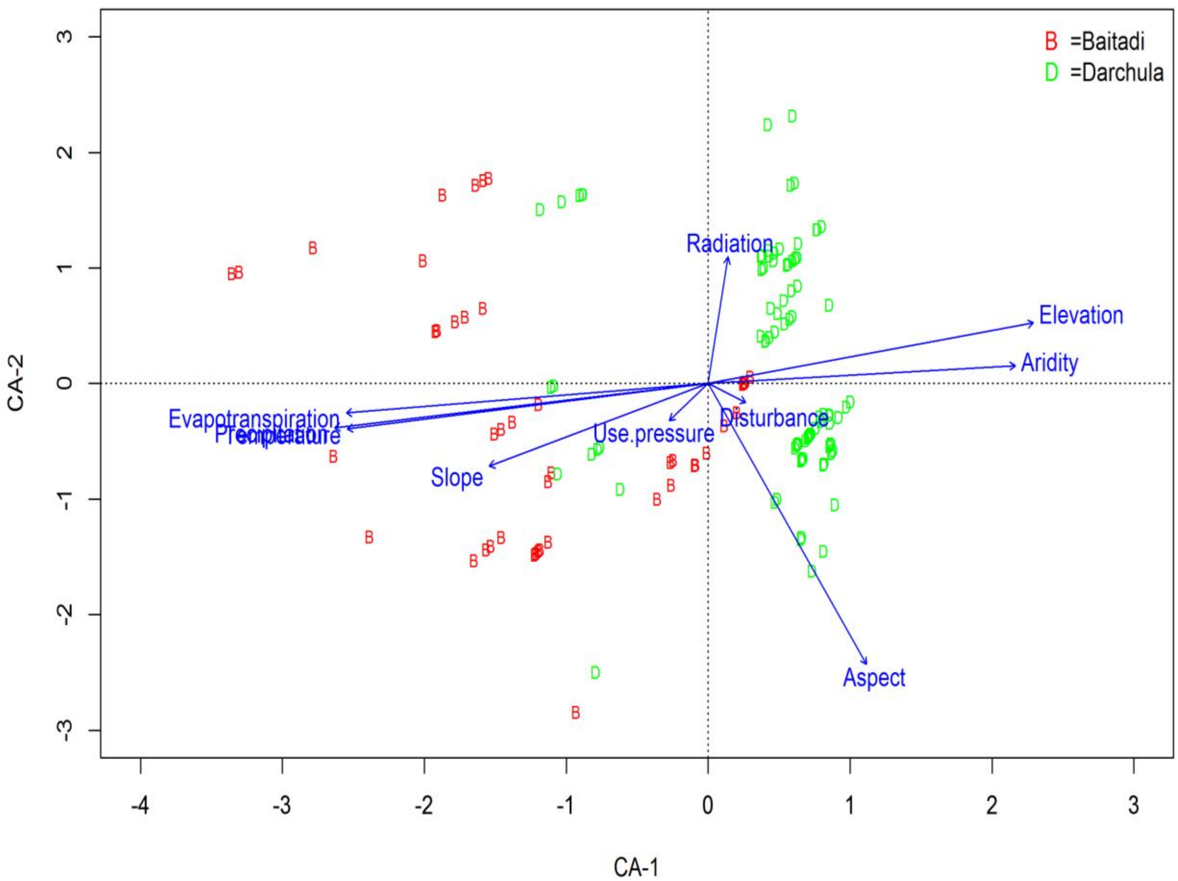

Figure 3.3 CCA ordination biplot of 141 quadrats and 10 variables in KSL, Nepal. B and D refer to the quadrats laid in Baitadi and Darchula district respectively. Plant communities in Darchula district are associated with high elevation and low temperature. Communities on the left occur in lower sites with higher temperature, precipitation and evapotranspiration. Communities in the central areas are in middle elevations associated with use pressure, disturbance and radiation.

Table 3.2 Coefficients of environmental variables with CCA axes (* significant)**

Variables	CA1	CA2	r2	Pr (>r)
Elevation	0.974	0.223	0.74	0.001***
Disturbance	0.853	-0.521	0.01	0.367
Aspect	0.417	-0.908	0.95	0.001***
Radiation	0.125	0.992	0.16	0.001***
Use pressure	-0.652	-0.758	0.02	0.199
Slope	-0.907	-0.420	0.38	0.001***
Temperature	-0.988	-0.151	0.88	0.001***
Precipitation	-0.989	-0.144	0.94	0.001***
Evapotranspiration	-0.995	-0.098	0.88	0.001***
Aridity	-0.997	0.071	0.63	0.001***

Some of the ten subject variables were significantly correlated with each other. Evapotranspiration, precipitation, aridity, slope and elevation for example were correlated (Table 3.3). Disturbance was insignificant to elevation and aridity increased with increasing elevation. Temperature, precipitation, evapotranspiration and slope decreased as elevation increased. Significant associations were recorded for precipitation, temperature, evapotranspiration and slope. Besides these, slope and elevation also showed important correlation (Table 3.3).

Table 3.3 Correlation coefficients of environmental and socio-economic factors

Factors	Slope	Aspect	Temperature	Precipitation	Evapo-transpiration	Aridity	Radiation	Disturbance	Elevation
Slope	1								
Aspect	-0.041	1							
Temperature	0.610*	-0.218	1						
Precipitation	0.620*	-0.253	0.984***	1					
Evapo-transpiration	0.479	-0.255	0.985***	0.975***	1				
Aridity	-0.286	0.189	-0.915**	-0.858*	-0.945**	1			
Radiation	0.078	-0.347	-0.088	-0.106	-0.114	0.117	1		
Disturbance	0.037	0.085	-0.098	-0.080	-0.108	0.143	-0.042	1	
Elevation	-0.575*	0.275	-0.648*	-0.731*	-0.626*	0.392	0.098	0.0493	1
Use pressure	0.169	0.093	0.191	0.159	0.175	-0.189	-0.005	-0.152	0.001

Significance level: *** high (> 0.95), ** moderate (0.90 - 0.95), * low (0.50 - 0.90)

We plotted species diversity and richness indices against the gradients of elevation, slope, temperature and aridity (Figure 3.4; Table 3.4; Appendix I). Based on the CCA and correlation analyses, they proved to be the significant variables affecting the vegetation and species distribution in study area; however, the R^2 is only about 10%. Both were found to have some relationships however, the elevation revealed the significant association (p 0.0003) with species richness. Aridity, temperature and slope were found significant (<0.001 – 0.003) for species diversity. Species diversity was found increasing and species richness decreasing as increasing elevation with R^2 <10% revealed the weak relationship.

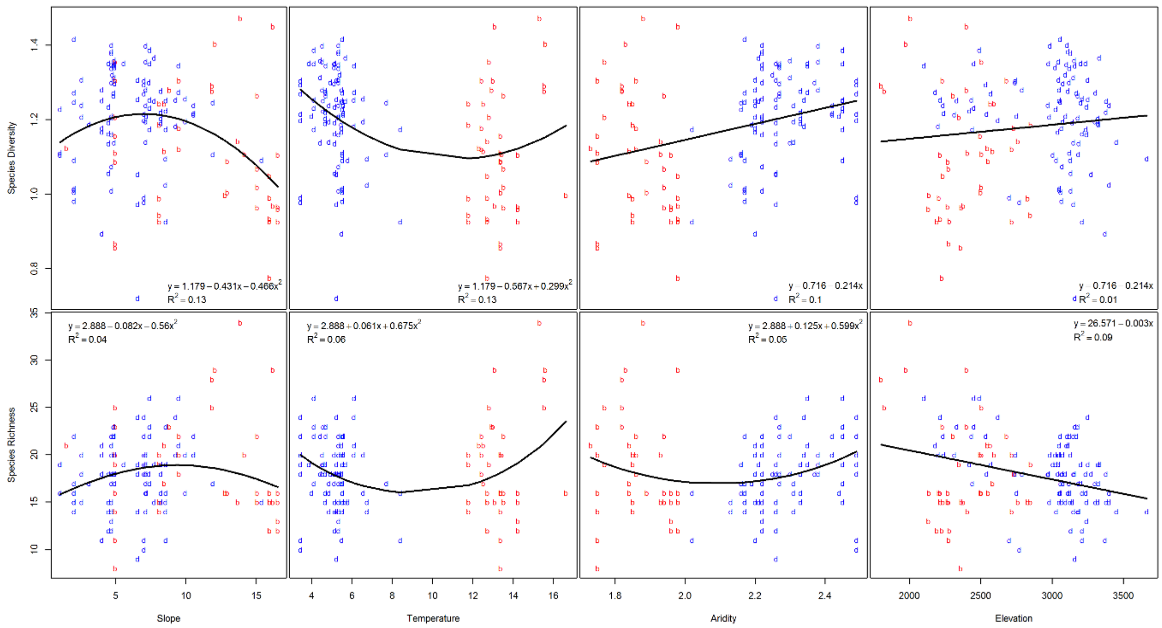

Figure 3.4 Changes in species diversity (above) and richness (below) along the gradients of slope, temperature, aridity and elevation in study area

Table 3.4 Correlation coefficients (p) and R^2 value of major environmental factors with diversity indices

Factors/Diversity indices	Slope	Temperature	Aridity	Elevation
Species diversity (H)	0.003 (13%)	<0.001 (13%)	<0.001 (10%)	0.209 (1%)
Species Richness (S)	0.73 (4%)	0.74 (6%)	0.57 (5%)	0.0003 (9%)

Forest Degradation and Management: Forest exploitation was common in study area where the landscape's slope is steep. A large number of communities of the districts depend heavily on local bio-resources of the area for livestock grazing, high-value medicinal plants, agriculture, religious and traditional rites, resulting in increasing pressures on local resources. The pattern was more intense in the mountainous areas (Darchula district) than in the hilly areas (Baitadi district), indicating that elevation and access are the factors of use. Snow-capped mountains above the tree line are valued as sacred sites whereas the alpine meadows, pastures and forests are regarded as assets for subsistence, livestock grazing and the collecting of high value medicinal plants like Himalayan caterpillar fungus - *Ophiocordyceps sinensis* (Berk.) G.H.Sung, Himalayan yew - *Taxus contorta,* Love apple - *Paris polyphylla* Sm., etc. *A. pindrow* and *P. wallichiana* forests were exploited for timber and medicinal plant collection. The households involved in *O. sinensis* collection in Darchula district gathered 140 kg in 1998 to 1,440 kg in 2004 (Chhetri & Lodhiyal, 2008) and 4,500 kg in 2008 (Pal, 2009) indicating the steady growth in commercial collection for getting quick economic return (Dadal, 2010) and high pressure to alpine pastures. Oak-Laurel forests were impacted by fodder and forage pressures. The forests of lower elevations were degraded by clear cutting for livelihood needs such as fuel-wood, fodder and clearing for agriculture. The extant forest fringes were further impacted by human use from the nearby human communities. Further environmental jeopardy is expected in the changed socio-cultural contexts.

Traditional rural activities such as the collection of forest plants for livelihood were affected by forest degradation attributed by dissents in altered distribution and productivity over time. Yet, the local level forest management was in place and the forests were conserved as community, national and protected forests. There are six types of forest ownership in the districts such as national, protected, community, leasehold, religious (sacred groves) and private. Indigenous forest conservation practices in study site Byash village of Darchula and adjoining villages of Sigas, Baitadi, were part of the early collaborative initiatives created to control the rampant deforestation by introducing a community forestry program in districts. Rotational cutting and selective thinning were the early forest management strategies.

Discussion

Species Diversity and Distribution: Species diversity was found to be increasing and species richness decreasing with increasing elevation (R^2 <10%), revealing a weak relationship. In mountainous regions, elevation shows the greatest effect in limiting plant species and community types (Chawla et al., 2008). Elevation change leads to changes in humidity, temperature and other factors that influence the variation of communities (Vittoz et al., 2010). Topographic gradients condensed over short elevational distances are capable of producing unique biodiversity (Loffler & Pape, 2008). The diversity values recorded for our study area lie within the reported range of 1.16 to 3.40 in the Himalaya (Kunwar & Sharma, 2004; Shah et al., 2009). Variations in species diversity are obvious in the landscape. The study area showed higher tree density (< 330 ha^{-1}) as compared to the density values (90 ha^{-1}) (Shaheen et al., 2012) and lower to that of the central Himalayan moist temperate forest (Chaturvedi & Singh, 1986). The basic reason for lower density is the unchecked cutting of dominant *A. pindrow* and *P.*

wallichiana, which are common useful species of the area. Any additional use pressure greater than the carrying capacity of the forest causes a proportional change in forest structure and composition, without any critical threshold of harvesting intensity (Cochrane, 2003). The species with multiple uses and narrow range distribution are at the verge of extinction because of persistent human disturbance and land-use and socio-cultural changes, resulting in jeopardy in vegetation composition. The ordination analysis showed that the species composition was more similar in Darchula.

Our findings can be compared with those of other studies from mountain valleys in the Himalayas, where plant families like Asteraceae, Lamiaceae, Poaceae, and Rosaceae were the most representative of the vegetation (Shaheen et al., 2011, 2012; Khan et al., 2015). Our study confirms Rosaceae with 19 species (10% of all species), Asteraceae with 13 species (7%), Lauraceae with six species (3%), Ericaceae, Lamiaceae and Polygonaceae with five species each (3%) and Poaceae with four species (2%). A number of graminoid species could be supported by grazing pressure (Loffler & Pape, 2008). Moerman (1979) suggests that there will be higher use reports and abundance of medicinal plants in a family with a larger number of species. Plant families Apiaceae, Asteraceae, Euphorbiaceae, Fabaceae, Lamiaceae and Ranunculaceae are considered as frequently medicinal (Moerman, 1979; Lewis et al., 2013).

We observed five useful species from Asteraceae, three species from Ericaceae, Fagaceae, Moraceae and Rosaceae each. Of the species rich genera, Quercus possessed three useful species and Rhododendron two. Of the seven highest IVI value species, six species *A. pindrow, P. wallichiana, Q. semecarpifolia, Drepanostachyum falcatum* (Nees) Keng f., *R. arboreum* D. Don*, T. contorta* were found useful, hinting at that more common a species was, more common was its usefulness. This appears in analogy to the fact that that a taxon with abundant species is often more useful, supporting the ecological apparency hypothesis which asserts that salient species are frequently be foraged (Thomas et al., 2009). Asteraceae and Rosaceae were found the most useful families in Gwallek, Baitadi district (Devkota & Karmacharya, 2003). Abundance and distribution of useful species was spatially varied i.e. out of 60 useful species only 44 were found in Baitadi and 38 in Darchula. The higher number of useful species in Baitadi district was attributed to its higher species richness of overall species and accessibility. Baitadi district is well known for the availability of useful plants (Bista & Webb, 2006). Thus, physiography and plant use influence forest and vegetation of an area (Klamn, 1985; Weckerle et al., 2006). The geographic isolation has facilitated the strengthening of unique biodiversity and indigenous knowledge of plant use (Garbyal et al., 2005a; Negi et al., 2017).

Interaction of Forest, Environmental and Socioeconomic Variables: The eight types of forest we reported were representative of the general vegetation in the landscape and conform to the earlier findings of that area (Lilleso et al., 2005; Elliott, 2012). Sacred landscape and a good number of groves (Bhatta, 2003) were associated with the diverse forest types of the region. The strong wisdom of faith on the local deities of sacred landscapes and grooves has played an important function in forest and biodiversity management. Chaudhary et al. (2010) estimated that there are 18 major forest types in the KSL-Nepal. Only eight types of forest (*Shorea robusta*, Riverine, *Pinus roxburghii*, *Alnus nepalensis*, *Aesculus-Juglans*, *Pinus wallichiana*, *Juniperus* and alpine meadow) were reported by Zomer at al. (2013) and five types (*S. robusta, P. roxburghii, Quercus* species, *P. wallichiana* and alpine scrub) by GoN (2014) from Darchula. Only four types of forest *P. roxburghii, Quercus species, Quercus-Persea* and *Quercus-Rhododendron* were reported from Baitadi (DFO, 2017).

Dominant species such as *A. pindrow, P. wallichiana, B. utilis, Q. semecarpifolia, R. arboreum*, etc. play important roles in patterning forests and vegetation in Darchula (Elliott, 2012). Darchula district is rich in forest types ranging from tropical humid hill Sal forest to alpine Nival pastures, meadows and Betula-Rhododendron scrub (Elliott, 2012) with a varied topography (Pant & Panta, 2004) however, the richness of species was low and that could be partially by their limited distribution range (MacArthur & Wilson, 1967; Gehrke & Linder, 2014). Thus, the pattern of vegetation is attributed to the effects of multiple environmental variables; elevation, disturbance, topography, and land-use on community composition and plant diversity. Vegetation patterns are determined by environmental factors that exhibit heterogeneity over space and time (Alexander & Millington, 2000). Variation in composition and assemblage of forest cover and vegetation was closely related to temperature, slope, aridity and elevation. The effects of elevation, aridity and precipitation on vegetation were significant, confirming the results of other studies (Lovett et al., 2006; Zhang et al., 2013). Temperature gradient directly associated with altitudinal and climatic variations of KSL influences diversity and distribution of vegetation (Mani, 1978).

The distribution of dominant species reflects vegetation differentiation and distribution along environmental gradients, such as the elevational gradient (Zhang & Ru, 2010). Elevation is one of the most important determinants of vegetation distribution in west Himalaya due to its direct impact on the micro-climate of the habitat (Singh et al., 2009). Although elevation, a proxy for temperature gradient, is the main controlling factor in species distributions, studies revealed that within a short vertical span other environmental factors like topography, aspect and exposure can also affect the forest composition by creating different micro-climates (Shank & Noorie, 1950).

High altitude and mountain ecosystems are in general more sensitive and vulnerable to environmental changes (Messerli & Ives, 1997). Elevation was found to be an important factor influencing management of vegetation and forest in KSL, substantiated by multiple environmental variables analysis. The change in diversity is a direct result of the interaction of elevation and human disturbance (Zhang & Dong, 2010). Aridity and temperature were also associated to influence the structure and composition of forest and vegetation. Because of its limited accessibility, the KSL has remained isolated in many ways from the rest of the world (Heim & Gansser, 1939). This can be seen in the variety of vegetation and forests.

The forests are important to local people as pasture for livestock, collection ground for medicinal plants and as praying grounds for pilgrims. The area is known for a variety of important plant species which are not only used for primary health care, but also highly valued in Nepali, Indian, Tibetan and Chinese systems of culture and markets (Garbyal et al., 2005a). West Himalayan moist temperate conifer dominant species like *P. wallichiana* and *A. pindrow* and broad leaf oak forest (*Ouercus* species) exhibit high economic and ecological value as they are directly linked with agriculture, fodder, fuel-wood, timber, resins, fruits and as a compost source while also promoting the mountain springs recharge (Valida, 1998).

A seventeen-year (1999-2016) overview on collection and trade data of medicinal plants from Baitadi and Darchula districts revealed a slight fluctuation in the number and quantity of species in trade over time (GoN, 2017) however, the species turnover was noticeable. The species most common in transition areas and disturbed forests were introduced over time (DFO, 2017). This indicates that indigenous species and distant forest are gradually being replaced by the species and sites of ruderal characteristics. This can lead to an increasing use of accessible and more available plants and sites resulting in forest degradation. The species with multiple uses (i.e. fire-wood, timber, medicine and fodder) have a higher demand, which intensifies the locals harvesting them, which subsequently increases the risk of overexploitation. Without sustainable harvesting, the species with redundant uses are at greater risk of population decline.

Forest Management: Forest degradation increased with enactment of Forest Nationalization Act, 1957, resulting in a short supply of fire-wood, fuel-wood, fodder and wood for building (Bajracharya, 1983). The extent of deforestation and degradation continued until 1970, which resulted in more than 50 % of the original forests disappearing or being converted into degraded scrub lands (Hill, 1999). The inefficient human use of the forests before the 1970s inhibited regeneration and trees reaching the mid-size class during the sampling period were relicts that regenerated by the chance (Timilsina et al., 2007). During late 1970s, the government of Nepal forcibly resettled a group of *Raute* (semi-nomadic group of people) from northern Darchula to Dadeldhura district (Fortier, 2009), deteriorating the integrity between forest and indigenous people. However, some local and indigenous forest management and religious fencings were in place in Byash, Huti and Pipalchauri (Darchula) (Chand & Wilson, 1987) and Kotgaun, Salena and Binashaun (Baitadi) (Chhetri & Pandey, 1992) to stop degradation. Far Western Nepal is rich in sacred grooves. The legacy of sacredness has been shown to have a major effect on culture and conservation due to the associated special precautions and restrictions on use (Khumbongmayum et al., 2005). As a result of limited human activity due to sociocultural taboos and prohibitions, sacred places frequently possess old-growth vegetation and many ecologically and socially valuable plant species.

Forest and vegetation cover improved since 1975 when the government shifted from protection-oriented use to conservation-focused wise use strategies (Ojha et al., 2009). Community forestry was formally instituted in 1979 and intensified after 1984 when the district forest offices were established. The first community forest in Baitadi was Bandasalani, handed over to community administration in 1992 (DoF, 2017). Until 2016, a total of 49,890 ha district forests of Baitadi had been handed over to 315 community forest user groups and 20,128 ha forest of Darchula to 228 groups for better management of forest. By 2010, the community managed forest cover was about 70% in Baitadi district and 35% in Darchula (Chaudhary et al., 2010). Human dimension of forest management was long considered a conservation suite in the remote places like KSL Nepal where the high-altitude sites are important to people as collection grounds for medicinal plants, pasture lands for livestock and praying grounds for pilgrims (Salick et al., 2014). Recently, Sigas protected forest was declared as a protected forest to conserve the biodiversity and culture of Sigas-dhura, Baitadi district (DFO, 2017).

In order to conserve forests and the typical culture of far-western Nepal (*Byashi*-*Shauka*), the northern part of Darchula has been declared as Api-Nampa Conservation Area (ANCA) (GoN, 2010). Social and cultural factors are essential elements of conservation of forests (Mcneely & Peet, 1985) have been long-rooted in Nepalese culture and are well appreciated in forestry management throughout Nepal (Klamn, 1985). Nonetheless, the forests of lower elevations and fringes were assaulted by human use from the nearby human habitations. Further jeopardy was expected in the changed contexts of population and land-use. The annual population growth in the districts (about 2%) was outpaced by the land-use change (forest cover loss 2.36%) (Kunwar et al., 2016). More than two thirds of the populations rely on forest products for their livelihoods (Manzardo et al., 1976). A continuous outmigration for menial work in India (Maharjan & Joshi, 2007; Poertner et al., 2011) and a greater percentage of absentee population of 7.51%, higher than the national average of 7.23%, clearly ruined the quality of local resources and knowledge. Families from the region have migrated to cities and lowlands, resulting in an accentuated decline in indigenous plants and forest management traditions (Farooquee & Saxena, 1996).

Conclusions

Baitadi and Darchula districts, a part of the Kailash Sacred Landscape, are rich in forests, vegetation and useful plant species and have long been associated with culture, physiography and indigenous management favorable for management of biodiversity of the area. The species diversity is a result of the interaction of elevation and human dimension. The collection and use of plants is influenced by species richness and accessibility and *vice-versa*. The biodiversity of study area is in great peril in the changed land-use and socio-cultural contexts. In the nexus of forest degradation and community based indigenous forest management; human dimension, elevation, and aridity of the area are found important for biodiversity and management. More participatory and community-based forest management interventions incorporating environmental, human, and conservation facets are deemed necessary. Integrated approaches acknowledging environmental and socio-cultural factors are therefore commendable in sustainable management of forest and vegetation in Baitadi and Darchula districts of KSL Nepal. We hope that the present study will provide a baseline for more detailed, complementary studies that focus on the effects of neighboring forest and vegetation types and distribution and dynamics plant species.

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INTERDEPENDENCIES OF PHYTOSOCIOLOGICAL INDICES AND USE VALUES: IMPLICATIONS FOR CONSERVATION IN KAILASH SACRED LANDSCAPE, NEPAL (SUBMITTED TO JOURNAL OF MOUNTAIN SCIENCE)

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Abstract

The present study explores the strategies by which people use plant resources in the context of availability of plants, accessibility of sites, and diversity of culture. We hypothesized that the most visible and accessible plants and sites are likely to be frequently foraged by people. The relationship was tested in Baitadi and Darchula districts of Kailash Sacred Landscape Nepal, using data from phytosociological studies and community interviews. We considered total use values (TUV), medicinal use values (MUV) and other use values (OUV) of plants for testing. Availability was assessed through using phytosociological indices whereas the accessibility was tested by the species use values in reference to spatial units (forest/non-forest areas, nearby/transition/distant areas, hill/mountainous district, Himalayan endemic/Pan-Himalayan/broadly distributed). We found a weak relationship between plant use values and plant availability and site accessibility. However, plant use value was influenced by diversity indices (Shannon diversity, species richness) and associated with cultural factors (specific products and sites, cultural preoccupancy and long rooted recognition) and varied at the level of use category. Higher MUV at Darchula district hinted that the knowledge of plant collection and use was less influenced by availability of resources and accessibility of sites and more dependent on quality of products and directed harvesting. Since plant apparency was not found to always be the most important factor, social and cultural factors appear to be more influential and help determine the nature of plant collection and use and aid in developing strategies for sustainable management.

Key words: Availability, apparency, access, plant use, conservation, Himalaya.

Introduction

Although there has been criticism on the use of ecological models in the analysis of human-nature relationship (Balee, 1989), ecological hypotheses about diversity, distribution and foraging of plant resources help explain the collection and use of plants in terms of ecological diversity (Begossi, 1996; Thomas et al., 2009). A half century ago, MacArthur & Pianka (1966) proposed the optimal foraging theory which predicted that the most productive areas with a high availability of plant resources (areas with higher energy) would have a larger amount of extraction events and would be more locally foraged, indicated by higher frequencies of plant use mentions

(Begon, 2006; Soldati & Alburquerque, 2012). The ecological apparency hypothesis (EAH) initially proposed by Feeny (1976) and Rhoades & Cates (1976) for herbivory studies hypothesizes that the visibility or apparency of the plant helps increase the overall collection and uses (Moerman, 1991; Lucena et al., 2007). Thus, it is hypothesized that the apparent species and sites are frequently foraged.

The apparent plants are woody, those easily visible due to their size (trees, shrubs, and large herbs) or life cycle characteristics (perennials) (Albuquerque & Lucena, 2005). To test this adapted hypothesis, Phillips & Gentry (1993a, 1993b) developed a quantitative measure of plant use, use value (UV), that attempts to measure the relative importance of a species to a human population based on diversity and distribution of plants. They stated that the local availability of a resource is linked to its relative importance to a given community. The apparent plants are expected to feature more strongly in local botanical knowledge, i.e., the largest, most dominant, and most frequent plants should have the highest use values, not because they are necessarily intrinsically more useful, but simply because they are more available or visible to human communities (Phillips & Gentry, 1993a, 1993b). Higher use values of plants could partly be a reflection of higher abundance in a given area and thus are more likely to be favored for collection than those that are rarely encountered (Giday et al., 2003).

Analogous to EAH, Moerman (1979) proposed a theory of non-random medicinal plant selection and suggested that there will be higher number of medicinal (useful) plant species in a family that has a larger number of species. Plant families that have more general species will be expected to have more useful species, including those used for medicine. Thus, the role of ecological processes and patterns in determining and responding to human use of plants is important (Salick, 1995). Begossi (1996) proposed the application of diversity indices to evaluate the diversity of plant uses. If the area is diverse in plant species, the use of plants is heterogeneous and if the area is less diverse the ethnobotany is less heterogeneous. It is often hypothesized that there exists a positive correlation between plant use/knowledge and plant density, diversity and habitat diversity (Bennett, 1992). It is also assumed that the number of species in a site should correlate with the number of plants collected and used by a community if random selection of plants is the underlying mechanism (Kindscher et al., 2013).

Most studies testing the ecological hypotheses through plant use values have been undertaken in humid forests, while the dry and semi-arid forests of the Himalayas have received little attention (Salick et al., 1999; Garbyal et al., 2007). We believe that a better understanding of ecological patterns that influence such phenomena can improve knowledge about plant management processes and the dynamics of plant resource use and conservation. Within this context, the overall objective of this study is to analyze the relation between usefulness of plants and their ecological importance in the Kailash, a sacred transboundary Landscape of Nepal, India and China. Thus, the principal aim of the present study is to analyze the local use and knowledge of plants to test the hypothesis that a plant's relative importance, measured by its UV, is related to its apparency. Specifically, our objectives were to (1) test whether there is an association between the usefulness of plants, proxied by their UV and phytosociological indices (relative frequency, relative density, relative abundance, IVI, Shannon-Weiner diversity index, species richness, total plants in each quadrat, family importance value, family use value), (2) analyze different patterns of association of UV across different plant forms (herbs, shrubs and trees), and (3) evaluate the use value and accessibility proxied by spatial units (forest/non-forest areas, nearby/transition/distant areas, hill/mountainous district, Himalayan endemic/pan-Himalayan/cosmopolitan). Information regarding phytosociological indices was derived from floristic studies in two different districts: one was the mountainous Darchula district with remote and relatively inaccessible areas and the other a hilly Baitadi district with relatively easy access.

Study Area - The Kailash Sacred Landscape: Our study area (Figure 4.1) stretches between 29º 22' - 30º 15' N and 80º 15' - 81º 45' E and 457 to 7132 m asl (meter above sea level) altitude consists of Baitadi and Darchula districts of far western Nepal. The area represents the southern part of the Kailash Sacred Landscape (KSL) and borders China in the north and India in the west. Numerous sacred high-altitude lakes and snow-covered mountains across the three countries characterize the KSL. The holy Mt. Kailash and the sacred Lake *Mansarowar* are the most important of these, and have been pilgrimage destinations for followers of Hinduism, Buddhism, Jainism, Sikhism, and Bon for several millennia (Zomer et al., 2013). Much of the area consists of dry, steep, semi-arid and rugged terrain, and only 7-21% of the districts is suitable for farming (Kunwar et al., 2012), resulting in regular food deficiencies (UNWFP, 2006). Because of its limited accessibility, the KSL has remained isolated in many ways (Garbyal et al., 2007). Situated south of the landscape, the hilly region (pahad) is highly populated and agriculture is a major form of livelihood. Forest types of the districts range from tropical Sal (*Shorea robusta* Gaertn.) forest to alpine Betula-Rhododendron scrub (Elliott, 2012) to steep, rugged and snow-covered nival zones. The bio-climate ranges from sub-tropical in the Baitadi district to alpine in the higher reaches of the mountainous Darchula district (Lilleso et al., 2005; Chaudhary et al., 2010). Upper Darchula district is originally known for growing amaranth (Balick & Cox, 1996) and is a part of the relict hemp culture (Clarke, 2007). More than two thirds of the populations still rely on indigenous livelihood strategies such as animal husbandry, transhumance, seasonal crop production and collection, and the use and trade of medicinal plants (Manzardo et al., 1976). The area is popularly known for a variety of medicinally important species which are not only used for primary health care, but also highly valued in Nepali, Indian, Tibetan and Chinese systems of culture and markets (Garbyal et al., 2005).

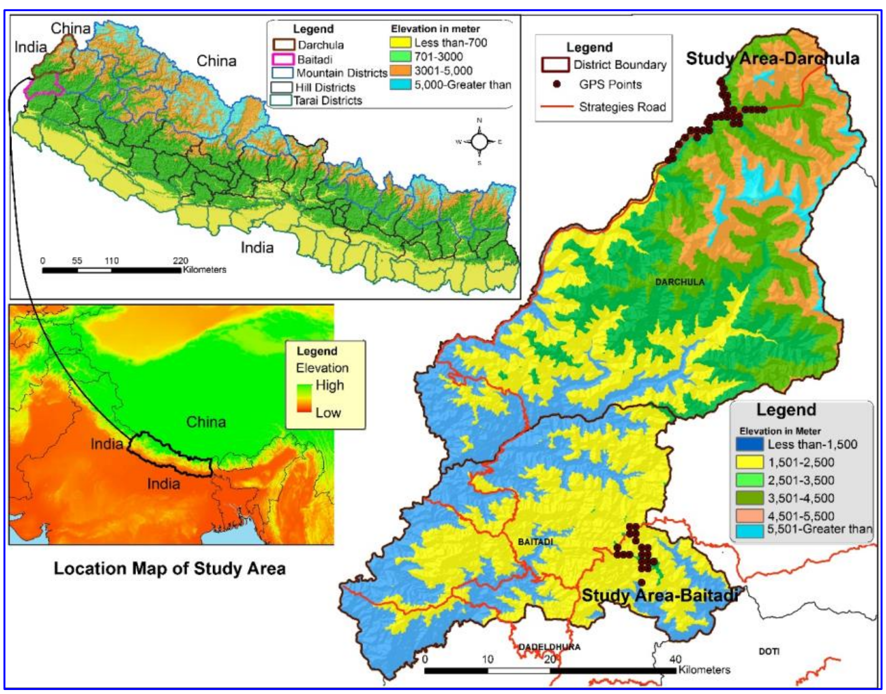

Figure 4.1 Study area map showing GPS points of ecological inventory

Methods

Vegetation Survey: Plant use knowledge and availability data were collected from phytosociological studies and interviews. A total of a 1.41 ha area was surveyed by laying 141 macro quadrats measuring 10x10 m^2 in Sigas forest of Baitadi district and Byash forest of Darchula district. One 5x5 m^2 meso-quadrat and two 1x1 m^2 micro-quadrats were nested within the macro quadrat to quantify the herbs and shrubs. Data were used to calculate phytosociological parameters (frequency, density, abundance and their relative values (IVI) following Mueller-Dombois & Ellenberg (1974) and diversity indices (Shannon diversity index – H and Species Richness – S). Expressed as a percentage, the relative density (RD) was calculated as the number of individuals of a given taxon in relation to the total number of individuals surveyed. The relative frequency (RF) was calculated based on the percentage of absolute frequency in relation to total frequency, which represents the sum of all absolute frequencies. Abundance is the relative representation of a species in a particular ecosystem. It is usually measured as the number of individuals found per sample. The relative abundance (RA) represents the percentage of absolute abundance in relation to the sum of absolute abundances of all taxa encountered. The importance value index (IVI) is a synthetic index for classifying species that combines their frequency, density, abundance, and relative values into a single value and is used in this work as an indication of their local availability. The IVI was calculated by using the following equation; IVI = RD + RA + RF (Mueller-Dombois & Ellenberg, 1974).

Sample Community: After plots were inventoried, we collected ethnobotanical data through interviews and snowball sampling. The sample community of Darchula district Byashi or Sauka is semi-nomadic (Atkinson, 1980), agro-pastoral and migratory, depending heavily on bio-resources of mountain area for livestock grazing, high-value medicinal plants collection and religious and ritual ceremonies. The Byanshi people are occupational traders of medicinal plants (Manzardo et al., 1976), who sell their products to the lowland groups of Nepal, India and China. The sample community of Baitadi district was composed of sedentary farmers and villagers including hill caste/ethnic groups Kshetri, Brahmin and Dalit. Agriculture, business, medicinal plant collection and trade and traditional healing are major occupation in Baitadi. The sample participants of the communities were selective, i.e. only traditional healers and or medicinal plant collectors and elderly people ages > 60 years (40-102 yrs) were interviewed after obtaining oral prior informed consent. Once a traditional healer/plant collector was identified, snowball sampling led the researcher to locate and identify peer respondents. To validate the sampling, a healer/plant collector list from earlier studies (Kunwar et al.; 2013, 2015, 2016) was referenced.

Ethnobotanical Survey: Ethnobotanical data were collected using semi-structured interviews (Annex D2). These interviews were carried out in three field visits between February 2017 and September 2017. The duration of each trip lasted about a month. A total of 100 participants (57 from Baitadi and 43 from Darchula) were interviewed. The interview form (Albuquerque & Lucena, 2004) included questions concerning the informants' knowledge about the three most important plants for their culture, primary health care, and livelihood category, and then ranking each species within the categories (score 3 as most important, 2 as moderate and 1 as general) for a particular use (Gomez-Beloz, 2002). Interviews were conducted individually whenever possible in an attempt to avoid any direct influences from third parties and to assure that the data supplied by the informants were as direct and reliable as possible (Phillips & Gentry, 1993a). Interviews were supplemented with other investigative techniques, such as participant observation and guided tours (Albuquerque & Lucena, 2004). Interviews were facilitated by a male local assistant and a female research assistant in each district. Baitadi was sampled first because it was on the way to Darchula. Darchula was visited only after April when the snow receded and local people ascended to the higher elevations. Interviews were somewhat limited, however, because the medicinal plant collectors of the district headed to the alpine pastures (> 3,600 m) to collect one of the high value medicinal plants Himalayan caterpillar fungus (*Ophiocordyceps sinensis*) in May. Both on spot and post-collection selling of medicinal plants are common. Thus the geo-ecological constraint and busy life aggravated by limited accessibility and accommodation was a major factor in Darchula affecting intensive research (Heim & Gansser, 1939; Manzardo, 1977). While participating in guided tours, we collected voucher specimens of all species that could not be identified in the field, which were processed, identified and deposited at the plant laboratory and herbarium (KATH) in Godawari, Nepal for future reference.

Data Analysis: Matching information from at least three respondents was considered a common response for quantitative analysis (Reyes-Garcia et al., 2006). To show the relative importance of a species, use values (UV) calculated by two different techniques (UVp – Phillips & Gentry (1993 a) and UVL – Lawrence et al. (2005) were employed. The UV is a combination of versatility (the number of distinct uses mentioned for a species) and popularity (the number of people who recognize a species as being useful) (Philips & Gentry, 1993 b). The Use Value (UVp) for each species was calculated by dividing the sum of all reports of its use by the total number of people interviewed (Phillips & Gentry, 1993 a). UVL was calculated based on rank score of species. UV by category (total, medicinal and non-medicinal (others)) of use for each species was calculated by dividing the total reports of the species in a particular category by the total number of people interviewed.

We tested apparency by using both availability and accessibility of plant species. The former was tested applying the phytosociological indices such as relative density, relative frequency, relative abundance, IVI, species richness and diversity index. The accessibility was tested by the use value of species with spatial units (forest/non-forest areas, nearby/transition/distant areas, hill/mountainous district, Himalayan endemic/Pan-Himalayan/broadly distributed). For precise interpretation we used the totals from the differential use, medicinal and a category labeled as “other.” All the non-medicinal uses mentioned by study participants such as fuel, fodder, forage, wood, use for cattle, use for culture and ritual were grouped together in “other” category. The IVI of a species is considered a good indicator of apparency because it provides composite information on frequency, density and abundance of a species, and therefore it can also account as the salient feature of a species (Thomas et al., 2009; Soldati et al., 2016). Therefore, we used IVI and its associates for analysis of association of plant usefulness, availability and distribution. Coefficients of Spearman correlation, Kruskal-Wallis test and simple regression analyses (Moerman, 1979) were used to evaluate the statistical significance (Sokal & Rholf, 1995).

Results

Density, Diversity and Distribution of Plants: A total of 191 plant species including 166 genera and 87 families were reported from 1.41 ha sample forest (Appendix H). The plant family Pinaceae was the most dominant family with the highest IVI value (124.69) followed by Rosaceae (78.04). Other dominant families based on IVI were Lauraceae, Asteraceae and Poaceae. Rosaceae was the family with the highest species richness (19 species) (Table 4.1). IVI was highest for Abies pindrow followed by *Pinus wallichiana, Daphne bholua, Quercus semecarpifolia* and *Arundinaria falcata* at species level. *A. pindrow, P. wallichiana* and *Berberis aristata* were the most frequent species in order. *P. wallichiana, A. pindrow* and *D. bholua* were the species with the highest density in the order listed. Out of 6,226 individuals in 191 quadrats, 530 (8.5%) stands were from *P. wallichiana* and 513 (8.23%) from *A. pindrow*, resulting as the most frequent and highest density species in study area.

Table 4.1 Dominant plant families and species in study area

Family	IVI	Species	IVI
Pinaceae	124.69	*Abies pindrow* Royle	56.81
Rosaceae	78.04	*Pinus wallichiana* A.B. Jackson	52.08
Lauraceae	54.15	*Daphne bholua* Buch.-Ham ex. D. Don	20.06
Asteraceae	46.59	*Quercus semecarpifolia* Sm.	19.01
Poaceae	41.54	*Drepanostachyum falcatum* (Nees) Keng f.	18.15
Fagaceae	38.91	*Rhododendron arboreum* Sm.	18.14
Ericaceae	34.19	*Taxus contorta* Griff.	15.08

Diversity in quadrats varied between 8 and 34 (mean 17.44±4.32) alpha diversity (i.e. species number or richness), whereas the Shannon diversity values ranged between 1.78 and 2.64. The total number of individual plants, 6,226, sampled from all of the quadrats, varied between 14 and 101 (mean 41.14±16.52) in each quadrat. Phytosociological study showed that there are 129 species in Baitadi and 126 in Darchula consisting of 63 common species.

Usefulness of Plants: A total of 122 useful plant species from 64 families including 102 from Baitadi and 92 from Darchula were reported in our ethnobotanical survey. Poaceae was especially rich with eight useful species, followed by Moraceae (seven), Apiaceae (six), Asteraceae (five), Fabaceae (five), and Fagaceae, Rosaceae and Urticaceae (four each). Families with the highest TUV were Poaceae (0.95), Fagaceae (0.93), Apiaceae (0.92) and Rosaceae (0.88) (Figure 4.2) (Appendix K). It was observed that *Swertia chirayita, Bergenia* *ciliata* and *Paris polyphylla* achieved the highest medicinal use value (MUV) 0.60, 0.57, and 0.52 respectively. The highest non-medicinal use value (OUV) was reported for *Prunus cerasoides* 0.53, *Quercus lanata* 0.51, and *Abies pindrow* 0.35. It shows that different species are used for different use categories and sometimes; a species also has multiple use values. The species with multiple uses are at the verge of extinction because of persistent human disturbance and landuse change. If we consider use value > 0.5 as a cut-off for evaluating the knowledge of consensus (Vandebroek, 2010), then only five species *Q. lanata, S. chirayita, B. ciliata, P. cerasoides,* and *P. polyphylla* had > 0.5 total use values (Table 2). The average TUV (0.11±0.011) shows that the value was less varied and the *B. ciliata, P. polyphylla* and *S. chirayita* were used medicinally for both districts, whereas *A. pindrow, A. archangelica* and *Q. lanata* were predominantly used in Baitadi district. The uses varied based on availability and cultural factors.

Table 4.2 Species with higher use values, frequent citations and higher rank scores

Species (Family)	**Total**		**Baitadi**		**Darchula**		**Use value**		
	# people mentioned, reports	Rank score	# people mentioned, reports	Rank score	# people mentioned, reports	Rank score	MUV	OUV	TUV
Swertia chirayita (Gentianaceae)	54 (63)	122	30 (37)	67	24 (26)	55	0.60	0.03	0.63
Quercus lanata (Fagaceae)	37 (62)	115	34 (58)	108	3 (4)	7	0.11	0.51	0.62
Bergenia ciliata (Saxifragaceae)	55 (61)	108	36 (42)	70	19 (19)	38	0.57	0.04	0.61
Prunus cerasoides (Rosaceae)	46 (57)	127	36 (47)	107	10 (10)	20	0.04	0.53	0.57
Paris polyphylla (Melanthiaceae)	50 (54)	105	23 (27)	57	27 (27)	58	0.52	0.02	0.54
Angelica archangelica (Apiaceae)	37 (39)	76	7 (9)	15	30 (30)	61	0.37	0.02	0.39
Abies pindrow (Pinaceae)	35 (35)	79	31 (31)	72	4 (4)	7	0.00	0.35	0.35

There is a high correlation coefficient (0.98) between the use values calculated for the species, using two different techniques (UVP and UVL). Species therefore tend to have the same relative importance. Of the 10 most important plants identified in this study, ordered by UVP and UVL, nine species were common to both use value techniques: *S. chirayita, Q. lanata, B. ciliata, P. cerasoides, P. polyphylla, A. archangelica, A. pindrow, Ficus religiosa* Linn. and *Chrysopogon aciculatus* (Retz.) Trin. (however, their order was different). The top tenth species in UVL was one of the important forage species (*Polygala abyssinica* R.Br. ex Fresen.) whereas that of UVP was medicinal *Neopicrorhiza scrophulariflora* (Pennell) Hong.

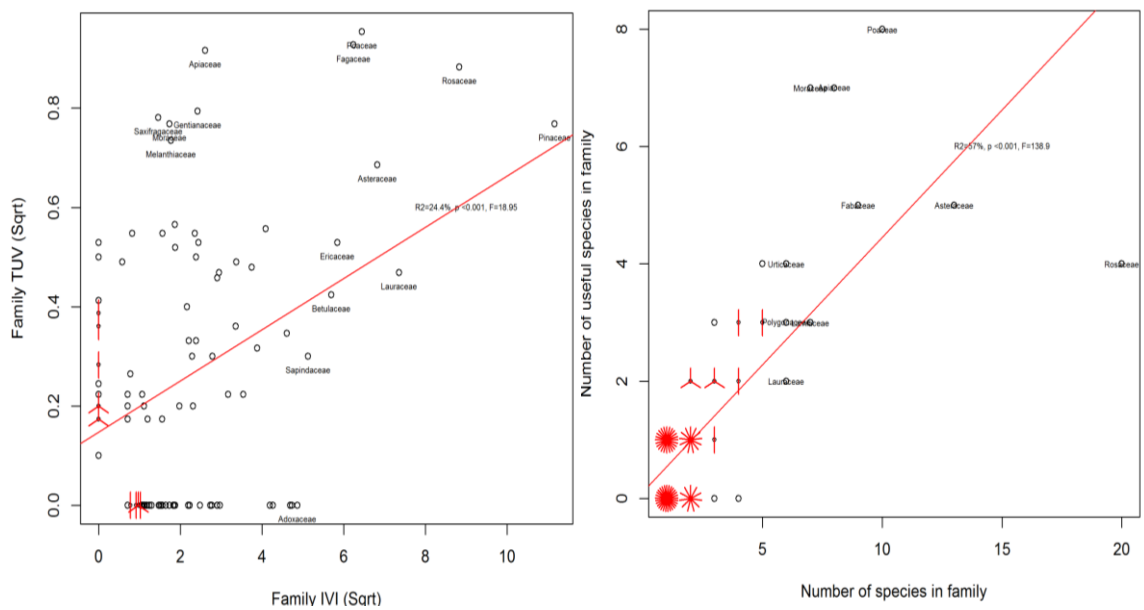

Figure 4.2 Sunflower plot of family importance value and use value (a, left) number of plants and useful plants in family (b, right)

Plant Use Value and Vegetation Index: We found a weak and nonexistent relation between vegetation (IVI) and use value (TUV and UVL) (Table 4.3). However, the subsets of use value and vegetation index were associated. Medicinal use value (MUV) was indifferent to the vegetation indices whereas the non-medicinal use value (OUV) was positively associated. IVI was strongly associated with OUV. Among the variables of vegetation index, abundance and frequency were strongly associated. However, the plant use value was less explained ranged between R^2 (0-16) (Figure 4.3 A-H). We evaluated the diversity indices (species richness and Shannon diversity) and usefulness of plants, which showed that the plant use value was moderately associated (p = 0.14-0.001) with R^2 explanation (1.4-45%) (Figure 4.4).

Table 4.3 Correlation coefficients between use values and vegetation indices

Vegetation indices	TUV			MUV			OUV			UVL		
	F	***p***	**R^2**	**F**	***p***	**R^2**	**F**	***p***	**R^2**	**F**	***p***	**R^2**
Rel. Frequency	1.33	0.25	0.1	1.43	0.23	1.1	8.93	0.003**	6.9	2.4	0.12	1.9
Rel. Density	1.28	0.25	1	1.17	0.28	0.9	7.9	0.005**	6.2	2.26	0.13	1.8
Rel. Abundance	2.45	0.11	2	0.89	0.34	0.7	11.08	0.001***	8.5	2.8	0.09	2.3
IVI	0.42	0.5	0.7	2.4	0.12	4	11.19	0.001***	16	1.03	0.31	1.7

** Moderately significant, *** Strongly significant

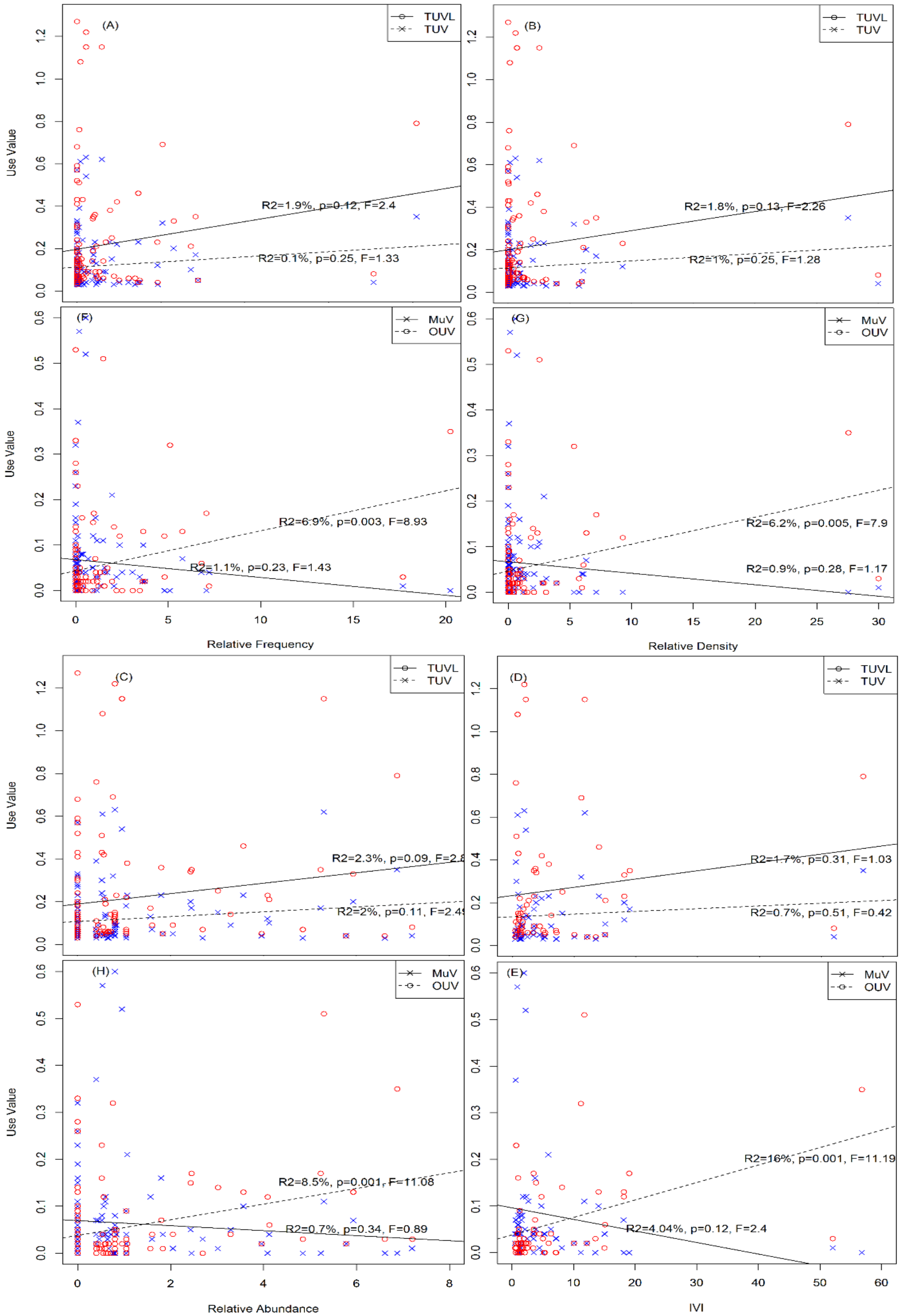

Figure 4.3 Plant use values and diversity indices (A-H)

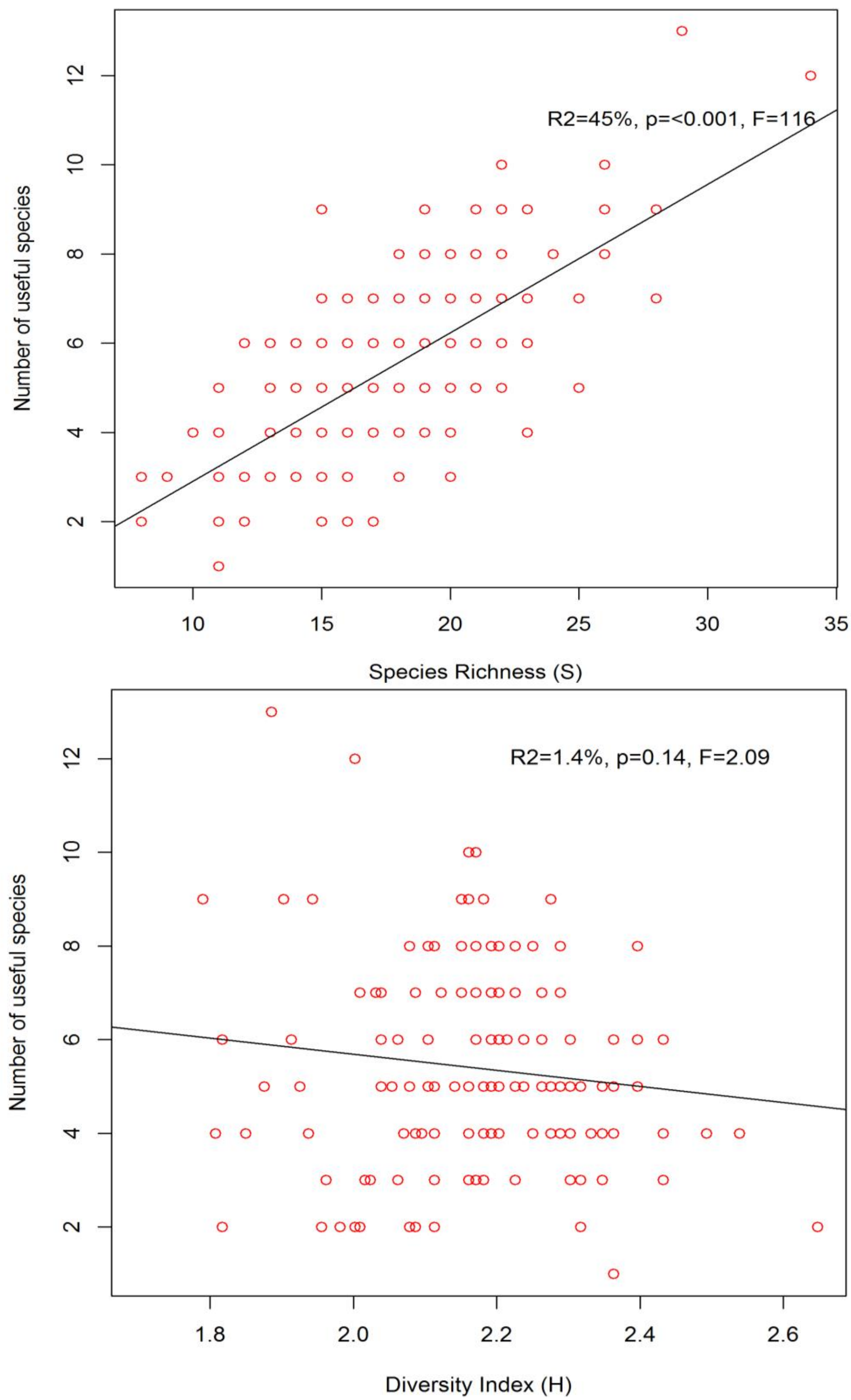

Figure 4.4 Plant use values and diversity indices

Plant Use Value, Availability and Accessibility: Availability was tested looking at whether or not the use value of apparent plants (trees and perennials) is higher. We partially rejected the null hypothesis and found that apparent trees were valued only for OUV (*p* <0.001) whereas the herbaceous annuals were used for medicinal uses (*p* <0.001) (Table 4.4). The distant forest areas and wild and quality products were always considered the first priority in which people chose to forage. However, we did not find a significant difference on plant use values between the variables of accessibility (variables ii-iii, Table 4.4), neither the distribution of species (iv-v) exhibited the difference (*p* = 0.05-0.81) (Table 4.4). MUV was associated with distant areas however; the significance level was low (*p* = 0.25-0.25). Only the species found in study quadrats (forest) (variable i), plant forms (variable vii) and type of nurture (variable vi) were found significant in contributing higher use values (Table 4.4).

Table 4.4 Kruskal-Wallis test based on relationship between plant use values and their distribution, origin and form

Variable (number of species n)	TUV		MUV		OUV	
i. Species found in forest quadrats (63)	0.14		0.08		0.06	
i. Species found outside forest quadrats (59)	0.08		0.04		0.04	
Kruskal-Wallis test	*H = 7.99*	*p = 0.004***	*H = 5.41*	*p = <0.019**	*H = 3.55*	*p = 0.059**
ii. Distant/forest (62)	0.12		0.07		0.04	
ii. Moderate/transition land (38)	0.10		0.06		0.04	
ii. Nearby/farm lands (22)	0.12		0.04		0.08	
Kruskal-Wallis test	*H = 0.17*	*p = 0.70*	*H = 2.75*	*p = 0.25*	*H = 1.30*	*p = 0.51*
iii. Baitadi (hilly district) (102)	0.157		0.09		0.13	
iii. Darchula (mountainous district) (92)	0.130		0.12		0.075	
Kruskal-Wallis test	*H = 1.27*	*p = 0.27*	*H = 3.78*	*p = 0.05**	*H = 0.90*	*p = 0.34*
iv. Elevational span <1000 m (32)	0.12		0.06		0.06	
iv. < 2000 m (67)	0.11		0.06		0.04	
iv. > 2000 m (23)	0.05		0.05		0.01	
Kruskal-Wallis test	*H = 0.05*	*p = 0.81*	*H = 0.62*	*p = 0.42*	*H = 2.73*	*p = 0.09*
v. Himalaya endemic (77)	0.12		0.06		0.05	
v. Pan-Himalaya (29)	0.10		0.04		0.05	
v. Broadly distributed/cosmopolitan (16)	0.11		0.08		0.03	
Kruskal-Wallis test	*H = 0.35*	*p = 0.83*	*H = 2.95*	*p = 0.22*	*H = 2.8*	*p = 0.24*
vi. Cultivated (18)	0.11		0.02		0.09	
vi. Wild, non-cultivated (56)	0.09		0.06		0.03	
vi. Species cultivated and wild collected (48)	0.14		0.08		0.05	
Kruskal-Wallis test	*H = 5.65*	*p = 0.05**	*H = 12.28*	*p = 0.002***	*H = 2.81*	*p = 0.27*
vii. Herbs/annuals (48)	0.13		0.11		0.02	
vii. Shrubs (29)	0.07		0.04		0.02	
vii. Trees/Perennials (45)	0.12		0.02		0.10	
Kruskal-Wallis test	*H = 6.19*	*p = 0.045**	*H = 20.84*	*p = <0.001****	*H = 36.62*	*p = <0.001****

* Low significant, ** Moderately significant, *** Strongly significant

Discussion

Plant Biodiversity and Ethnobotany: By combining the species from community interviews and phytosociological studies, a total of 255 species including 122 useful from 105 families was reported with the highest number of species (20) from Rosaceae, 13 from Asteraceae and ten from Poaceae (Appendix K). Of about 1,265 plant species recorded from western Nepal (Rokaya et al., 2012) and about 50% are subject to traditional use (Kunwar & Bussmann, 2008), we were able to catalogue about 25% of the plant species of western Nepal with about 50% useful species from study area. This account indicates that the study area is rich in both forest flora and useful flora. Out of 122 useful species, 60 were recorded only from quadrats laid in forests. In addition, another 19 useful species were forest based, totaling 82 (67%) useful species, which were collected from forests (Appendix J). Higher use values of species from the distant areas are related to the fact that those species are well recognized culturally in that area even though they are less apparent and accessible. However, the collection was differential on use values. Of the top seven useful plants, four were sought for medicinal uses whereas the other three for socio-cultural uses (Table 4.2). *P. cerasoides* was culturally valued for rites whereas *Q. lanata* as fodder and *A. pindrow* for wood and fuelwood. Since modern medicine is limited in the study area (Kunwar et al., 2016), utilization and management of local and distant plants as ethnomedicinal was long rooted and central to combatting diseases and ailments.

Plant Family Importance Value: Plant availability was tested by employing family indices. Lucena et al. (2007) stated that the single most important factor in determining the usefulness of a plant species is its family. Families with the highest TUV were Apiaceae (0.95), Fagaceae (0.86), Poaceae (0.81) and Rosaceae (0.78) whereas, the families with the highest number of useful species were Apiaceae, Poaceae and Moraceae with seven species each and Asteraceae and Fabaceae with five species each (Figure 4.2a). Since we observed the higher importance value and use value of the same families, we obtained a strong correlation between them (p < 000.1, R^2 = 24) (Figure 4.2a). The number of useful plant species in a family was also positively linked to the number of species in that family (p < 000.1, R^2 = 57) (Figure 4.2b), consistent with the findings of Moerman (1979): family with abundant species emerges with abundant useful species. We also observed the higher TUV of less abundant families Apiaceae, Saxifragaceae, Melanthiaceae, Gentianaceae and Moraceae. We argued that the role of cultural factors led to finding linkages of less abundant species with high use values. Therefore, other values associated with ethnography, culture and history might also play role in discerning the patterns of plant collection.

Plant Use Value and Availability: Use value was ranged from less than one, inferring that the species of the area were appeared less versatile and less convergent in uses in two sample districts. The most species with low use-values was frequently observed (Phillips & Gentry, 1993a; Torre-Cuadros & Islebe, 2003). Each species was valued for a specific use and the ethnobotany of the area was restricted and heterogeneous. The biodiverse area is featured with heterogeneous use values (Begossi, 1996), hinted that the area is rich in biodiversity and ethnobotany. Diverse use value of the study area was well explained by higher R^2 (20-24) % and significant p coefficients <0.001. It is also plausible that human communities that inhabit ecosystems rich in species use different species (Salick et al., 1999; Ladio & Lozada, 2004) to diversify their repertoire, resulting in diverse knowledge of ethnobotany.

Neither UVL nor TUV revealed the strong positive association with IVI however, the association was significant at level of subsets of use category and phytosociological index (Figure 4.3 A-H). Nonexistent relations between IVI and plant use values were reported by Torre-Cuadros & Islebe (2003) and Albuquerque & Lucena (2005) from the dry Caatinga forest, Brazil. It is therefore reasonable to assume that if the use pressure is directed to the species of less IVI, then the resource scarcity and biodiversity conservation could be aggravated. Thus the study of plant use is always helpful in developing strategies for conservation of plants and forests (Sanchez-Azofeita et al., 2005). The pattern of plant use may change depending on the use (categories) that informants attribute to each species in the region. Because of this reason, it has been observed that the only other use values (OUV) (or nonmedicinal values) have been significantly correlated ($p < 0.001$) with all subsets of vegetation index (RF, RD, RA and IVI) yet, the R^2 explanation was low (< 16%) (Table 4.3). This indicates that although the availability is important for certain category of uses, it is not the only factor that explains the selection and use of plant species. Thomas et al. (2009); Lucena et al. (2012) and Ribeiro et al. (2014) showed that the phytosociological indices were more associated for nonmedicinal (fuel and construction) uses or wood use category. Nonmedicinal use value (OUV) may be more suited to the apparency hypothesis, because availability may play a major role in species importance and where more generalist and non-directed harvesting has taken place.

The weak association between MUV and phytosociological indices indicates that availability is not always important to differential use of medicinal plants in local knowledge systems. Among the subset of phytosociological index, abundance was significant, as Lucena et al. (2007) explained. They showed that the frequency is more interesting than the basal area (dominance) for medicinal plant use. Lawrence et al. (2005, page 46) stated that "the abundance of a species is only a crude refection of its overall apparency, and measures of ecological dominance (such as basal area) might better indicate the impacts of plant apparency on human values."

Indifference of MUV with phytosociological indices may be explained primarily by direct harvesting and/or by the popularity of the particular uses of that species. *P. polyphylla* (Satuwa) is one of the top five useful species in the area, and is popular for its medicinal uses since people believe that its seven leaves are useful for seven diseases (cultural preoccupancy). Species popularity and usefulness are often related (Araujo et al., 2008). This indicates that the knowledge of plant use in the study area is less influenced by availability of resources and more dependent on cultural preoccupancy and the quality of resources, regardless of the availability of species and distance required to access. In a week, Sundays and Wednesdays were considered good days to collect medicinal plants while Saturdays and Tuesdays were often avoided. Local communities refrained from collecting religious and cultural plants on Mondays, since Monday is considered as a holy day for lord Shiva. *Ficus religiosa* (Peepal), *Prunus cerasoides* (Paiyu), *Mangifera indica* (Aanp), *Phyllanthus emblica* (Awala) and *Aegle marmelos* (Bael) are cultural and religious trees of Nepal (Majupuria & Joshi, 2009). Participants considered these five trees as Panchpallav (a ritual assortment of five holy leaves) and used them ritually during three major events of life: birth, marriage and funeral ceremony. The winter solstice (usually December 15th in Nepal) is also considered a “no harm” day in the study area. The seeking of quality products was circumscribed with the personal and cultural traditions regardless of the distance and cost incurred. Although access to the distant areas demands more time and energy, they are foraged for quality products for health benefits, refuting optimal foraging theory. Ladio & Lozada (2000) reported that the distance from the resource area influences the selection of the site being visited; that is, the time and energy required to visit each area for the collection are two variables to be optimized during extraction events.

As our area is rich in biodiversity, indigenous medical systems and traditional knowledge (Manzardo, 1977; Kunwar et al., 2016), the distant forest areas with wild and quality species were always prioritized for foraging. This was attributed by cultural factors and intensive landuse change among other reasons. The annual population growth in the districts (about 2%) was outpaced by the landuse change (forest cover loss 2.36%) (Kunwar et al., 2016). Despite that the MUV was higher for the areas of limited access; the general uses (OUV) were related to accessibility, revealing the association of accessible areas, mundane collection and socio-acculturation.

Because of declining interest and acceptance of traditional systems among younger generation, the knowledgebase is gradually eroding in Byash area of Kailash India (Negi et al., 2017). People lamented about the socio-acculturation in the study area and the declining quality in products and collection. Although the cultivated plants were found to be the most associated with the medicinal plant use values in some studies (Gazzaneo et al., 2005; Hart et al., 2017), we found a different pattern. Introduction of cultivated species or those found in secondary forests is largely set up in African-Brazilian and European pharmacopoeia (Voeks, 1996). Our results coincided with the findings of many other studies (Stepp & Moerman, 2001; Stepp, 2004) that cited the outstanding presence of herbaceous plants, partially refutes the application of apparency hypothesis. Trees and perennials are likely to be browsed frequently in apparency hypothesis (Phillips & Gentry, 1993a).

Plant Use Value and Accessibility: We did not find a significant difference of use values between Baitadi and Darchula (p = 0.05-0.34) (Table 4.4), even though Baitadi district is more accessible than Darchula. However, Darchula district had a higher MUV and Baitadi had a higher non-medicinal (OUV), inferring that the distant areas are still valued as refuge sites for specific uses, such as quality medicinal plants. Participants emphasized that the sacred groves usually found in distant areas are rich in quality medicinal plants. Nonetheless, the sacred groves are prohibited for exploitation. Baitadi and Darchula districts are rich in sacred groves in Nepal (Bhatta, 2003). Thus, species found in distant and undisturbed (limited access) forests were more valued for their medicinal aspects than the species grown in transition land and ruderal areas. Forage in distant areas usually ideal for quality medicine was sought by traditional healers. The quality collections were specific to elderly groups and traditional healers who went to distant undisturbed areas (Ramos et al., 2008). Local healers favor indigenous/endemic species and show higher preferences for wild habitats, self-crafted materials and self-processing to assure that they have the right materials, composition and procedure to prepare their medicine (Kunwar et al., 2015). The need for quality may explain the nonexistent or negative correlation between availability and use values. Nearby areas were found associated with non-medicinal OUV use category ($p > 0.05$). This was also substantiated by the coefficients of use values of species found in quadrats and outside quadrats ($p \leq 0.05$).

We compared the use value of species of Himalayan endemic, Pan-Himalayan and broadly distributed with an assumption that the species of broader distribution are frequently used. However, the use values of species with the broad elevational span (> 2000 m) and cosmopolitan distribution were insignificant (p = 0.09-0.83). The mean use value of endemic species was higher even though the insignificant ($p > 0.05$). Higher use values of endemic species were attributed to the cultural prominence of the species or to the long recognition of the particular species and its uses. Thus, we can assert that one of the other factors associated with the usefulness of species is the well-known and long rooted recognition of the species, which is not necessarily related to their apparency.

The long history of a community's contact with nature translates into a tradition that integrates a high number of indigenous medicinal plants used for local livelihood (Prance, 1972; Dalle & Potvin, 2004). Thus, social and cultural attributes are more important for management.

Implication for Conservation: In testing if apparency is related to the use value of a species, the analyses demonstrated a weak and nonexistent relation between the phytosociological and ethnobotanical variables. Neither UVL nor TUV and MUV revealed the strong association with plant importance value. It is therefore reasonable to assume that if the use pressure is directed to less salient species, then the resource scarcity and biodiversity conservation could be aggravated. Frequent low use values of species infer that there is no serious harvesting pressure on a whole in a community. However, the species with higher than cut-off use value are always at risk. The species with multiple uses are at the verge of extinction because of persistent human disturbance and landuse change. The specialized collection (cultural preoccupancy, directed harvesting) is always influenced by personal use and health benefits and constrained by geography (Manzardo et al., 1976). Sustainable resource management in sacred landscapes is often aided by culture and community beliefs (Rist et al., 2003). Thus conservation strategies addressing local knowledge, culture, history and geography in addition to the biological and ecological characteristics would be most appropriate.

Conclusions

Our study area is rich in useful plant species and the people of this area showed a large repertoire of knowledge that helps them execute different plant use strategies in conjunction with culture and geography. This knowledge is the result of the area's biodiversity, cultural preoccupancy, long rooted and well known recognition of the species, and the compliance of using local resources in reference to the geo-ecological constraints. The factors associated with ethnography, culture and history also play role in discerning the patterns of plant collection and use. Low range of plant use values inferred that the species of the study area were less versatile in uses. They were valued for specific uses resulting in heterogeneity in the knowledge and consistent with the biodiversity of the area. The weak relationship between plant use values and phytosociological indices indicates that availability is not the only factor that explains the selection and use of plants. These patterns partially refute our hypothesis and indicate the need to conserve both biological and cultural resources of both nearby and distant areas. These findings urge the need for conservation of both biological and cultural components of forest and villages. By obtaining the knowledge about the use value of plants and their ecological information and their interdependencies, a better strategy of management of human communities and biodiversity would be possible.

Conflict of Interests: The authors declare that they have no conflict of interest.

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CROSS-CULTURAL COMPARISON OF PLANT USE KNOWLEDGE IN BAITADI AND DARCHULA DISTRICTS, NEPAL HIMALAYA (PUBLISHED IN JOURNAL OF ETHNOBIOLOGY AND ETHNOMEDICINE 2018, 14:40)

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Abstract

Background: This study seeks to better understand the human-nature interface and to measure the variability of plant use knowledge among cultures, through inter and intracultural analyses. We compared plant collection, use and management of two sub-culturally distinct groups (Baitadi and Darchula) of the Nepal Himalaya. They inhabit different physiographic regions; yet share the same ecological landscape, environmental resources, and livelihood challenges. We hypothesized that the elderly, native and traditional healers living in remote and rural places possess diverse and detailed knowledge of plant use and conservation than young, non-native non-healers.

Methods: A total of 106 people were contacted for interviews, and 100 (68 men and 32 women) agreed to share ethnobotanical, demographic and socioeconomic information. They were asked about the three most important plants for their socioeconomic benefit, culture, primary health care and livelihood.

Results: The knowledge of plant collection, use and its transfer was strongly associated with the cultural heritage whereas the ecogeographical condition influences the ways in which plants are collected and used. The divergent knowledge of plant collection, use and transfer between the participants of Baitadi and Darchula was significantly (p < 0.001) attributed to the cultural heritage of the area. The low consensus of plant use (FiC 0 - 0.87; IASc 0 - 0.67) between Baitadi and Darchula district could be due to cultural divergence, varied accessibility, physiographic heterogeneity and biodiversity uniqueness.

Conclusions: Difference in plant use knowledge may help in diversifying the strategies of plant use in accordance with the livelihood, culture and environment and therefore more studies measuring these aspects can further the ecosystem and cultural health of the region.

Keywords: Medicinal plants, Use reports, Consensus, Transhumance, Intracultural, Nepal Himalaya.

Background

Human communities that inhabit remote and rugged ecosystems use diverse livelihood strategies such as utilizing different ethno-ecological environments (Ladio & Lozada, 2004; Thomas et al., 2008) defined by the availability of plants (Phillips & Gentry, 1993a), altitudinal gradient and accessibility (Aldunate et al., 1981), culture (Weckerle et al., 2006; Fadiman, 2013) and adaptation (Paniagua-Zambrana et al., 2014). When there is little arable land, indigenous livelihood strategies include animal husbandry, transhumance, seasonal crop production and collection, use and trade of medicinal plants (Manzardo, 1977; Cameron, 1996; Bisa & Webb, 2006). However, changes in lifestyle as a result of globalization, increasing population, land-use change and climate warming affect these livelihood strategies. Socio-acculturation of mountain people and plants jeopardize the human-biodiversity linkage in the region (Zomer et al., 2013). The collection and use of plants, hailed for socio-economic gain, cultural heritage and drug development (Farnsworth & Morris, 1976; Bhattarai, 1992; Bussmann & Sharon, 2006; Negi et al., 2017) has now been threatened due to local people's changing perceptions and their socioeconomic and cultural transformations (Vandebroek et al., 2004; Toledo et al., 2009; Byg et al., 2010).

The knowledge and practice associated with the collection and uses of plants varies within any culture, because of the abundance and quality of species, geography of the region, origin of the plants, residence of the people, social status and relationships within the community (Manzardo, 1977; Toledo et al., 2007; Cetinkaya, 2009; Thomas s et al., 2009; Soldati et al., 2016). Cultural factors are sometimes mediated through local classification systems (Ellen, 1999), language (Maffi, 2005; Saslis-Lagaudakis et al., 2011), human cognition, cultural history (Prance, 1972; Hitchcock, 1973), beliefs, religion (Pieroni et al., 2011; Aryal et al., 2018), taboos, social networks and access to information (Toledo et al., 2007; Lbeyrie et al., 2014). Different subsets of sociocultural factors such as settlement, population, family size, gender, age, ethnicity, education, economy, occupation, possession, etc. also influence knowledge of plant use (Phillips & Gentry, 1993a; Byg & Baslev, 2001; Fadiman, 2005; Reyes-Garcia et al., 2006; Voeks, 2007; Paniagua-Zambrana et al., 2014; Atreya et al., 2018).

Studies have demonstrated that ethnobotanical knowledge increases with an individual's age and length of residence (Muller et al., 2015). Thus, cultural variables seem more essential in explaining community knowledge of collection and plant use (Maffi, 2005) in addition to the sustainability of plant resources. A continuous outmigration foments a decline in the number of healers and indigenous knowledge holders (Farooquee & Saxena, 1996; Rudel et al., 2002; Brusle, 2008; Bhatt, 2010; Poertner et al., 2011) resulting in weakened indigenous knowledge and use-systems (Turner & Clifton, 2009).

Here, we compared the knowledge of collection and plant use of two subculturally distinct groups inhabiting different physiographic regions within the same ecological landscape with access to similar environmental resources. Cross-cultural studies were parsimoniously studied before 1998 (Heinrich et al., 1998), but nowadays they are increasingly being analyzed (Saslis-Lagaudakis et al., 2011; Pieroni et al., 2011; Lardos & Heinrich, 2013; Gairola et al., 2014; Aziz et al., 2018). Intercultural comparison has practical applications because we can address both the consensus and variations of plant use knowledge (Quave & Pieroni, 2015).

In this paper, we carried out a cross-cultural study focusing on different human groups and how their demographic (gender, age), socio-economic variables (ethnicity, education, occupation, land and livestock ownership, and food availability) and cultural (length of residence, settlement, language, household size and livelihood) variables influence the knowledge of plant use. We hypothesized that the elderly, native and traditional healers living in remote and rural physiographic condition possess more diverse and detailed knowledge of plant use and conservation than young, non-native and non-healers.

Methodology

Study Area: The Kailash Sacred Landscape (KSL) is a trans-boundary landscape comprised of parts of the southwestern Tibetan Autonomous Region of China and adjacent parts of northern India and northwestern Nepal (Chaudhary et al., 2010). At its heart, high upon the Tibetan plateau, lie Mt. Kailash (6,638 m asl) and two adjacent holy lakes (Mansarowar), considered a sacred pilgrimage site by over a billion people practicing five religions: Hinduism, Buddhism, Jainism, Sikhism and Bon for several millennia (Zomer et al., 2013). The pilgrimage routes to Mt. Kailash and Mansarowar via Urai pass (Bajhang, Nepal) and Lipu lekh (Darchula, Nepal) augment the cultural history of the region (Manzardo et al., 1976; Pandey, 1989; Zomer et al., 2013; Pandey et al., 2016).

The KSL-Nepal occupies 42% of the total KSL, which covers four mountain districts (Darchula, Humla, Baitadi and Bajhang) in the far-western part of the country. This is one of the most underdeveloped regions of Nepal and faces numerous conservation and development challenges because of the harsh climate, poor accessibility, marginality and high level of poverty

Cameron, 1996). These cultural and developmental premises are intertwined with historical accounts. Before the Anglo-Nepalese war (Gurkha war) of 1814-16, the entirety of Kumaon Garhwal to Bairath (Baitadi), Doti was designated as the Katyuri Kingdom under Nepal administration (Kumar, 1967), and the corpus of feudal rites was considered a unifying aspect of culture (Oakley & Gairola, 1977). There are a number of commemorative pillars erected in about 1200 AD in Dehimandu, Baitadi and adjoining areas memorializing the victorious warriors of the region (Sharma, 1997).

The long history of contact of a community with nature infers a tradition and culture that integrate a high number of indigenous medicinal plants for local livelihood (Prance, 1972). Only about 15-25% of the KSL is cultivable (Farooquee et al., 1994; FAO, 2010; Zomer et al., 2013; Uddin et al., 2015b), leading to prolonged poverty, which contributes to environmental challenges and calls for sustainable development of the region (Zomer & Oli, 2011; Negi et al., 2017).

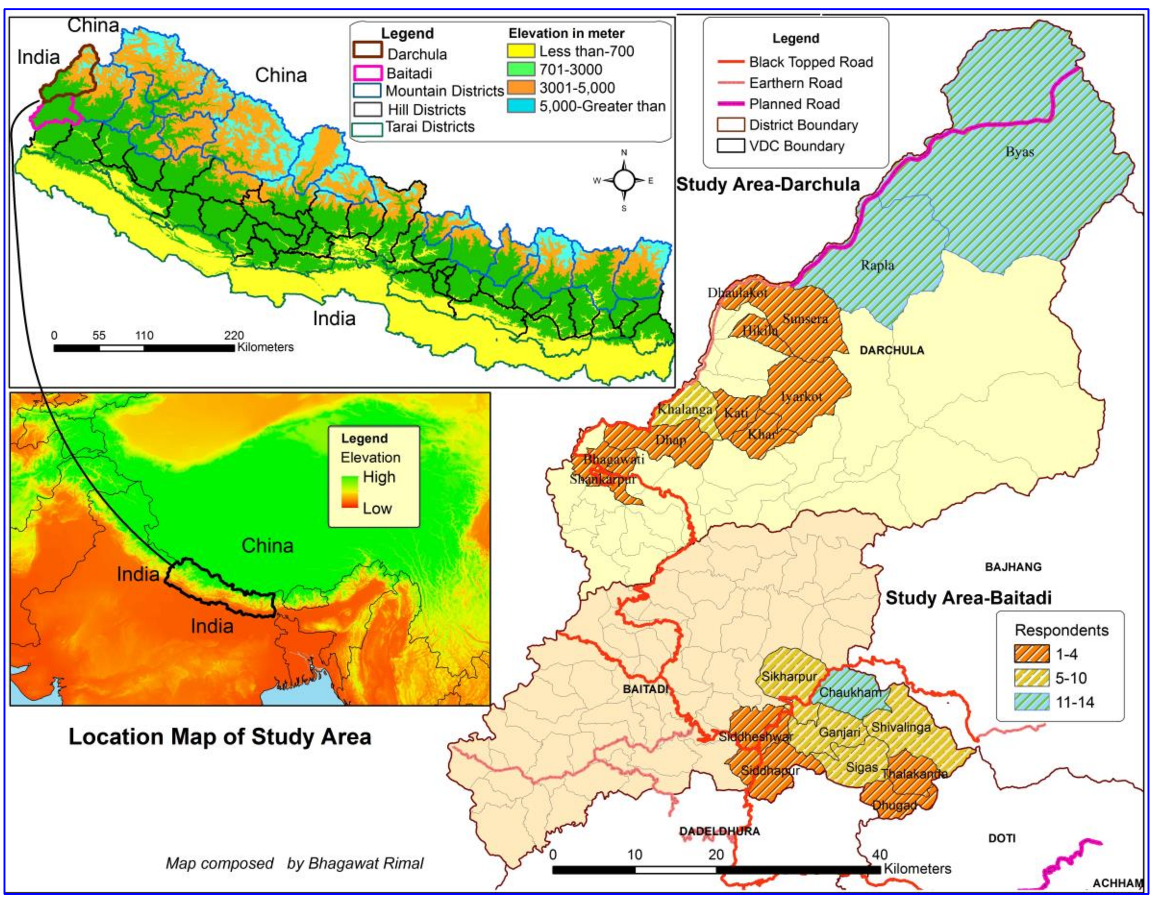

Figure 5.1 Map showing location and physiography of study area and village-wise frequency of respondents.

Baitadi and Darchula, the study districts (29º 22' N to 30º 15' N / 80º 15' E to 81º 45' E) located at the westernmost end of the country, represent far-western Nepal bordering India and China (Figure 5.1). The study districts respectively represent hill and mountain ecosystems (IUCN, 2000). Situated in the southern Himalayan foothills, the hill region mostly between 700 and 3,000 m above sea level (asl) is highly populated, and agriculture is the major form of livelihood. The mountains are regarded as collection grounds for medicinal plants, summer grazing lands and sacred sites for rituals (Garbyal et al., 2007). Traditional mountain agro-pastoral systems predominate in Darchula and integrate with transhumance, animal husbandry and medicinal plant collection and trade. These livelihood strategies are adapted for subsistence within the steep terrain and variable climatic conditions.

Ethnographic Setting: There are more than 30 ethnic and 10 minority groups in the study area including the indigenous groups Byashi and Santhal in Darchula and Kusunda, Dom and Dhanuk in Baitadi (GoN, 2011). Chhetri is the study area's dominant ethnic group (about 60%) followed by Brahmin (about 20%), *Dalit* (Lohar/Kami, Sarki, Dhanuk 10%) and others 10%. Chhetri and Brahmin are relatively privileged groups with the highest well-being index (GoN, 2014). Even though the *Dalit* are receiving reserved access and opportunities provided by the Nepal Government, they are still disadvantaged due to the socio-cultural and class system (Cameron, 1998).

The sample community of Baitadi district was composed of sedentary farmers and villagers including hill caste Chhetri, Brahmin and *Dalit*. Brahmin, Chhetri and *Dalit* are predominant in Baitadi district. Agriculture, wage labor, medicinal plant collection and trade and traditional healing are the major occupations in Baitadi (Chhetri & Pandey, 1992; Devkota & Karmacharya, 2003; Kunwar et al., 2015; Atreya et al., 2018) however, the former contributes the most (UNFCO, 2013). Baitadi district is renowned for sociocultural sacred peaks (Bhatta, 2003). Sacred forests are parts of the cultural heritage that represent important spiritual sites (Wickramasinghe, 1997) and local people believe that their livelihood and cultural existence are greatly dependent on the blessings of their deities (Chandrashekara & Sankar, 1998).

The legacy of sacredness, recently demarcated as the Kailash Sacred Landscape, has been shown to have a major effect on culture, conservation, ecology and environment due to the associated special precautions and restrictions on use (Khumbongmayum et al., 2005). As a result of limited human activity due to sociocultural taboos and prohibitions, sacred places frequently possess old-growth vegetation and many ecologically and socio-culturally valuable plant species (Chand & Wilson, 1987; Ramakrishnan, 1996).

The Byashi is a Tibeto-Burman minority group with a population of about 4,000 in the country. About 500 live in Chyanrung, Byash village and about 500 in Rapla, Shitola and Khalanga villages (GoN, 2011). They are part of a group of people living throughout the Kumaon hills (Negi et al., 2017), as well as in Darchula (study district), Humla and Bajhang districts of Nepal (Nawa, 2002). They are semi-nomadic (Atkinson, 1989), living 6 months in Byash village (> 3,000 m asl) in the summer and then descending to the lowlands (Khalanga) for the rest of the year (Manzardo, 1977). The Byash village is covered in snow by winter. They represent the cultural practices and belief systems of the Nepal, far-west, and they speak the Byashi/Rang language (Nawa, 2002), claim to be both Hindus and pre-Buddhist and are well known for hospitality. Their houses are decorated with fine carved and reddish brown-painted windows and doors.

Like other Buddhists in Nepal, they use *Abies* poles for mounting prayer flags in the yard. *A. pindrow* is a very good resource as prayers flag, fuelwood, furniture, butter churners, medicine and agricultural implements in mountain communities. Other Temperate-Alpine medicinal plant species *A. archangelica, D. hatagirea, N. scrophulariflora, O. sinensis*, etc. are used and conserved in Darchula district for a long period (ANSAB, 2003). The average landholding of a Byashi family in Darchula is small and of poor quality, feeding a family only 3 to 4 months in a year (Manzardo et al., 1977). Famines occur often in the district (UNWFP, 2006; Chaudhary et al., 2010; Bradford, 2018) aggravated by limited cultivable land. Collection of hay (grasses) and edible and medicinal plants is a common strategy to offset these hungry periods. The supplementary agriculture of Byash is based primarily on potato (*S. tuberosum*) and bitter buckwheat (*F. tartaricum*), though sweet buckwheat (*F. esculentum*), naked barley (*H. vulgare*), beans (*P. vulgaris*), mustard (*B. rapa*), small-grained wheat (*Napal*), etc. are grown. In addition, a cash crop radish is sliced, dried and taken to northern border Taklakot and into Tibet to barter for salt. Some high value medicinal plants are bartered to the lowlands and to India in exchange for food and grains (Manzardo et al., 1976). Widespread collection and bartered species are Yartsagumba (*O. sinensis*), Jimbu (*A. hypsistum*), and Satuwa (*P. polyphylla*). This trans-boundary trade and transhumance are important livelihood strategies (Manzardo et al., 1976; Edwards, 1996).

Forest resources and alpine pastures complement the mountain agricultural system in both study districts, meeting fuel, fodder, timber and medicinal needs. Fuelwood is commonly used for heating and cooking. Agriculture, livestock, woolen products and the medicinal plant trade are four major livelihoods maintaining household economies. Because of the remote location, reliance on traditional medicine is associated with wild medicinal plants and on the harmonious existence of spirit and matter. Many traditional healers worship and pray to plants before collecting them, acknowledging the spiritual powers of the vegetation (Cameron, 2011). They believe that plants become more medicinal when processed spiritually and materially (Chandrashekara & Sankar, 1998; Garbyal et al., 2007). Thus, trade pairing with pastoralism and transhumance in this constrained environment is a survival strategy (Heim & Gansser, 1939; Haimendorf, 1975; Manzardo, 1977). The strategic modes of pasture resource utilization are rotational grazing based on a system of transhumance and medicinal plant harvesting (Rawat et al., 2013). However, the traditional trade and transhumance were disrupted when the trade routes were closed in 1962 because of Sino-Indian border conflict (Jianlin et al., 2002; Garbyal et al., 2005b). This activated contemporary sociocultural and economic transformation, as certain kinds of traditional knowledge began to decline and socio-acculturation and outmigration led people to pursue different economic opportunities to meet new survival challenges (Farooquee & Saxena, 1996; Bhatt, 2010). Thus, the traditional subsistence economy in far-western Nepal Himalaya has experienced substantial change in the recent decades (Zomer et al., 2013; Aryal et al., 2018; Atreya et al., 2018) while certain kinds of traditional knowledge in the research area began to decline in recent decades, including that around human-plant relationships.

Data Collection: Informed consent forms were obtained for all oral interview participants written in accordance with the FAU, IRB and Nepal research protocols. Inventory based interviews were carried out with the help of a local assistant and a research associate in each district. Participants were selected based on the dominant groups in the district, elderly people and occupational affiliations. Only the traditional healers, plant collectors and traders and elderly people of age 40-102 years were consulted for interviews. Once a traditional healer or a plant collector/trader was identified, snowball sampling was applied to locate and identify peer respondents. The list of traditional healers and plant collectors was referenced from village secretaries, tea vendors and earlier studies (Kunwar et al., 2012, 2013, 2015).

A total of 106 people were contacted for interviews and 100 (68 men and 32 women) agreed to share ethnobotanical, demographic and socioeconomic information. A two-page semi-structured questionnaire was developed in Nepali script prior to the start of fieldwork and administered for interviews. The interviews were carried out during three field visits, the duration of each trip lasting about a month between February and September 2017. A total 100 participants including 58 from Chhetri, 14 from Brahmin, 24 from Byashi and four from *Dalit* caste group were interviewed. There were 57 participants including 47 Chhetri, six Brahmin and four *Dalit* from nine villages of Baitadi district and 43 participants including 11 Chhetri, eight Brahmin and 24 Byashi from 12 villages from Darchula district. Informal discussions were held during the evenings while staying with local communities and sometimes with tea vendors. Tea shops are excellent arenas for observing interactions between communities and discussion of open ended questions (Putnam, 1975).

The interview participants were asked to list the three most important plants for each category, e.g. socioeconomic benefit, culture, primary health care and livelihood. Demographic information was collected for each participant including: socio-economic status, age, occupation, education, family size, livestock, land ownership, where they migrated from, languages they speak, length of residence, distance of home from district center, nearest health post and forest. Interviews were supplemented with other investigative techniques, such as participant observation, walk-in-the-woods interviews and informal meetings (Albuquerque & Lucena, 2005).

Interviews were conducted individually whenever possible to avoid any direct influences from third parties. The sampling effort was tested by a Jackknife 1st order richness estimator 100 permutation species-use curve performed in R. Species-use curve was drawn from the cumulative number of species mentioned as being used versus the number of informants interviewed (Kristensen & Baslev, 2003). While participating in the guided tours, voucher specimens of the species that could not be identified in the field were collected by participants and field assistants and processed and deposited at the Plant laboratory and herbarium (KATH), Lalitpur, Nepal for future reference. Earlier studies carried out in and around the study area were used as a taxonomic reference of general species. Plant taxon was verified by using *The Plant List* (retrieved from www.theplantlist.org).

Data Analysis: Matching information (use reports) from at least three respondents was considered a common response for quantitative analysis (Reyes-Garcia et al., 2006). To determine the influence of socioeconomic factors, we used three different indicators of knowledge: 1) use reports: representing the sum of all uses reported by an informant for all species known by that person, 2) useful species: representing the sum of all useful species an informant knew and 3) use value. Emic use types were later grouped into 19 etic categories for further analyses following Cook (1995). To identify the proportion of culturally important species in each study district, the Index of Agreement on Species (IAS) was calculated following Trotter & Logan (1986): IAS = (ns-nu)/(ns-l) whereby ns is the number of use reports of a given species is mentioned by all the participants and nu the number of use types attributed to that species. IAS was corrected to Index of Agreement on Species consensus (IASc) for the number of participants who knew a use for the species through the formula: IASc = IAS*(Pu/Pt) where Pu represents the the number of participants who reported a use and Pt equals the total number of participants interviewed about the species (Vandebroek, 2010). IASc values vary between 0 and 1, with 0 representing no agreement and 1 total agreement. In this paper, we determined the proportion of plant species with an IASc value > 0.5; this value was chosen as an arbitrary cut-off point for culturally important species following Vandebroek (2010).

The frequency of citation of a specific use, that is, the number of individual use-reports (nur) for a type of use category, serves to establish the consensus across the respondents (Weckerle et al., 2018). The cultural consensus on a particular use category can help inform efficacy of a plant to that particular use category (Trotter & Logan, 1986; Heinrich et al., 2009). The efficacy of plants can be perceived by determining the Fic values. The FiC was calculated as: nur – nspp.used/nur–1 where nur shows the number of use reports while nspp shows the number of species used. After analyzing the FiC values of both districts, a comparison was made to sort out consensus of uses across the two districts. The two main measures of "plant knowledge" consisted of (1) the cumulative number of participants who reported a use for each plant species at the group (cultural) level and (2) the number of plant species used at the level of individual participant. Other measures used to correlate plant knowledge with consensus included the unique use-reports (UUR) by a participant.

Statistical Analysis: We grouped the socioeconomic and demographic data into nominal variable: (1) gender, (2) education, (3) occupation, (4) livelihood type, (5) access to opportunity, (6) food availability, (7) languages spoken and continuous variable: (1) age, (2) household size, (3) livestock size, (4) land size, (5) length of residence, (6) years of healing (7) distance from home to forest and (8) distance from home to health post. Cross-cultural analysis was made by (1) gender: male, female, (2) education: literate, non-literate, (3) occupation: healers, non-healers, (4) livelihood type: suburban, hill, sedentary (Baitadi); rural, mountain, semi-nomadic (Darchula), (5) food availability: < 6 months, > 6 months, (6) Language spoken: two and more, and (7) access to opportunity: privileged group (Chhetri and Brahmin), under-privileged (Byashi and *Dalit*). Statistical models were used to explore how socio-cultural variables interact among themselves and with the knowledge of plant collection, use and management intensity. We considered p values < 0.05 as statistically significant (Sokal & Rholf, 1995). For count variables, a GLM regression with Poisson logit (link) was used to see the effect of settlement, length of residence, size of household, livestock and land and age and experience of participants against plant uses. For categorical variables, emmeans (least square regression of means at logical scale) GLM was used. All the analyses were performed in R studio 3.4.1.

Results

Useful Species and Cultural Consensus: A total of 1,434 use reports from 122 useful plant species were recorded from 100 participants. Each species was reported for 1- 10 use types and 1-63 use reports. The participants from Baitadi district recorded 917 use reports (16.08 person^{-1} use reports) whereas that of Darchula district was 517 (12 person^{-1}) (Appendix G). The use reports were assigned to 89 emic use types later categorized into 19 etic categories for further analyses (Table 5.1). Of 122 useful species, 102 were found useful in Baitadi and 92 in Darchula with 72 common. The species-use curve approached an asymptote as the number of interviews increased in Baitadi district (57 participants) indicating that there will not be further additions of useful species. However, the curve was not leveled-off in Darchula district (43 participants) indicating that further sampling of respondents would yield some new useful species (Figure 5.2).

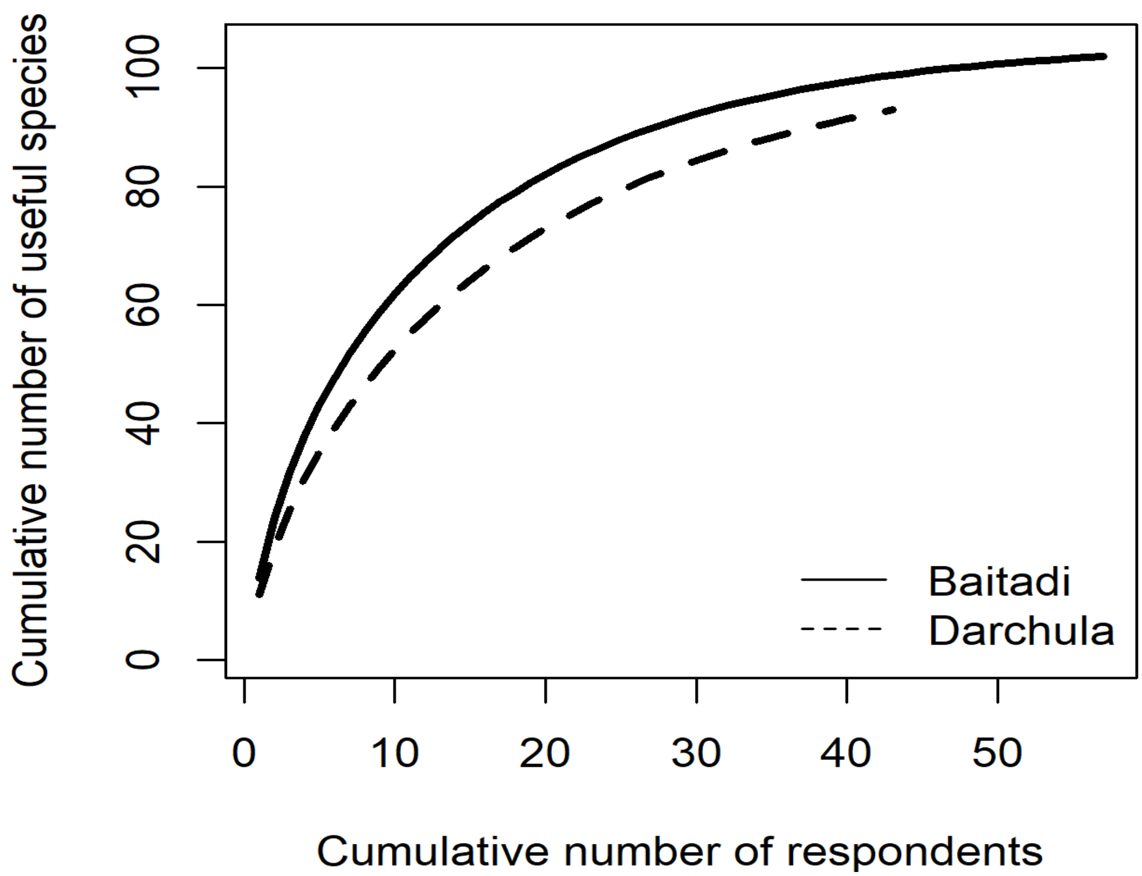

Figure 5.2 Species-use curve showing the records of number of useful species against the number of respondents leveled off after 50th participant

Of the 19 categories we grouped, 16 categories were found significant for both districts and pursed for further analyses. The categories with less than 3 use reports were not considered for further analysis. The recorded FiC values for 19 categories were ranged from 0 to 0.87 in both of the districts revealed that the use reports are species specific and less shared among the participants and district groups. In comparison, highest FiC value was reported for socio-cultural and livelihood use (wood, fuel, fodder) (FiC 0.87) in Baitadi district in contrast to the highest FiC value (0.83) was recorded for medicinal use treatment of gallstone and endocrine aliments in Darchula district. The second highest FiC 0.85 and 0.81 respectively for Baitadi and Darchula district were recorded for use of ritual purpose (Table 5.1).

Table 5.1 Emic and etic categories and informant consensus factor (FiC)

Etic category (Abbreviation)	Emic use type	Baitadi			Darchula			Av.
		Use reports	**Useful species**	**FiC**	**Use reports**	**Useful species**	**FiC**	
Ritual (Rit)	Ritual, religious, evil spirits, luck	120	18	0.85	85	20	0.77	0.81
Digestive – metabolism (Dig)	Diarrhea, dysentery, stomachache, nausea, anthelmintic, appendicitis, gastric, indigestion	102	23	0.78	137	35	0.75	0.76
Infection (Inf)	TB, fever, typhoid, tetanus, leprosy, polio	47	14	0.71	78	19	0.76	0.74
Social – materials (Soc)	Wood, fuel, fodder, forage, rope, bedding, agricultural implements	272	36	0.87	28	16	0.44	0.65
Pain – inflammation (Pai)	Cuts, wounds, burn, injury, analgesic, toothache, headache	53	23	0.57	45	16	0.65	0.61
Respiratory (Res)	Pneumonia, cold, cough, larynx-sound	58	23	0.61	22	9	0.61	0.61
Livestock (Liv)	Livestock health, veterinary	19	15	0.22				0.11
Muskulo-skeletal (Mus)	Fracture, sprain, joint pain, backache, bath (rheumatism),	36	16	0.57	24	12	0.52	0.54
Anti – poisoning (Poi)	Snake bite, antidoting, scorpion sting, piscicidal, antileech, insecticidal	21	10	0.55	11	6	0.5	0.52
Food (Foo)	Vegetable, edible, spices	43	20	0.54	10	6	0.44	0.49
Immune (Imm)	Immune, anticancer, nutrition, appetite, growth, tonic	4	3	0.33	18	7	0.64	0.32
Endocrine (End)	Gall bladder, gall stone, diabetes				13	3	0.83	0.41
Genito – urinary (Gen)	Urine infection, hydrocele, piles	9	3	0.75	3	3	0	0.37
Circulatory – blood (Cir)	Blood pressure, heart disease, jaundice	15	10	0.35	16	12	0.26	0.31
Household – economy (Eco)	Dye, oil, resin	13	6	0.58				0.29
Reproductive (Rep)	Lactation, fertility, conceive, abortion, dudhelo (mammary gland complication)	7	4	0.5	4	4	0	0.25
Skin (Ski)	Acne, scabies, skin swell, hair fall, macadam, pilo, pitka (skin rashes)	35	18	0.5	6	6	0	0.25
Nervous (Ner)	Paralysis, memory longevity, dizziness, antidepressant, chito (epilepsy)	12	11	0.09	9	9	0	0.04
Sensory (Sen)	Eye, ear	3	3	0	0	0	0	0

We considered IASc > 0.5 as a cut-off value for identifying the highly consented species. Results showed that there are eight species with IASc value > 0.5 (Table 5.2). The comparison of informant agreement values between the Baitadi and Darchula districts was significantly different ($p < 0.001$). In order to investigate the relationship between plant knowledge and consensus at the group (cultural) level, plant species were ranked according to their IASc value. In Baitadi, an IASc value > 0.5 was obtained for five species: *P. cerasoides*, *A. pindrow*, *Chrysopogon aciculatus* (Retz.) Trin., *B. ciliata* and *Quercus lanata* Sm. whereas only three species: *A. archangelica*, *N. scrophulariflora* and *P. polyphylla* were recorded as high IASc value > 0.5 in Darchula (Figure 5.3). Species with < 0.5 IASc are given in Appendix G.

Table 5.2 Plant species with IASc score >0.5

Scientific name	Family	Baitadi				Darchula			
		Use types #	**Use reports**	**Participants (n)**	**IASc**	**Use types #**	**Use reports**	**Participants (n)**	**IASc**
Abies pindrow	Pinaceae	1	31	31	0.543*	2	4	4	0.062
Angelica archangelica	Apiaceae	4	9	7	0.076	2	30	30	0.673*
Bergenia ciliata	Saxifragaceae	7	42	36	0.539*	3	20	19	0.395
Chrysopogon aciculatus	Poaceae	1	31	31	0.543*	1	1	1	0
Ficus religiosa	Moraceae	1	23	23	0.403	1	10	10	0.232
Neopicrorhiza scrophulariflora	Plantaginaceae	1	1	1	0	4	31	28	0.586*
Paris polyphylla	Melanthiaceae	5	27	23	0.341	4	28	27	0.558*
Polygala abyssinica	Polygalaceae	2	28	27	0.456	0	0	0	0
Prunus cerasoides	Rosaceae	4	47	36	0.59*	1	10	10	0.232
Quercus lanata	Fagaceae	7	58	34	0.533*	2	4	3	0.046
Swertia chirayita	Gentianaceae	5	37	30	0.467	6	26	24	0.446

* Significant, n = Participants in district, Total Participants (N) = 100

Analysis of use value of plants at two different cultures revealed that three species *P. polyphylla, N. scrophulariflora* and *A. archangelica* are medicinal and emerged in quadrant “D” with their high IASC value (0.55-0.67) in Darchula district (Figure 5.3 Right). Five species appeared in quadrant “B” (*A. pindrow, B. ciliata, C. aciculatus, P. cerasoides* and *Q. lanata*) with high IASc value (> 0.5) and were important in the Baitadi district. . Of five > 0.5 IASc species in Baitadi, only one species *B. ciliata* was used as medicinal and the rest four were used for socio-cultural purposes. *A. pindrow* was valued as a timber/wood species, *Q. lanata* as a fire-wood and fodder, *C. aciculatus* as forage for livestock feeding and *P. cerasoides* for ritual ceremonies. The species appeared in quadrant “A” were highly consented in both districts whereas those that appeared in quadrant “C” were insignificant in uses and consensus. None of the species was highly consented in both district indicated that the use value of plant species was specific to the district groups and culturally divergent.

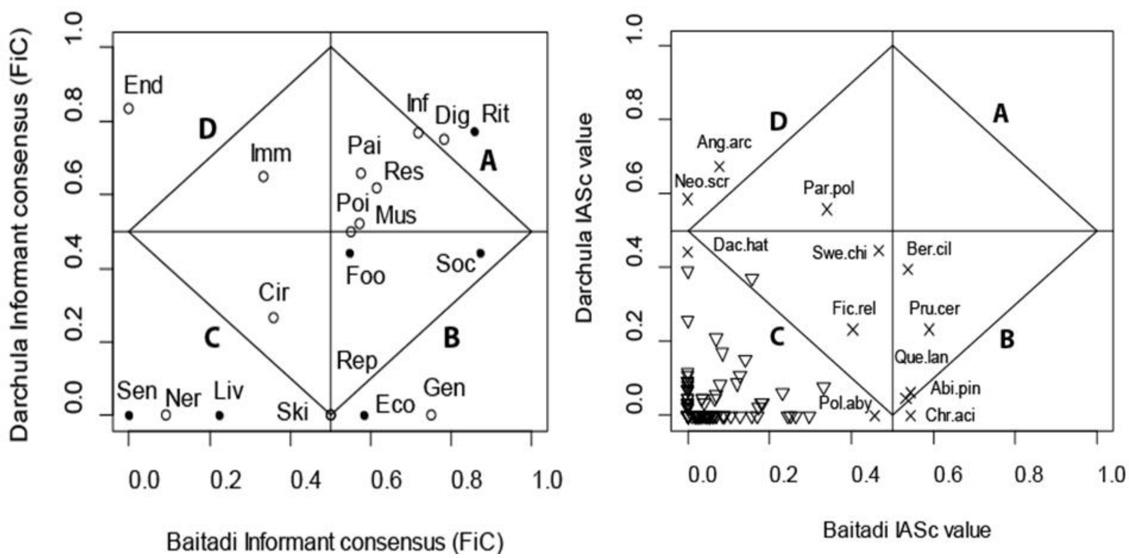

Figure 5.3 Cultural consensus matrix of two groups (Baitadi and Darchula participants)

Right - Species: *Abi.pin=A.pindrow, Ang.arc=A. archangelica, Ber.cil=B. ciliata, Chr.aci=C.aciculatus, Fic.rel=F. religiosa, Neo.scr=N. scrophulariflora, Par.pol=P. polyphylla, Pol.aby=P. abyssinica, Pru.cer=P. cerasoides, Que.lan=Q. lanata, Swe.chi=S. chirayita.* **Left** – Use category: Cir=Circulatory, Dig=Digestive, Eco=Economic, End=Endocrine; Foo=Food, Gen=Genito-urinary, Imm=Immune, Inf=Infections, Liv=Livestock, Mus=Musculo-skeleton, Ner=Nervous, Pai=Pain, Poi=Anti-poisoning, Rep=Reproductive, Res=Respiratory, Rit=Ritual, Ski=Skin-cutaneous, Sen=Sensory and Soc=Social.

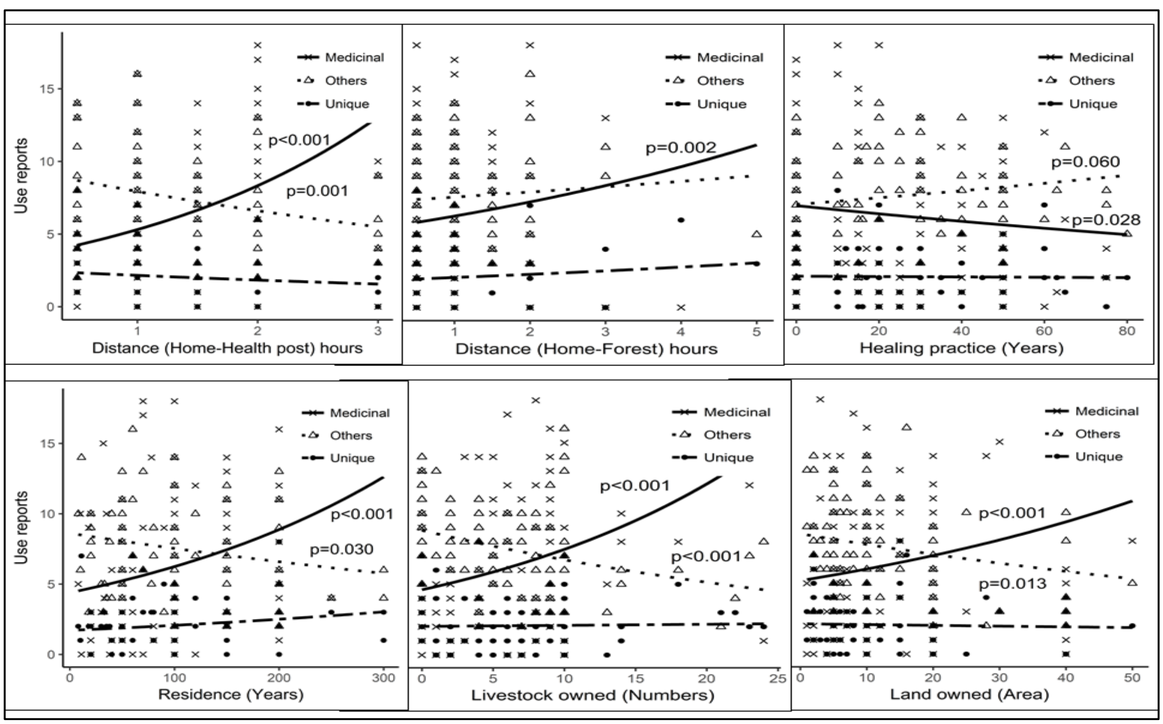

Figure 5.4 Generalized linear model regression of plant use knowledge of participants along the gradients of socio-cultural asset, length of residence and the time required to access resources. Column represents number of use reports cited by participants.

Intracultural Knowledge: A total of fifteen socio-cultural factors was tested against the 3 types of plant use reports: medicinal use reports - MUR, other use reports - OUR and unique use reports - UUR (Appendix L). Of the eight continuous variables, four: length of residence, posession of livestock and land and the distance required to access health post were found significant (p < 0.001-0.03) for both MUR and OUR (Table 5.3, Figure 5.4). Other factors such as distance required to forest access, length of healing practice and household size of the participants were insignificant for MUR however, OUR was partially influenced. The unique use report (UUR) was indifferent to continuous variables at all. UUR was also insignificantly different at all categorical variables except the opportunity access and education of the participants (p = 0.045, p = 0.043 respectively) (Table 5.3, 5.4).

The participants living in the study area for generations possessed the highest knowledge of plant use, which was significantly different (p < 0.001), from the ones moving there more recently. Higher plant use knowledge was also associated with the participants who had a larger number of livestock (p < 0.001) and greater land size (p < 0.001) and family member (p = 0.001); however, the latter was insignificant (p = 0.148) to OUR. The settlement: distance from home to a health post (p < 0.001) and home to forest (p = 0.002) was positively associated to MUR; however, the OUR knowledge was insignificant to the distance of home to forest. Unlike other studies, age of the participants did not show any statistical significant variation (p = 0.55) on means of the knowledge of plant use at all (Table 5.3).

Table 5.3 GLM (Poisson's) regression coefficients of predictor variables against plant use reports

SN	Explanatory variables (continuous)	Medicinal (MUR)	Others (OUR)	Unique (UUR)
1	Length of residence (year)	<0.001***	0.030*	0.077
2	Livestock owned (number)	<0.001***	<0.001***	0.795
3	Land owned (area)	<0.001***	0.013*	0.698
4	Home-health post distance (hour)	<0.001***	0.001**	0.145
5	Home-forest distance (hour)	0.002**	0.356	0.253
6	Household size (number)	0.001**	0.148	0.141
7	Healing practice (year)	0.028*	0.060	0.854
8	Age (year)	0.556	0.115	0.651

*** Strongly significant, ** Moderately significant, * Low significant, >0.05 Non significant (Ns)

Contrarily, the healing experience of the participants was negatively associated with MUR (p = 0.028). Mixed result was obtained when the participants who were categorized into healers and non-healers by their occupation and assessed their knowledge of MUR (p = 0.17) and OUR (*p* < 0.001). Though healers were more knowledgeable on MUR (7.79), it was statistically insignificant (*p* = 0.17). They also provided less knowledge about OUR (5.83) and UUR (1.99) than the non-healer respondents. In the study area, the variation of plant use knowledge was closely related to the categorical variables: livelihood, access to opportunity, gender, occupation and language spoken by the partipants, among which livelihood was significant (*p* <0.001) for both MUR and OUR. The latter four were significant for OUR and UUR. Even though, participants responded differently about the plant recognition, identification, collection and uses (Case et al., 2005), this was beyond the scope of this present study, and we analyzed only the use responses of the participants. We partially rejected our null hypothesis and found the significant difference (<0.001) on plant use knowledge was between the participants with agribusiness and agro-pastoral livelihood and hill/suburban and remote/rural setting.

Table 5.4 Analysis of deviance of plant use reports with categorical variables (GLM fit with Poisson error)

Explanatory variables	Factors	MUR		OUR		UUR	
		Mean	*p*	Mean	*p*	Mean	*p*
Livelihood	Baitadi/sedentary (suburban, hill) (57)	6.75	<0.001***	8.92	<0.001***	2.06	0.99
	Darchula/seminomadic (rural, mountain) (43)	8.69		2.88		2.04	
Access to opportunity	Privileged (Brahmin, Chhetri) (72)	7.40	0.27	7.38	<0.001***	2.24	0.045*
	Under-privileged (Byashi, *Dalit*) (28)	8.07		3.60		1.60	
Gender	Male (68)	7.59	0.99	6.72	0.023*	2.26	0.49
	Female (32)	7.58		5.49		2.36	
Occupation	Healers (77)	7.79	0.17	5.83	<0.001***	1.99	0.79
	Non-healer (23)	6.91		7.99		2.02	
Languages spoken	≤ 2 (81)	7.46	0.36	6.99	<0.001***	2.26	0.51
	> 2 (19)	8.10		5.72		2.07	
Education	Nonliterate (51)	7.78	0.47	6.03	0.23	2.09	0.043*
	Literate (49)	7.38		6.63		1.78	
Food availability	< 6 months (72)	7.51	0.65	6.36	0.84	2.04	0.75
	> 6 months (28)	7.78		6.25		2.14	

*** Strongly significant, ** Moderately significant, * Low significant, >0.05 Non significant

Discussion

Useful Plants and Their Use Values: The account of 122 useful plant species was about 50% of the total 255 plant species recorded from the districts. The record of higher number of medicinal plants and edible fruits from herbs and trees respectively was in line with the findings of Toledo et al. (2009). The extensive usage of plants for livelihood and health care indicates that this is clearly an important part of culture. Poaceae was a richly represented plant family with eight useful plant species followed by Moraceae with seven, Apiaceae with six and Asteraceae and Fabaceae with five each. Our record of higher number of useful plant species from Poaceae, Asteraceae and Fabaceae, the most species-rich plant families in the world, was supported by the hypothesis of Moerman (Moerman, 1979): families with abundant species emerges with an abundance of useful species. Asteraceae and Poaceae are the richest plant families in Darchula (Elliott, 2012; Pandey et al., 2017). Records of higher numbers of useful plant species from the plant families Asteraceae, Fabaceae and Rosaceae were already manifested in and around KSL, Nepal (Shah & Joshi, 1971; Devkota & Karmacharya, 2003; Garbyal et al., 2005a; Gangwar et al., 2010; Kunwar et al., 2015; GoN/DOED, 2016; Negi et al., 2017). Family-wise IASc value also revealed that the families Poaceae and Fagaceae were highly consented as useful (IASc 0.79 and 0.59 respectively) followed by Rosaceae and Pinaceae 0.54 each.

Intercultural Analysis: The species with high consensus (> 0.5) were greatly varied at use types and district level. Out of 122 useful botanical taxa documented in this study, only three species *A. archangelica, P. polyphylla* and *N. scrophulariflora* received the highest consensus (IASc > 0.5) among the participants of Darchula. All three species were used as medicine. The use of *N. scrophulariflora* against fever and headache was folkloric with higher IASc in KSL, Nepal supported by the ealier findings (Garbyal et al., 2005a; Gangwar et al., 2010; Kunwar et al., 2015; Negi et al., 2017). *P. polyphylla* is considered as a common antidoting plant and *A. angelica* as effective herbal for indigestion in traditional medicine. Species *A. pindrow, B. ciliata, C. aciculatus*, *P. cerasoides* and *Q. lanata* received the highest IASc (> 0.5) among the participants of Baitadi. All species except *B. ciliata* were used for livelihood and ritual uses. *P. cerasoides* emerged as important for participants for ritual uses. Other ritual species with less IASc (< 0.5) reported in this study were *Ficus religiosa* L., *Mangifera indica* L., *Butea monosperma* (Lam.) Kuntze and *Selinum wallichianum* (DC.) Raizada & H.O. Saxena. All these species are reported as ritual and culturally valuable in KSL, India (Shah & Joshi, 1971; Bhatt, 2010). *Aegle marmelos* (L.) Correa, *F. religiosa, P. cerasoides, M. indica, P. emblica* are cultural and religious plants of Nepal (Majupuria & Joshi, 2009). Participants considered these five trees as *Panch pallav* (a ritual assortment of five holy leaves) and used them ritually during three major events of life: birth, marriage and funeral ceremonies. Besides these, *Artemisia indica* Willd. (Kurjo), *Ocimum tenuiflorum* L. (Tulsi), *Syzygium cumini* (Jamun) were also reported as ritual plants in this study.

Other high IASc species *A. pindrow, C. aciculatus* and *Q. lanata* from Baitadi district were regarded as useful for livelihood as wood, fuel and fodder. Since we considered the Baitadi district as relatively accessible than Darchula, all the useful plants with high consensus of the district are associated with the accessibility and availability. Of the five high IASc (. 0.5) species, *F. religiosa, P. cerasoides* and *Q. lanata* are abundant at nearby settlements. The high consensus value species were not only being frequently used in study area, they were also reported as highly useful in other villages of study districts (Pant et al., 2005; Kunwar et al., 2015; Aryal et al., 2018). Of the total eight species with high IASc (> 0.5), four were for medicinal purposes and four were for non-medicinal (livelihood and ritual) purposes. This result illustrates that despite living in the same cultural landscape, the species uses were differently valued, perhaps because of different ethnic groups, accessibility, use values and livelihood strategies. This result was supported by the fact that none of the highest IASc common species was emerged in quadrat A. Darchula district is relatively undisturbed and more distant than Baitadi district. Traditional healers often cite the distant and undisturbed sites as refuges for quality and quantity of medicinal plant products. Other studies report similar findings from adjoining areas of India (Garbyal et al., 2005b) and other parts of the world (Byg et al., 2007; Adnan & Holscher, 2011), where a higher number of indigenous species with medicinal usage are being used at remote and higher altitudes.

The result of IASc was supported by informant consensus factor FiC. Naturally both assess the consensus however, the first assesses the consensus at species level whereas the later evaluates at use types/category. The highest FiC (0.87) was reported for socio-cultural livelihood use (wood, fuel, fodder) followed by 0.85 for cultural/ritual uses in Baitadi district. Contrarily the highest FiC value (0.83) was recorded for medicinal use in treatment of gallstone and endocrine aliments in Darchula district. Higher FiC values indicate the consent of informants on the specific use of a plant in a traditional use system (Teklehaymanot & Giday, 2007). The average FiC value of Baitadi and Darchula district showed that ritual use of plants possesses the highest FiC value (0.81) followed by digestive system disorder (0.76) and infections (0.74). Higher consensus on ritual uses was consistent with sacredness of the area. Baitadi and Darchula districts are southern parts of the KSL, and they are well known for culture and religious based taboos, religious fencing and a high number of sacred peaks (Oakley & Gairola, 1977; Chand & Wilson, 1987; Sharma, 1997; Chhetri & Pandey, 1992; Bhatta, 2003).

The frequent use of medicinal plants to cure ailments could be attributed to the high preponderance of digestive and infectious disorders in the area. This account aligns with the government reports (GoN, 2011; DDO, 2010) stating the prevalence of diarrhea and dysentery in far-western Nepal. The health and development index, partly a measure of nutritional status, ranks the study districts (Baitadi and Darchula) 66 and 62 among 75 districts of the country (GoN, 2011). Health was further jeopardized by food deficiencies (UNWFP, 2006; Brusle, 2008; Chaudhary et al., 2010; Bradford, 2018). The situation was provoked by people drinking contaminated water, eating improperly stored and spoiled foods and conditions of poor nutrition.

The highest number of taxa and use reports for treatment of stomach disorders in Darchula district was also observed by Aryal et al. (2018). Since our study area is a food deficit and 72% participants had food deficiency > 6 months/year, the tradition of wild plant collection, use and management was a common strategy to combat poverty paired with geo-ecological constraints and sacredness of the landscape, resulting in insignificant difference between the groups of people with food deficiencies. The role of plant collection in Darchula and Baitadi districts in complementing food availability was appreciated (Aryal et al., 2018). The low consensus of plant use between Baitadi and Darchula district could be due to both cultural divergence, varied accessibility as well as physiographic heterogeneity.

We found a cultural distinction in collection, use and conservation of plants. Mountainous pastoral communities of Darchula people often collect plants from remote areas for medical ethnobotany. They reported that their household economy was completented by 8.13±4.75% from the sales of medicinal plants of rural undisturbed areas whereas the less (5.96±5.46%) was reported in Baitadi district. The sedentary hilly farmers of Baitadi value plants more for social, ritutal and livelihood and often generalist collectors from nearby areas of settlements forage there. Conversely, the forage from distant forest areas in Darchula was associated with quality products, traditional medicine and elder healers.

Since the Darchula people are occupational traders of medicinal plants, they have long been foraging medicinal plants products from remote and relatively undisturbed areas and selling them to lowland groups and to India and China for grains. While collecting medicinal plants, many collectors worship and pray to plants and acknowledge the spiritual powers for quality products (Cameron, 2011) because they do believe that plants become more medicinal when processed both spiritually and materially (Chandrashekara & Sankar, 1998; Garbyal et al., 2007). Thus, mountains are valued as sacred sites and destinations for livestock grazing and the collection of quality medicinal plants for rural household (Christensen et al., 2008; Pouliot et al., 2016).

People often trade medicinal plants such as *A. wallichii* Kunth (Ban lasun), *A. hypsistum* (Jimbu), *B. ciliata* (Vedaite)*, Delphinium denudatum* Wall. ex Hook.f. (Nirmasi), *P. polyphylla* (Satuwa), *N. grandiflora* (Jatamansi), *N. scrophulariflora* (Katuko), *O. sinensis* (Yartsagumba) and *Z. armatum* (Timur), etc. The pursuit of collection, bartering and trade of medicinal plants was dated back to 1960s (Manzardo, 1977; Bista & Webb, 2006; DFO, 2016). The plants were bartered for grains in the districts before trading (Clarke, 2007) and the tradition was balanced until 1970s' (Hitchcock, 1973; Chand & Wilson, 1987; Chhetri & Pandey, 1992). When the district forest offices were set up in 1970s, the institutionalized trading practice was started, and abundant species such as *B. ciliata, S. chirayita, V. jatamansii*, etc. were collected for trading.

Nepal Government records (2000-2016) show that *S. chirayita* was traded 3.6 tons in 1999, 4 tons in 2008 and 2.7 tons in 2016 from both districts (GoN, 2006-2016). Other local medicinal plants *Asparagus racemosus*, *B. asiatica*, *C. tamala* were also collected from both districts in 1999 for marketing purpose. The households involved in collection of *O. sinensis* from remote alpine pasture in Darchula district gathered 140 kg in 1998 to 1,440 kg in 2004 (Chhetri & Lodhiyal, 2008), 4,500 kg in 2008 (Pal, 2009) and 5,000 kg in 2016 (DFO, 2016) indicating the steady growth in collection of high value medicinal plants in an effort to earn quick economic returns. Although an indepth investigation of trade dynamics in the districts was outside of the scope of this study, it is noteworthy that several informants recalled the bartering, citing the importance of traditional trade and lamenting the declining medicinal plants because of market-driven collection.

Such directed and culture mediated collection and use of plants for personal gain (health and income) over communal incentives (social and ritual significance) yield a direct impact on resource conservation. Persistence of intercultural divergences occurred in specialized medicinal and ritual uses of plants or trade of certain species. The distinction of knowledge of cultural groups substantiates the hypothesis that cultural differences play an important role in the transfer and maintenance of indigenous knowledge. Despite the persistence of different strategies for collection and utilization of plants, the geographic adversaries have strengthened a homogenous strategy of employing locally available plants for livelihood and culture. A way of life in rural hills/mountains involves adjusting to the difficult environment, little food, and limited accessibility, with appropriate strategies (Macfarlane, 1976). Thus, the tie between people local plants, people and places is strong and inseparable in Darchul and Baitadi districts, far-western nepal.

Intracultural Analysis: An intracultural difference of plant use knowledge at the individual level was evident with the cultural heritage. Participants' year of residence in the study area, size of their livestock herd and land, family size the participants and the time required to access health post ($p \leq 0.001$) were positively associated with the ethnomedicinal knowledge of plant use. The greater length of residence in an area helps in procuring greater vast knowledge required to use the resources wisely (Wilkinson, 1987). There were two household lineages in Baitadi district, living there for more than 300 years, that described usefulness of 16 plants and 20 use reports each, higher than the average record (use reports 14.34; useful plants 12.68 person^{-1}). This supports the tenet of a positive association between longer residence and greater knowledge.

Limited access to health centers compels people to use local resources for their primary health care, inferring the role of geography. *N. scrophulariflora, A. archangelica, P. polyphylla* are abundant in remote and wild forests and highly medicinal (IASc > 0.5). *O. sinensis* grows well in alpine pastures is folkloric as tonic and antipyretic in Darchula. This could be one reason that local communities forage the wild and distance sites for quality products regardless of the distance and geo-ecological constraints. While herding, summer grazing and ascending for collection of medicinal plants, local people share the knowledge of plant identification, collection, uses and conservation. Horizontal transmission of knowledge among shepherds and herders while herding and transhumance contributes a high amount of knowledge sharing, aiding knowledge conservation. The cultural values often aid the knowledge of plant use, collection and management in high altitude areas (Weckerle et al., 2006).

The transhumance practice generates a deep connection to the environment, enhanced by the fact that during this time the families have limited choices (Ladio & Lozada, 2003). The indigenous livelihood strategies such as animal husbandry, transhumance with their livestock, and medicinal plant collection were interlinked in study area. Livestock ownership linked positively with ethnobotanical knowledge in mountains (Chinsembu et al., 2014). The size of livestock herd, land owned and family member were slightly correlated (household~land 0.38, household ~ livestock 0.41 and land ~ livestock 0.48). Larger family owns larger herds (Mehra & Mathur, 2001; Mafimisebi et al., 2012), which is important for the transhumance community (Aryal et al., 2014). Household size increases brought about an increased utilization of medicinal plants, perhaps due to economic pressure in larger families. The positive correlation between medicinal plant use and age has been noted elsewhere (Finerman & Sackett, 2003; Pant et al., 2005). However, we did not obtain a significant relationship between the participants' age and the knowledge of plant use and accepted the null hypothesis. No difference of plant use knowledge along the age was reported by McMillen (2012).

OUR and UUR were insignificant along age whereas the MUR was slightly significant ($p = 0.55$) indicating that the knowledge of medicinal plant use was insignificantly decreased as age increases. Our results indicated that plant use knowledge was less varied among the participants because *in situ* transmission is underway when needed as described by Phillips & Gentry (1993a) and Paniagua-Zambrana et al. (2014). Age group (40-59, 60-79, >80 yrs) analysis also did not reveal the significantly different MUR knowledge ($p = 0.46$-0.95) among them, however, the age-group (40-59 yrs) possessed the highest MUR 8.19± 0.53 comparable to MUR 7.2±0.79 of >80 yrs age-group.

A nonexistent relation ($p = 0.32$) was already reported from adjoining villages of our study sites (Kunwar et al., 2015) and semi-arid and transhumance communities of Patagonia, Argentina

(p = 0.34) (Lozada & Ladio, 2006). Earlier studies argue that the age group 65-75 holds a greater knowledge of plant use (Mahwasane & Boadua, 2013). Guimbo et al. (2011) found that gender and age have strong effects on the local knowledge of useful plants. However, in this study the role of both factors was insignificant in differentiating the knowledge of plant uses. Neither MUR nor UUR was significantly different in relation to gender. However, the OUR was varied (p = 0.023) and was higher (6.72±5.2) among the male participants. The gendered division of labor in Nepal supported this result where males are often engaged in summer grazing, livestock herding, and extraction of plants from inaccessible sites that would take them to relatively remote and distant sites. Pfeiffer & Butz (2005) reported that plant use is differentiated with men and women due to resource access, and their social roles. Women are more likely involved in managing local resources that are available nearby (Momsen, 2004) and are associated with anthropogenic landscapes (Voeks, 2007).

A weak association of age and plant use knowledge could be attributed to the (non-random) selective samples and the unwillingness or inability to share information explicitly by the elderly groups. The secrecy of medicinal plant knowledge is a common practice in different parts of the world (Kala, 2005) and it was common among the traditional healers in our study area. In the *Baidhya* tradition - local healing tradition in Far Western Nepal (Bhattarai, 1992; Cameron, 2011; Kunwar et al., 2015), the main knowledge of healing is kept with sanctity and secrecy and is confined to few healers.

Healers generally believed that the medicines would lose their efficacy if too many people knew about their use. Elders generally consider Sundays and Wednesdays as good days in collection of medicinal plants while Saturdays and Tuesdays are often avoided due to religious considerations. Again they deterred to collect religious and cultural plants on Mondays, since Monday is considered as a holy day for lord *Shiva*. Thus, the plant knowledge often belongs to the specialty domain of a culture and limited number of individuals and may be secretive for this purpose (Vandebroek, 2010), whereas other general knowledge is widely available to other community members and freely shared.

Species-use curve showed that the curve attained asymptote in Baitadi district (range of respondents age 40-96 yrs). However, the curve was not leveled-off in Darchula district (range of respondents age 41-102 yrs). As sampling effort increases in Darchula, more elders/healers will be encountered and more species are likely to be recorded. Thus, if we consider elders as sample respondents for ethnobotanical studies, a greater number of samples are required in order to find the saturation point of the community consensus and statistical significant values of knowledge (Heck et al., 1975).

General knowledge such as OUR was commonly shared among communities through cultural learning ($p = 0.06$) whereas the specialty knowledge like use of medicinal plants for ailments (MUR -0.028) and unique use reports (UUR 0.85) were transmitted through closed and vertical sharing with directed and dedicated apprenticeships under the tutelage of senior practitioners, resulting in constrained transfer. There were 75% (57 out of 77) traditional healers that learned medicinal plant use knowledge from their parents and grandparents (vertical transfer), whereas 25% healers learned themselves or from peer healers (horizontal transfer). Vertical knowledge transmission is often associated with family members and the sharing of secretive medicinal plant use knowledge (Bhattarai, 1992; Cameron, 1998). Even though the difference was insignificant, the knowledge of healers (MUR 7.79±0.34) influenced the use of medicinal plant collection and use, comparable to that of non-healers (MUR 6.91±0.56).

Moreover, the knowledge was effaced by the decline of traditional healers and their limited sharing (Kunwar et al., 2015; Aryal et al., 2018). Lower population growth in the districts (0.70-0.92) than the national average (1.44) and higher than national outmigration rates (absentee population of 7.51% higher than the national average 7.23%) (GoN, 2011), produced a decline in the number of healers and those with traditional knowledge. Families from the region have migrated to cities and lowlands, resulting in accentuated decline in tradition of indigenous land-use and plant collection, use and management. There were about 15 traditional healers in each village in KSL, Nepal in 2014 whereas only six in each village were reported in the present study. The number of healers is decreasing fast (about 7% per annum) in KSL, Nepal (Kunwar et al., 2015) resulting in threatened knowledge of plant use.

The participants who are nonliterate had also significant UUR ($p = 0.043$). MUR was also influenced by literacy level of participants (nonliterate 7.78±2.81, literate 7.38±3.14). Higher knowledge of MUR to the nonliterate participants could be attributed by their direct association with forest and natural reosurces and frequent and first choice of traditional and home based medicines for ailments. Thorsen & Pouliot (2016) showed that the traditional medicine is the first choice and ultimate hope of recovery of chronic illeness among rural elders and nonliterate people of Nepal. The prevalence of traditional medicine was attributed by the limited number of health workers (one health worker for every 3,300 people in Baitadi and 1,900 in Darchula) (DDO, 2010) than the traditional healers (one for every 100 people) in Nepal (Gillam, 1989; WRI, 2005), and the belief and long rooted tradition/history of using quality medicinal plants in rural and remote areas. A similar account of higher traditional knowledge of plant use among nonliterate participants was reported by Umair et al. (2017) in Pakistan, Himalaya. The participants who speak only one or two dialects were significantly knowledgeable to OUR ($p < 0.001$).

Among the subets of use reports, MUR and OUR were significantly different ($p < 0.001$) between the participants of different livelihood type: semi-nomadic communities from rural mountains of Darchula (MUR 8.69±3.01) and sedentary communities with suburban setting of Baitadi (MUR 6.75±2.67). Most of the people from Darchula district inhabiting in remote areas are occupational medicinal plant collectors and traders, and do summer grazing, travellling during transhumance and often seek high value medicinal plants for trading purposes. The under-privileged groups (Byashi and *Dalit*) were knowledgeable on MUR (8.07±3.2) however insignificant ($p = 0.27$). They were less knowledgeable on general use reports (3.60±3.14, $p < 0.001$) and unique use report 1.60±1.37, $p = 0.045$).

The *Dalit* are disadvantaged groups of the country and have limited access to the natural resources in Darchula district because of the sociocultural and caste system (Manzardo et al., 1977; Graner, 1997; Cameron, 2009; Folmar et al., 2015). Their limited access could have limited their plant use. MUR was specific to indigenous underprivileged minority groups and rural agro-pastoral livelihood type because of the subsistence economy and historical connectivity to the medicinal plants (Shrestha, 2001). OUR was folkloric to their counterpart with highest significance level (p < 0.001). OUR was significantly different (p <0.001-0.023) for five out of seven categorical variables: access to opportinity, gender, occupation, language spoken and livelihood type. The higher mean values of OUR 7.38 and 8.92 compared to 3.60 and 2.88 respectively of privileged groups and from sedentary communities indicated that the communities living with amenities and better priviledge were more knowledgeable about general non-medicinal uses (OUR) such as uses for livelihood and rituals and divergent from Darchula people.

Sedentary community living in low-elevation environment has accommodated livelihood to an economic system based in agriculture, markets and jobs. Being close to markets, availability of medical supplements in markets and pursuance of agribusiness livelihood contribute to the reduced dependency on medicinal plant resources and contribute less to MUR in Baitadi lowlands. The use of modern medicine, increasing road linkages, decreasing plant resource availability and agriculture intensification are responsible for the changing medicinal plant use knowledge in Baitadi (Atreya et al., 2018). The use knowledge of ritual and religious plants is still persistent regardless of the modern facility if cultural supplements are unavailable in the markets. High culturally shared species (IASc) are found nearby settlements and common for general uses whereas the specialty use (such as MUR) species are foraged by trained personnel, guided methods and from the remote undisturbed sites (Byg et al., 2007). The difference in plant use knowledge may help in diversifying the livelihood strategies in accordance with the environment.

Conclusions

The extensive usage of plants for socio-economic reasons, livelihood and rituals indicates that the plants, people and culture in the Nepal Himalaya are inseparable. We found that the knowledge of plant use seems to follow a pattern according to ecological conditions (availability) as well as the cultural significance of the landscape. However, the latter prevails. The use knowledge of plants coincided with the richness of species and plant families. Foraging by the agro-pastoral communities from the remote undisturbed areas for quality products and medicines in Darchula district was divergent with the collections from ruderal and nearby areas in Baitadi district by generalist collectors for ritual uses.

General knowledge of plant use such as OUR was commonly shared among communities through cultural learning whereas the specialty knowledge like use of medicinal plants for ailments (MUR) and unique use reports different from peers (UUR) was transmitted through closed and vertical sharing with directed and dedicated apprenticeships under the tutelage of senior practitioners. The regional particularities - geographic (isolation, accessibility, settlement) and cultural (livestock, land, length of residence and livelihood, and rites) - seem relevant in explaining the main differences in the plant use knowledge in Baitadi and Darchula districts, Nepal. These results contribute to a growing body of literature that expands our understanding of patterns of knowledge of useful plants across culture and geography.

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FOREST COVER AND LAND-USE CHANGE IN RURAL MOUNTAIN DISTRICT DARCHULA, FAR WESTERN NEPAL (PUBLISHED IN THE FLORIDA GEOGRAPHER 49:1-14)

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Abstract

Description of land-use dynamics provides insights into the ecological and biogeographical processes. The relationship of human and biological components and climatic conditions are well incorporated in land-use analysis. In the present communication, we aim to map the forest and land-use changes and analyze the alteration at spatial and temporal scales in order to better understand the geo-ecological and socio-cultural complexities using aerial photography, satellite imagery and topographic maps. An account of forest cover change was evidenced over time. Community based forest management system aided restoring forest cover whereas the overexploitation and human migration were subjected to degradation. These changes were considered accentuated as urbanization, human migration, population growth and overexploitation are underway. However, in the recent period (between 2010 and 2016), the cover of forest was slightly increased, consistent to the countrys' profile of forest cover change, serves a hope of better human-nature interactions in the days ahead asks more integrated and periodic researches for precise monitoring.

Key words: Land-use, Forest, Darchula, Kailash Sacred Landscape, Nepal.

Introduction

The high altitudinal gradient, complex topography, fragility, high warming rate, biodiversity hotspots and close proximity to indigenous communities make the Himalaya environment a rare combination of climatic, anthropogenic, geology, culture, ecology and topographic characters (Korner, 1998). However, they are threatened by global climate change (Yao et al., 2006), and aggravated by human induced forest degradation, deforestation and habitat fragmentation (Houghton, 2003; Das, 2008). Climate change has left several biological fingerprints including change in land cover and land-use (Comarazamy et al., 2012) as well as change in species composition, range and distribution shift of species and alterations in phenology of organisms (Billings, 1974; Menzel, 1999; Parmesan & Yohe, 2003). However, mountainous regions very sensitive to climate change and curtailed by land-use and land cover change (Khanal, 2002) are understudied (Schickkoff, 2005; Shrestha, 2005; Xu et al., 2007; Regmi, 2008; Bernstein et al., 2008; Eriksson et al., 2009; Elliott, 2012).

Covering an understudied area like the Himalaya mountains and considering attributes like land-use/cover change may give insights to analyze the alterations on socio-economy, culture, ecology and landscapes and help understand the broad geo-ecological paradigm (Chhetri, 2015). Analysis of socio-cultural information within the framework of GIS/Remote Sensing has proven to be a valuable entity for validation of driving forces of land-use land cover change in Himalaya as well as other landscape (Paudel & Anderson, 2010; Rimal et al., 2017a). Ecological complexity and heterogeneity can be understood by considering a complex view that includes many relevant factors (climate, topography, land-use and human culture) and considers a cross scale (coarse and finer) study (Holtmeier, 2009). The description of land-use dynamics provides insights into the ecological and biogeographical processes and relationship between human and biological components and climatic conditions (Gunderson & Holling, 2002; Shi & Wu, 2013). However, digital maps of recent land-use and land cover change and developments in the Nepal Himalaya are scarcely available. Thus, in the present communication, we aim to identify the latest changes of land-use land cover and assess the changes at various spatial and temporal scales in order to understand the geo-ecological and socio-cultural complexities.

Methodology

Study Area Description: This study was carried out in the Darchula district, Far Western Nepal, a part of Kailash Scared Landscape (KSL). The KSL, a trans-boundary landscape within China, India and Nepal has been set up to conserve ecosystem services and biodiversity of the area through sustainable resource management (Chettri et al*.,* 2009). The KSL contains some of the highest and most remote mountains in the world, including the sacred Mount Kailash (6,638 m), which is located on the edge of the Tibetan Plateau and the border of Nepal and Tibet. The landscape's bioclimatic zones include hot and semi-arid regions in the southwest, lush green and humid valleys in the mid-hills, extensive mountain forests, moist alpine meadows, remote and arid trans-Himalayan valleys and high altitude grasslands and steppes, as well as extensive permanent snow and ice ranges (Zomer et al., 2013). The landscape exhibits significant heterogeneity, both geographically and culturally, covering at least four major geological and physiographic zones and inhabited by seminomadic *Raute* tribe and a minority ethnic group *Byashi-Sauka*. Ranging from below 400 m asl to over 6,600 m asl and characterized by extreme variations in topography, the ecosystems of the KSL range from moist subtropical to temperate, alpine and cold high altitude desert bio-climates (Zomer et al., 2013).

Our study area, Darchula district is one of the most inaccessible and underdeveloped regions of Nepal and faces numerous conservation and development challenges. The district with 233,700 ha area with trans-Himalayan and mountain geography has facilitated the strengthening of unique biodiversity and indigenous knowledge of plant use (Negi et al., 2017). The diverse geographic has given support to high level of biodiversity including an array of forest types (such as moist subtropical broadleaf to temperate oak forests, alpine conifers and high altitude pastures) (Zomer & Oli, 2011; Elliott, 2012). The harsh climate, poor accessibility, marginality, and high level of poverty manifest high dependency on natural resources leading to overexploitation (Roy et al., 2009). The rugged terrain, geographic heterogeneity and unsustainable harvesting (Kunwar et al., 2012; Kunwar et al., 2015) pose a serious threat to the land-use systems, with implications for natural biodiversity and human development (Uddin et al., 2015a).

Methods

Recent studies use aerial photography and satellite imagery as a tool for mapping and tracking updates and assessing land use and land cover change for environmental monitoring (Zhao et al., 2016; Paudel et al., 2016; Wang et al., 2017) complex area monitoring and mapping. Geographic information system (GIS) and remote sensing (RS) tools are cost effective and accurate for LULC monitoring which provide excellent information of spatiotemporal change in global to local scale (Rimal, 2017b). The release of freely available high-resolution satellite images (i.e., Google Earth), which approach the quality of aerial photographs, opened up new possibilities. Google Earth is frequently used to display scientific results (Scambos et al., 2007) but in some cases also as a data source (Sato & Harp, 2009).

There are different time-series LULC data developed from different sources (e.g., National remote sensing center for 1984, Master Plan for Forestry Sector, 1985, LRMP, 1986, Cadastral survey after 1992, National level forest inventory 1994, Japan forest technology association 2000) (GoN, 2008). Recently, the Department of Forest has prepared forest resource map in 2016 (DFRS, 2015) and Uddin et al. (2015a) published land cover change dynamics of Kailash Nepal. The Kailash sacred landscape is a transboundary landscape among Nepal, India and China. However, comparison of the over-time database is largely hindered by the validity regarding the purpose, methodology, accuracy, data sources and scale of information. Thus, in this study we analyze the forest and land cover change of Darchula using time series data from 1990 to 2016 and assess the changes at spatial and temporal scales.

Geometric rectification was carried out using a road network map in the local projection system (UTM). Image enhancement, contrast stretching and false color composites were created to improve the visual interpretability of the image by increasing apparent distinctions between the features. Knowledge-based visual interpretation, texture and association analysis were performed at the preliminary stage. Rivers, roads, settlement and buildings were manually delineated by interactive interpretation procedures (following the tonal, textural, contextual, pattern, size, shape, shadow, association and site pattern of each sample category (Zong et al., 2014). Identification was also done with the help of topographic maps, supervised and isodata classification maps.

Attributed tables of previous maps before digitization and after digitization were compared and the changes were detected. Topographic maps of high mountain regions provide useful information about terrain (altitude, slope, depressions, etc.) Rivers, contours and village boundaries were taken for making DEM and hillshade of the district. DEM was used to assign the elevation. The .tiff files of the three layers were stacked in ERDAS photogrammetry and maps were produced in Arc GIS by using DEM (Zoomer et al., 2002). Their attributes were exported to excel for further analysis.

Data Acquisition and Analyses

A topographical map published by the Survey Department, Government of Nepal, 1996, for the study area with a scale of 1: 25,000 was used as the reference map for the analysis of images. The map was based on an aerial photograph at a scale of 1:50,000 taken in 1996. All the required digitized layers were collected from the Department of Survey, Nepal. However, many of the datasets are available and generated by digitizing topographic maps scaled 1: 25,000 so in most cases the spatial and semantic resolution of information is too poor to be used in local spatial analyses. Again digital data extracted from 1:25,000 or 1: 50,000 scaled maps only cover small parts of the investigation area and therefore seldom meet the needs for research (Gspurning et al., 2004). Thus, remote sensing techniques and digital methods of data analyses were used that provide an accuracy assessment, independent from the local situation and the cartographer. Henceforth, three consecutive maps (1990, 2000, 2010) of the same area were collected and their features were analyzed at temporal scales.

Moreover, three time-series atmospherically corrected surface reflectance (SR) Landsat images for the year 1996, January 9, 2006 March 1 and 2016 February 17 (Path/Row, 144/39) were obtained from the United State Geological Survey (USGS) website (https://earthexplorer.usgs.gov/) for further analysis and verification. SR data are ready for application analysis as they include atmospheric correction, geometric correction and other requirements and they are useful for land cover monitoring (Rimal et al., 2017a). The maximum cloud-free images were included in the study. All the images were clear and nearly free of clouds. However, some images contained seasonal snowfall cover in the northern part. All data was projected in UTM (i.e. UTM WGS 1984, Zone 44N). A topographical map published by Survey Department, Government of Nepal, 2000 (scale 1:25000) was used as the reference for image analyses. Google Earth image was used for ground-truthing. A 30 m digital elevation model (DEM) data was collected form SRTM. All obtainable images, pre-processing, stacked, subset and classification were accomplished using ENVI software and classified using support vector machines (SVM). A modified version of land cover classification scheme was used for remotely sensed data as recommended by Anderson et al., (1976) (Table 6.1).

Table 6.1 Land cover classification scheme

Land cover types	Description
Urban (Built up)	Urban and rural settlements, commercial areas, industrial areas, construction areas, traffic, airports, public service areas (school, college, hospital)
Cultivated land	Wet and dry croplands, orchards
Forest	Evergreen broad leaf forest, deciduous forest, scattered forest, low density sparse forest, degraded forest/ Mix of trees (<5 m tall), other natural covers
Grass	Mainly grass field- (dense coverage grass, moderate coverage grass and low coverage grass)
Barren land	Cliffs/ small landslide, bare rocks, other permanently abandoned land
Sand	Sand area, other unused land, river bank
Water	River, lake/pond, canal, reservoir
Ice and Snow cover	Perpetual/ temporary snow cover, Perpetual ice/ glacier lake

Results and Discussion

Land Cover: The land cover of Darchula district shows the least cover of agricultural lands and the most of forests, snow cover and barren land. The northern area of the district is ruderal, bare and dry due to steep geography. South and western parts of the district are lowland, more accessible and cultivated. Because of the steep and fragile geology (Figure 6.1), forest degradation is serious and further loss is anticipated (Uddin et al., 2015a) since 70 percent of the population of KSL area is dependent on agriculture (Zomer & Oli, 2011). As traditional farming in the district meets food only about six months a year the alternative livelihood strategies like transhumance, animal husbandry and collection of forest products are very common. Human communities that inhabit in remote, rugged and rich ecosystems use diverse livelihood strategies such as utilization of different ethno-ecological environments, sometimes defined in accordance with altitudinal gradient and distance of accessibility (Aldunate et al., 1981) and associated with adaptive measures to the changed environment.

Forest Cover Until 1990: The change in forest cover in the district was non-linear however, insignificant over time. The change of forests subjected to cultivation purpose was elusive. There was severe deforestation before 1970s due to forest nationalization (Forest Nationalization Act 1957) and cadastral survey (Chand & Wilson, 1987) and it was aggravated due to pressure of fuel wood, fodder collection and grazing (Chhetri & Pandey, 1992). Forests were considered an open access commodity and the rate of forest degradation for cropland was intense until the 1970s; resulting in imbalance of economic development, human activities and the overall environment (Collins & Jenkins, 1996). Decreasing forest cover by 50% and increasing croplands by 55% was reported in the Karnali zone between 1950 and 1972 (Bishop, 1990).

Community managed forest system introduced in the Darchula district in 1979 was a breakthrough in controlling the deforestation and reiterating the green cover (Campbell, 1987), nonetheless, the recovery was slow but consistent in the early years between 1980 and 1990 (Gautam et al., 2004). However, some local and indigenous forest management interventions were in place in Byash, Huti and Pipalchauri (Darchula) (Chand & Wilson, 1987) before 1979 to derail the degradation. Between 1979 and 1986, there was a consistent increase in forest cover (MPFS, 1988) with less than five percent increase between 1978 and 1998 in the Baitadi and Darchula districts (Chaudhary et al., 2010). Whole Mountainous areas of Nepal experienced increased forest cover between 1979 and 1985 (Nield, 1985) and so was in the Darchula district (Chand & Wilson, 1987). Over time, district community forest management took momentum and the forest cover increase was supplemented.

Forest Cover After 1990: However, the handing over the government owned forests to communities was discontinued in 2005 and has resulted in decreased in forest cover. There was 9% decrease in forest cover aftermath in the district between 2001 and 2016, consistent to the findings of Uddin et al. (2015a). Built up areas (settlement, buildings, roads) were rapidly increased, as seen in other areas (LRMP, 1986; Acharya & Dangi, 2009; Humagain, 2012; Uddin et al., 2015b). Whole the country faced the severe deforestation in the recent decades with 0.01% per annum (Reddy et al., 2018). We speculate that the intensive changes in the recent years could be due to anthropogenic causes such as increasing human migration and laying the land fallow provoking rampant growth of non-native invasives. The forests once degraded were laid unattended and aggravated by the growth of ruderals. A social factor, continuous out-migration from the study area for menial work in India and low-land Tarai (Poertner et al., 2011) has left agricultural lands fallow, led to lack of labor (Maren et al., 2013) and a change in indigenous land-use management systems (Pant et al., 2005), also fomented forest degradation. Increasing forest degradation and shrub cover were anthropogenic and attributed by overgrazing, forest fires, over-exploitation and out-migration (Ekholm, 1975). Contested with the earlier studies (Khanal, 2002; Humagain, 2012; Uddin et al., 2015a; Paudel et al., 2016), forest cover was not subjected to change into cultivated land in Darchula district.

The decade long land-use change analysis of the district revealed that the change in forest cover between 1990 and 2010 was negative (Table 6.2). There was 2.36% forest cover loss between 1990 and 2010 in Darchula district. This finding was supported by the intensive changes of NDVI at northern part of the district (Kunwar et al., 2016). A recent study by Uddin et al., (2015a) on land cover change and forest fragmentation of Northern Darchula showed that there was a 9% decrease in forest cover and 12% increase in cropland between 1990 and 2009. Cropland expansion, high dependency on forest, and overexploitation of forest resources are the major drivers of land-use change and fragmentation and inevitable over time as urbanization, human migration, population growth, etc. are under way. A further 4% decline in forest cover and 5% increase in cropland were predicted by 2030, together with a slight increase in grassland and barren area (Uddin et al., 2015a) may worsen the forest cover of the district.

Table 6.2 Selected land cover status of Darchula district between 1990 and 2016

Year	Forest (ha)	Shrub land (ha)	River/Water body (ha)	Barren land (ha)	Others (ha)
1990	58,940 (25.2%)	16,924 (7.2%)	788 (0.3%)	14,844 (6.3%)	142,834 (61.1%)
1996	57,639 (24.6%)	16,965 (7.2%)	824 (0.3%)	18,100 (7.7%)	140,172 (59.9%)
2000	58,021 (24.8%)	16,663 (7.1%)	762 (0.3%)	18,201 (7.7%)	140,053 (59.9%)
2006	59,220 (25.3%)	16,464 (7.0%)	779 (0.3%)	13,700 (5.8%)	143,537 (61.4%)
2010	57,544 (24.6%)	16,644 (7.1%)	884 (0.3%)	15,684(6.7%)	142,944 (61.1%)
2016	59,090 (25.2%)	17,105 (7.3%)	596 (0.2%)	13,035 (5.5%)	143,874 (61.5%)

Moreover, time-series atmospherically corrected SR Landsat images of 1996, 2006 and 2016 revealed that there was a gradual increase in grasslands at the cost of recession of snow cover (Figure 6.1). Since the deforestation is least in Far Western Nepal (5.5%) during 1930-2014 (Reddy et al., 2018) and the negligible in mountainous areas (Schweik et al., 2003) resulting in insignificant changes in forest cover between 2006 and 2016 (Table 6.2) in mountainous district of Far Western Nepal. Whole country faced 1.9% forest loss between 1990 and 2000 and 0.7% between 2000 and 2010 (-1.23/yr) (Saatchi et al., 2011). We also recorded a little transition in recent decade between 2006 and 2016 however; in the last five years the cover has been increased, consistent with the government record (DFRS, 2015). DFRS (2015) recorded that the forest cover of the nation is 40%, which was a slight increment from the last monitoring (39.6% in 1998, DFRS, 1998). We expect a better human-nature interaction in Darchula district in the days ahead in the nexus of forest restoration and sustainable development.

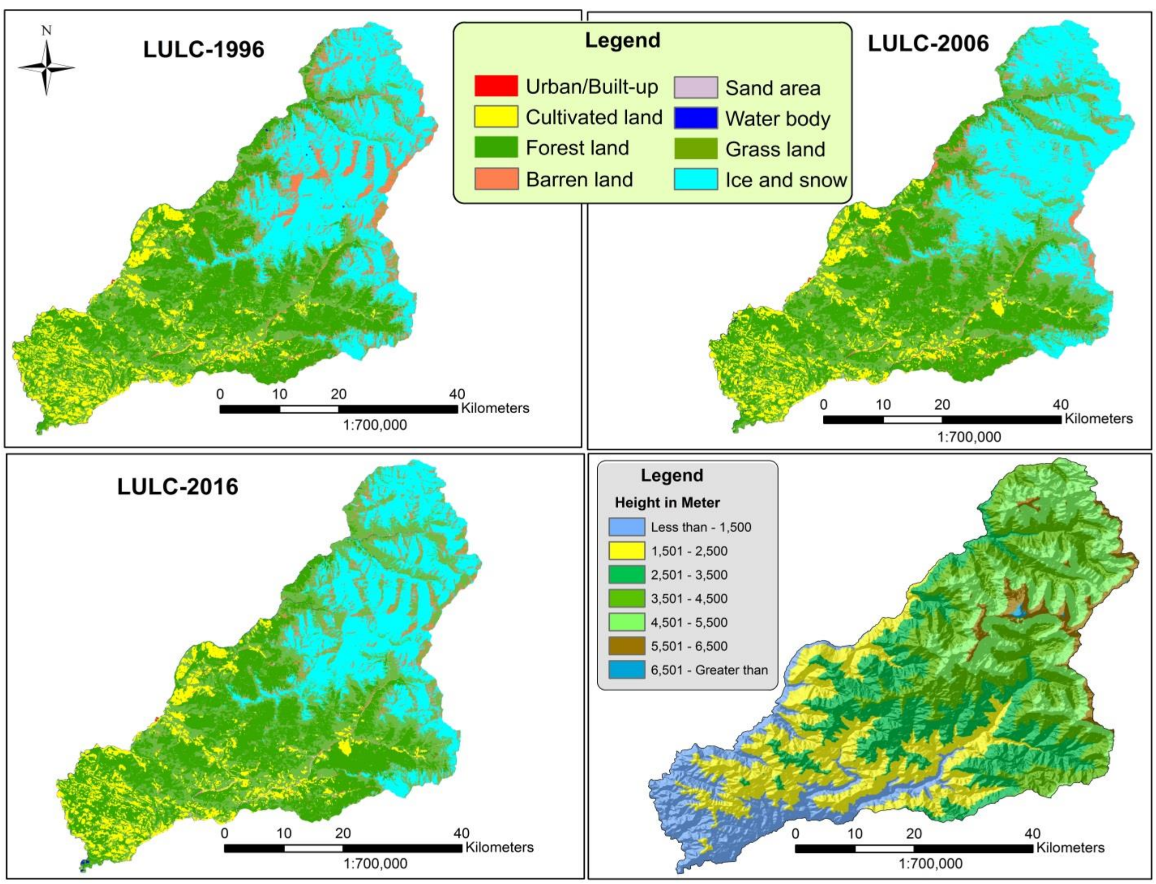

Figure 6.1 Land-use and land cover of Darchula, 1996-2016

Overall, the forest growth was outpaced by the pressures associated with population growth, migration and effacing indigenous forest management knowledge. The changes in land-use practices, including sedentarization of pastoralists, overharvesting of high-value medicinal plants, uncontrolled livestock grazing and rapid increases in the number of tourists in alpine areas and the resultant pressures, have led to degradation of forest resources in the KSL (Rawat et al., 2014). The local communities depend largely on the high-altitude rangelands for their livelihoods and for cash income from collection and sale of non-wood forest products namely *O. sinensis* (Himalayan caterpillar fungus) and aromatic herbs (Dadal, 2010; Chaudhary et al., 2010; Kunwar et al., 2015).

Conclusions

This study applies state-of-art methods by combining three geospatial tools: Arc GIS, ERDAS and Google Earth for interpretation of physiographical characteristics of an area for future use of research. The change in forest cover in the district was non-linear however, insignificant over time. The regained forest cover with the help of community based management system was jeopardized by the recent changes. The loss of forest cover until 2010 was analogous to the alteration of human socio-culture, weather pattern and lifestyle. High dependency on forest and over-exploitation of forest resources were the major drivers of the change and they are still in place as urbanization, human migration, population growth and exploitation of government forests are under way. However, there was a little transition between 2010 and 2016, analogous to the countrys' forest cover transformation is a hope of better human-nature interactions in the days ahead.

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SUMMARY OF RESEARCH FINDINGS, CONCLUSIONS AND FUTURE DIRECTIONS

Baitadi and Darchula districts are rich in forest, vegetation and useful plant species and the people of this area showed a large repertoire of knowledge that helps them execute different strategies of plant uses suited to their culture, environments and geography. The populations residing in this rural, remote, rugged, risky and biodiverse environment have adopted and adapted diverse livelihood strategies such as transhumance (summer grazing, animal husbandry, agro-pastoral) and medicinal plant collection and trade. Collection of plants plays an overriding role in the study area, as large populations rely on the forest and useful plants as their primary source of livelihood.

The knowledge of plant collection, use and its transfer was strongly associated with the cultural heritage whereas the eco-geographical condition influences the ways in which plants are collected and used culturally. The collection and use of plants is influenced by species richness and accessibility. The rich knowledge of plant use is the result of the biodiversity of the area, cultural preoccupancy, long-rooted and well-known recognition of the species and the wise use of local resources. A pastoral way of life in arid mountains ensures an ability to move quickly over difficult terrain in extreme conditions with an accurate eye with little food. The extensive usage of plants for socio-economic situations, livelihood and rituals indicates that the plants and culture at KSL, Nepal are inseparable. Widespread belief in the effectiveness of traditional therapies is attributed to people using medicinal plants these over many generations through apprenticeship tutelage. However, the number of traditional healers is decreasing, threatening the existence of tradtitional medicine. The disinterest of the younger generation in practicing traditional medicine, socio-acculturation and the limited sharing of detailed traditional knowledge by elders and healers may pose implications for the conservation of traditional knowledge, ultimately, jeopardizing local biodiversity and livelihood.

The preliminary results of the new records and reports about the plants form the KSL, Nepal demonstrate that the area is a great repository of useful plants and ethnobotanical knowledge. The richness of useful plants and the diversity of plant use knowledge in the remote and rural areas of Kailash, Nepal provided the potential for further research on plant – people interactions. However, the continuous change in land-use, climatic variables and socio-cultural behaviors predicts that forest degradation is expected to accelerate, urging more participatory and community based forest conservation measures with acknowledgement of human, cultural and environmental variables for sustainable management. Conservation of indigenous knowledge before being effaced is thus strongly urged. Enhancing the sustainable use and conservation of useful plants through indigenous knowledge can benefit and improve the local biodiversity and livelihood.

APPENDICES

Appendix A. Forest types in Baitadi and Darchula districts, Nepal

Forest types	Association	Chaudhary et al., (2010)		Zomer et al., (2013)
		Baitadi	Darchula	
1. Hill Sal Forest (700-1,000 m asl)#	*Shorea robusta* Forest (*Anogeissus latifolia, Terminalia tomentosa, Adina cordifolia, Bauhinia vahlii*)	+		+
2. Riverine forest (700-1,500 m asl)	Riverine forest with *Toona, Acacia, and Albizia (Bombax malabaricum, Mallotus philippensis, Acacia catechu*)	+		+
3. Chir pine forest (1,000-2,700 m asl)!#	*Pinus roxburghii* forest (*Olea cuspidata, Capparis spinosa, Woodfordia fructicosa, Indigofera heterantha*)	+	+	+
4. Alder forest (500-2,700 m asl)	*Alnus nepalensis* forest, *A. nitida* forest (*Juglans regia, Quercus floribunda, Populus ciliata*)	++	+	+
5. Oak Forest (2,000-3,100 m asl)!	*Quercus floribunda* forest (2,100-2,750 m asl) (*Alnus nepalensis, Q. leucotrichophora*)	++	+	
	Quercus leucotrichophora, Q. lanata) - Chir pine (*Pinus roxburghii*) forest (2,000-2,450 m asl)	+	+	
	Q. semecarpifolia - blue pine *(Pinus wallichiana*) forest (2,450-3,000 m asl)		+	
	Quercus semecarpifolia forest (2,450-3,100 m asl) (*Abies spectabilis, Betula utilis, Rosa sericea*)	++	++	
6.1 Himalayan Blue Pine forest (2,000-3,500 m asl)	Pine (*Pinus wallichiana*) forest (2,000-3,200 m asl) (*Picea smithiana, Abies pindrow, Q. leuchotrichophora*)		+	
6.2 Pinus-Picea-Abies forest (2,800-3,500 m asl)	*Pinus wallichiana, Picea smithiana, Abies spectabilis, Sorbus cuspidata, Q. semecarpifolia, Juglans regia, Juniperus wallichiana*		+	+
7. Lower temperate mixed broadleaved forest (2,000-2,500 m asl)	*Magnolia kisopa, Castanopsis tribuloides, Alnus nepalensis, Euonymous echinatus, Daphne papyracea*	++		
8. Upper temperate mixed broad-leaved forest (2,000-2,900 m asl)!#	Aesculus- Juglans-Acer (*Aesculus indica, Juglans regia, Acer caesium*) (*Betula alnoides, Alnus nepalensis, Quercus floribunda, Q. semecarpifolia, Prunus cornuata*)	++		+
9. Mountain oak-Rhododendron forest*!	*Q. semecarpifolia, Rhododendron arboretum, Prunus cornuata, Aesculus indica*	++		
10. Hemlock forest (2,100-3,200 m asl)	*Tsuga dumosa* forest (*Pinus wallichiana, Abies spectabilis, Sorbus cuspidata, Ilex dipyrena*)		+	
11. Himalayan Cypress forest 2,100-2,900 m asl)	*Cupressus torulosa-Abies pindrow* (*Rosa macrophylla, Syringa emodi*)		+	
	Cupressus torulosa (Juniperus indica, Viburnum cotinifolium, Berberis species, Cotoneaster species)		+	
12. Himalayan Spruce forest (2,150-3,200 m asl)	*Picea smithiana (Pinus wallichiana, Abies pindrow, Tsuga dumosa, Populus ciliate, Betula utilis*)			
13. Fir Forest#	*Abies pindrow* (21,50-2,900 m asl)		+	
	Abies spectabilis (3,050-3,950m) (*Sorbus foliolosa, Taxus contorta, Rosa sericea, Cotoneaster acuminata, Ribes graciale*)		++	
	Abies spectabilis-Betula utilis forest (3,000-4,000 m asl)		+	
	Abies spectabilis-Juniperus indica forest (3,000-3,500 m asl)			
14. Himalayan Cedar forest (2,000-2,600 m asl)	*Pinus wallichiana, Rosa sericea, Berberis aristata, Cotoneaster frigidus, Spiraea canescens*)	+	++	
15. Poplar forest (2,150-3,200 m asl)	*Populus ciliata (Picea smithiana, Pinus wallichiana, Hippophae salicifolia, Rosa sericea, Jasminus officinale*)			
16. Birch forest (2,900-4,000 m asl)	*Betula utilis* forest (2,900-3,800 m asl) (*Prunus rufa, Acer caesium, Sorbus microphylla, Lonicera myrtillus*)		+	
	Betula utilis-Rhododendron campanulatum (3,500-4,000 m asl) (*Abies spectabilis, Prunus cornuta, Ribes graciale, Lonicera myrtillus*)			
17. Moist Alpine shrub (3,650-4,400 m asl)#	*Juniperus wallichiana, Rhododendron lepidotum, R. anthopogon, Potentilla fruticosa, Lonicera obovata*)		+	+
18. Caragana Steppe (4,000-4,500 m asl)	*Caragana gerardiana, C. brevifolia, Myricaria rosea*)			
19. Upper alpine meadows (4,500-5,000 m asl)	*Festuca ovina, Kobresia seliculmus, Agrostis munroana, Allium carolinianum, Arenaria polytrichoides, Saxifraga stenophylla)*			+

Source: ++, * recorded in the present study, ! DFO record, 2017; # GoN record, 2015.

Appendix B. Institutional Review Board letter from Florida Atlantic University

FAU
FLORIDA
ATLANTIC
UNIVERSITY

Institutional Review Board
Division of Research
777 Glades Rd.
Boca Raton, FL 33431
Tel: 561.297.1383
fau.edu/research/researchint

Charles Dukes, Ed.D., Chair

DATE:	January 9, 2017
TO:	Maria Fadiman, PhD
FROM:	Florida Atlantic University Social, Behavioral and Educational Research IRB
PROTOCOL #:	990471-1
PROTOCOL TITLE:	[990471-1] Ethnobotany in Kailash Sacred Landscape Nepal: Ecology, Ethnography and Ethnomedicine
SUBMISSION TYPE:	New Project
REVIEW CATEGORY:	Exemption category # *A3*
ACTION:	DETERMINATION OF EXEMPT STATUS
EFFECTIVE DATE:	January 9, 2017

Thank you for your submission of New Project materials for this research study. The Florida Atlantic University Social, Behavioral and Educational Research IRB has determined this project is EXEMPT FROM FEDERAL REGULATIONS. Therefore, you may initiate your research study.

We will keep a copy of this correspondence on file in our office. Please keep the IRB informed of any substantive change in your procedures, so that the exemption status may be re-evaluated if needed. Substantive changes are changes that are not minor and may result in increased risk or burden or decreased benefits to participants. Please also inform our office if you encounter any problem involving human subjects while conducting your research.

If you have any questions or comments about this correspondence, please contact Donna Simonovitch at:

Institutional Review Board
Research Integrity/Division of Research
Florida Atlantic University
Boca Raton, FL 33431
Phone: 561.297.1383
researchintegrity@fau.edu

* Please include your protocol number and title in all correspondence with this office.

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within our records.

- 1 -

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Appendix C1. Consents from Department of National Parks and Wildlife Conservation, Kathmandu

नेपाल सरकार
वन तथा भू-संरक्षण मन्त्रालय
राष्ट्रिय निकुञ्ज तथा वन्यजन्तु संरक्षण विभाग
(इकोलोजी शाखा)

फोन नं. : ४२२०२१६, ४२२०८५०, ४२२०९१२, ४२२७९२६
फ्याक्स नं. ४२२७६७५

संकेत नं. :-
पत्र संख्या :- ०७२/७३ इको. ११४
चलानी नं. :- १६८१

पो. ब. नं. - ८६०
बबरमहल, काठमाडौं
Email: info@dnpwc.gov.np
http//:www.dnpwc.gov.np

नेपाल सरकार वन तथा भू-संरक्षण मन्त्रालय राष्ट्रिय निकुञ्ज तथा वन्यजन्तु संरक्षण विभाग २०३७

मिति:- २०७३/११/०६

विषय:- अध्ययन अनुसन्धान अनुमति सम्बन्धमा ।

श्री अपि नाम्पा संरक्षण क्षेत्र कार्यालय,
दार्चुला ।

प्रस्तुत विषयमा त्यस संरक्षण क्षेत्रमा निम्नानुसार अध्ययन अनुसन्धान अनुमति प्रदान गरिएको व्यहोरा अनुरोध छ ।

अनुसन्धानकर्ताको नाम	**पहिलो** रिपु	**बीचको**	**थर** कुँवर
अनुसन्धानकर्ताको ठेगाना	**स्थायी:** कास्की नेपाल **अस्थायी:** फ्लोरिडा, अमेरिका	**ई-मेल:** rkunwar@fau.edu	**फोन नं.:** 9841275021
सम्बद्ध संस्था	**संस्थाको नाम:** Florida Atlantic University	**ठेगाना:** Boca Raton Florida	
पद	विद्यार्थी		
अनुसन्धानको तह	विद्यावारिधी	**संस्थागत:**	
अनुसन्धानको शिर्षक	**Ethnobotany in Kailash Sacred Landscape Nepal: Ecology, Ethnobotany and Ethnomedicine**		
अनुसन्धानको विधि	Ecological Transect, Questionnaire survey, Ethnobotanical Survey, Ethnography	**नमुना संकलन:** नगर्ने	**नमुनाको परिक्षण:**
अनुसन्धानको समयावधि	२०७३ फागुन देखि २०७४ माघ		
अनुसन्धानका शर्तहरु	१. अनुसन्धानकर्ताले राष्ट्रिय निकुन्ज तथा वन्यजन्तु संरक्षण ऐन २०२९ र नियमावली २०३० तथा यस मातहतका सबै नियमावालिहरुको पूर्ण पालना गर्नु पर्ने छ । २. अनुसन्धानकर्ताले विभाग र सम्बन्धित संरक्षित क्षेत्रसंग समन्वय गरि कार्य गर्नु पर्ने छ । ३. अनुसन्धानकर्ताले आफ्नो अनुसन्धानको प्रस्ताव सम्बन्धित संरक्षित क्षेत्रमा समेत पेश गर्नु पर्नेछ । ४. अनुसन्धानकर्ताले अनुसन्धान समाप्त भएपछि एक प्रति कागजी प्रतिवेदन र एक प्रति		

Appendix C2. Consents from local agencies (DFO, Baitadi)

फोन नं ०९५-५२०१६२
ईमेल :-baidfo@dof.gov.np

नेपाल सरकार
वन तथा [illegible]ण मन्त्रालय
[illegible]ग

जिल्ला वन कार्यालय

बैतडी

पत्र संख्या :२०७३।०७४
चलानी नं.:-

मिति २०७३।११।१५

विषय :- जो जसं सग सम्वन्ध राख्दछ ।

प्रस्तुत विषयमा पवित्र कैलाश भू-परिधी क्षेत्र अर्न्तगत पर्ने यस बैतडी जिल्लामा फलौरीडा एटलान्टिक यूनिभ सिटीवाट विद्यावारीधी गर्न लाग्नु भएका श्री रीपु कुवँरले इथ्नो वोटानी विषयमा अनुसन्धान गर्न लाग्नु भएको र यो विषय यस जिल्ला वन कार्यालयका दुर्लभ वनस्पति र वनस्पति व्यवस्थापनमा समेत सहयोग पुग्ने हुदां आवश्यक सहयोग गरीदिनु हुन अनुरोध छ ।

(प्रभात सापकोटा)
जिल्ला वन अधिकृत

३५९

Appendix D1. Checklist for ecological survey and quadrat sampling

Date:	Code	C/O(Name of collector):
Transect No.	Plot No.	Face/Aspect:
Elevation:	Lat.	Long.
Slope:	Forest type:	Dominant species in forest
Name of location:	Address:	District:
	Environmental	
Canopy: ………. %.	Grazing:	Distance from settlement:
Firing:	Trail in plot::	Distance from trail
Soil type: Dead trees:		Lopping/felling/cutting
Exotic plants:		Others:

Name of species	10 m *10 m			1m * 1m		
	Trees/Poles (Diameter 10 cm or more)			Seedlings, herbs and med plants		Remarks
	No.	Dia.	Ht	No.	Cover	Remarks
Other plant species around plot						
Name of species	Local name, use, conservation status if any					Remarks

Appendix D2. Semi-structured questionnaire (Nepali and English) for ethnobotanical interview

अनुसन्धान सहभागीता सम्झौता

कैलाश पवित्र भु परिधि क्षेत्रको मानव र बनस्पती सम्वन्धी परम्परागत ज्ञानको सर्वेक्षण, अध्ययन, बिश्लेशण र संरक्षण

रिपु कुवर

फ्लोरिडा एटलान्टिक युनिभरसिटि

भु बिज्ञान बिभाग, ३३४३१, बोका र्‍याटन, फ्लोरिडा

फोनः १ ४७० ५५४ ५६४६ इमेलः rkunwar@fau.edu

जि पि ओ बक्स १९२२५, काठमाडौ, नेपाल

फोनः १ ९८४९ १३० ६०२

इमेलः ripukunwar@gmail.com

यस अध्ययनको उद्देश्य कैलाश पवित्र भु परिधि क्षेत्रको मानव र बनस्पती सम्बन्धको परम्परागत ज्ञानको सर्वेक्षण, अध्ययन, बिश्लेशण र संरक्षण गर्नु हो । यसो गरिरहदा यिनको वातावरणिय, जलवायु, पर्यावरणिय, सामाजिक, आर्थीक, सास्कृतिक, भौगोलिक, र भुउपयोग सम्बन्धि अन्तरसम्वन्धको अध्ययन र बिश्लेशण एवं मानव, बनस्पती र प्रकृतीको दिगो सम्बन्धको अनुशन्धान एवं ब्याख्या गर्नलागी यस क्षेत्रमा बसोबास गर्ने ब्यक्तिहरु जो बनस्पती तथा जडिबुटीको बारेमा प्रशस्त ज्ञान राख्नु हुन्छ, उहाहरुसगं भेट गरिनेछ र मानव, बनस्पती र परम्परागत ज्ञान र तिनको अन्तरसम्बन्धको गहन अध्ययन अनुशन्धान गरिनेछ ।

यस अध्ययन कुनै पनि प्रयोगशाला, उत्पादन, तथा बेच बिखनको उदेश्यले प्रभाबित छैन । यो अध्ययन स्थानीय, राष्ट्रिय र अन्तराष्ट्रिय मान्यता अनुरुप परिचालीत छ । यो बिशुद्द प्राज्ञिक र अनुशन्धनात्मक हुनेछ । यसका लागी मेरो उदेश्य गाउका बैद्य, बृद बृदाहरु भेट्ने, उनिहरुसंग भएको मानव, बनस्पती र जडिबुटी बारेको स्थापति एवं सम्बन्धित परम्परागत ज्ञानको सर्वेक्षण र अध्ययन गरि त्यसको तथ्यांक कोस तयार गर्ने र लेख रचनाहरु प्रकाशित गरेर ब्यक्ति,ऽ समुदाय, समाज, र राज्यलई सुसुचित गर्दै गराउदै अन्तराष्ट्रिय स्तरमा नेपालको उपस्थिती देखाउनु पनि हो ।

आज म तपाईसंग तपाईको जिवनको महत्वपुर्ण बिरुवाहरु के हुन, कहा पाईन्छ, के के नामले चिनिन्छ, लगाएत अन्य सम्पुर्ण जानकारी लिने प्रयत्न गर्नेछु । यदि तपाई राजी हुनुहुन्छ भने म यो कुराकानी एवं अर्न्तवार्ता अगाडि बढाउन चाहन्छु र सम्झनाको लागी टिपोटहरु कापीमा लेख्ने अनुमती चाहन्छु । सुचना गोप्यताको लागी नामलाई कोडमा बदलिने छ र यस अध्ययन, प्रकाशन पश्चात यी सम्पुर्ण टिपोट नोटहरु नष्ट गरिनेछ । तपाईको ईच्छा विना तपाईको नाम सार्वजनिक गरिने छैन ।

यस अर्न्तवार्तामा भाग लिदै गर्दा हामी दुबै भाग लिने अथवा दिने पक्षलाई कुनै आर्थिक लाभ हानी हुने छैन । यी माथीका कुराहरुमा समर्थन जनाउने र यस अर्न्तवार्तामा भाग लिने वा नलिने तपाईको स्व बिचार हो । यो अर्न्तवार्ता करिब आधी घण्टाको हुनेछ । यस प्रश्नावलीमा सोधिएका प्रश्नहरु तपाईलाई असहज लागेमा बिचैमा पनी तपाई अर्न्तवार्ता छोड्न सक्नु हुन्छ ।

तपाईलाई यस अध्ययन सम्वन्धि केहि थप जानकारी चाहिएमा मलाई सोध्न सक्नु हुनेछ अथवा माथीको मेरो ठेगानामा सम्पर्क राख्न सक्नु हुनेछ ।

तपाई यस अर्न्तवार्तामा सहभागी भएर मलाई सहयोग गर्न मन्जुर हुनुहुन्छ ?

FAU Institutional Review Board

990471-1	
Approved On:	January 9, 2017
Expires On:	N/A

नमस्कार		प्रश्नावली		मिती	
कोड नं	यो ठाउको उचाइ		भु अक्षांश, देशान्तर		
गा वि स	ठेगाना				
१। व्यक्तिगत विवरण					
नाम	पढाई		लिंग	उमेर	
मुख्य पेशा	धर्म		बोल्ने भाषा : १	२	३
तपाई यहा बस्नु भएको कती भयो ?	तपाई बसाई सरेर आउनु भएको भए कहा बाट आउनु भएको हो (जिल्ला, ठाउ?				
घरपरिवार संख्या	सबै घरमा हुनुहुन्छ ?		विदेश		
तपाईको घरमा खाना र अन्न को उपलब्धता	६ महिना भन्दा कम,		६ देखि १२ महिना सम्म,	१२ महिना भन्दा बढि	
बर्षभरिको घरको खर्चको ब्यबस्था (१ देखी ६ सम्म)	कृषी	(बैदेसिक) रोजगार	ज्याला मजदुरी	ब्यापार बजार	जडिबुटी अन्य
घरको आम्दानी /अन्न खाना मा जडिबुटी संकलनको हिस्सा (प्रतिशतमा)					
तपाईको जग्गा जमिन	घर		गाई वस्तु	अन्य	
घर देखि जंगलसम्मको दुरि (समय)	घर देखि सदरमुकामसम्मको दुरि (समय)			घर देखि स्वास्थ्य केन्द्रसम्मको दुरि (समय)	
२। बैद्य सम्वधि उपचार र जडिबुटीको प्रयोग					
तपाई बैद्य सम्वधि उपचार र जडिबुटीको प्रयोग गर्दै आउनु भएको छ ?					
कति समय भयो बैद्य सम्वधि उपचार गर्न लाग्नु भएको ?			को कहाबाट कसरी सिक्नु भयो ?		
तपाईको बुबा, हजुरबुबा बैद्य सम्वन्धि काम गर्नु हुन्थ्यो ?			तपाईको छोरा, छोरी वा कोही गर्दै हुनुहुन्छ कि		
३। जडिबुटी संकलन					
तपाई जडिबुटी जन्य बिरुवाहरु कहा कहाबाट संकलन गर्नु हुन्छ? (टिक लगाउने)			जंगल	खेतवारी	बजार
प्राय को जान्छ जडिबुटी जन्य बिरुवाहरु संकलन गर्न			जडिबुटी संकलन मूख्य /प्राथमिक काम हो ?		
४। बिरामी र रोग					
तपाईकहा प्राय कस्ता मानिसहरु धेरैजसो उपचारको लागी आउछन्? (मुख्य १ मा टिक लगाउने)					
गरिब	मध्ययम	धनि	पुरुष	महिला	अन्य
जनजाती	बाहुन क्षेत्री	दलित	बाल बच्चा	युवा युवती	बुढा बुढी
स्थानिय	जिल्लाका	टाढा टाढा बाट	पहिलो पटक	अस्पतालको उपचार पछि	दाहोरयाएर
तपाईकहा आउने बिरामीको चाप	बढ्दो		उस्तै		घट्दो
मुख्य के कस्ता रोगको निदानको लागी तपाईकहां आउछन्?	१		२		३
तपाईले अहिलेसम्म उपचार गराएर अत्यधिक सफल हुनुभएको रोगको नाम १			२	३	
तपाईले उपचार गराउदा प्रयोग गर्ने अन्य मुख्य चिजहरु (जडिबुटी बिरुवा बाहेक)			१	२	३
गाउको प्रमुख स्वास्थ्य समस्या के हो ?	१		२		३
तपाईको गा वि स मा तपाईजस्तै उपचार गराउने अरु कति जना छन र को को, तिनको ठेगाना'''					
१					
२					
३					
तपाईकहा पछिल्लो पटक आउनुभएको बिरामीको जानकारी - कहिले, कहाबाट, को, के कामको लागी					

६। तपाईको जिवनको ३ सबैभन्दा महत्वपुर्ण विरुवाहरु को अध्ययन (कृपया क्रमश १ माथी बाट तलसम्म भरिसके पछि २, ३, ४, ५ भर्नु होला)

तपाईको जिवनको ५ सबैभन्दा महत्वपुर्ण विरुवाहरु[३]	स्वास्थ्य/औषधिय, सामाजिक/सास्कृतिक, आर्थिक/जिविकोपार्जन, पर्यावरणिय (प्रयाप्त भएर), भौगोलिक हिसाबले (अरु नपाउने भएर)				
	१.	२.	३.	४.	५.
के कामलाई महत्वपुर्ण[३]					
यो् कहिले कसरी र के काममा प्रयोग गर्ने					
यो बिरुवाको प्रयोग माथीका मध्ये कुन १ कारण होला					
यो बिरुवा कहिलेबाट प्रयोगमा आएको होला, बुबा हजुरबुबाले प्रयोग गर्नुभयो					
यो बिरुवा कहिले कहा बाट संकलन गर्ने					
जंगलमा पाउने भए कुन **सरकारी,सँमुदायीक,ब्यत्तिगत**					
यो सबैभन्दा नजिक पाउने ठाँउ, दुरि					
यो बिरुवा नभएको भए अर्को कुन बिरुवा महत्तवपुण हुन्थ्यो यो कामकालागी[२]					
यो पनि नभएको भए अर्को कुन विरुवा[१]					
माथीको १ नं को बिरुवाको अन्य भाषमा यसको नाम					
भबिष्यमा यसको उपलब्धता **कुनै एक** (प्रशस्त, ठिकै, न्युन)					
माथीको १ नं को बिरुवाका **यसको दोश्रो प्रयोग**[२]					
माथीको १ नं को बिरुवाका **यसको अन्य प्रयोग**[१]					
यसको केहि सामाजीक कथन, सास्कृतिक किम्बदन्ती, प्रचलन ' (उदाहरणको लागी विवाह, न्वारन, मर्दा पर्दा, पास्नी, आदि), प्रयोगमा कुनै बार, महिना, समय, ठाउ जातजाती, अन्य केहि बिशेष छ रु					
माथी भनिएका मध्ये कुनै गर्न, खान, प्रयोग गर्दा नराम्रो हुने केहिरु					
यसको दिगो संरक्षणलाई केगर्नु पर्ला	१	१	१	१	१
अन्य औषधि जन्य विरुवाहरु के के छन र तिनको प्रयोग	१		४		
	२		५		
	३		६		

3

AGREEMENT TO PARTICIPATE IN RESEARCH
[Agreement for Lay People and Specialist Healer to Participate in Research]

"Ethnobotany of Kailash Sacred Landscape, Nepal: Ecology, Ethnography and Ethnomedicine"

Ripu Kunwar, FAU

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My goal in this study is to assess plant-people relationship through ecological, socio-cultural, land-use and physiographical perspectives, and identify the major variables defining their strong relationship.
I would like to speak with people
who identify, collect, use and conserve useful plants so I can understand their thoughts and ideas.

Objectives of this study
1. Inventory plants and assess their ecological values, usefulness and conservation status.
2. Analyze relationship of ecological values with plant distribution, uses and conservation.
3. Catalogue ethnobotanical, ethnomedicinal and other useful plants of study area and identify which types of plants and uses are more important in sustainable plant-people relationship.
4. Assess plants and places used in ethnobotany and analyze their changes or pattern.
5. Identify the species and uses with redundant utilities and scope their functions in resilience of biodiversity and indigenous knowledge.
6. Assess the number of useful and medicinal plants and their sites that people know, use and conserve at cross-cultural scales
7. Analyze the knowledge of people about plant identification, collection, uses and conservation.
8. Map spatial distribution of most important useful plants with taking into account the ecological, physiographic and socio-cultural values.

This research is not investigating treatments. It has no relationship with a laboratory and no goal to manufacture medicine. My studies are not about those topics and I have no intent or ability to do carry out such research. My studies are about culture, the environment, and the ways people use natural resources.
My plan is to visit places where useful plants are collected, and used in order to understand to the relationship of plants, people and places.

Today I would like to know about the five most important plants of your life and the places where you are used to collect them.
I invite you to participate in my research, to ask and be asked questions, and to share your ideas. If you agree, I would like to record our conversation with pen and paper. These notes I take in my notebook are for my use to help me remember what you say. This may last for about half an hour. After I finish my research activities, I will write a book for my studies at the university. In my book, I will not include anything that can identify you as a participant unless you agree.

It is your choice to agree or not to agree to participate in this research. This interview takes ½ hours to complete. Feel free. If you are asked questions that you do not feel like answering, feel free to decline to discuss them. In short, I would like you to be open and free to terminate responding as you do like to proceed.

Before continuing, do you have any questions or concerns?

Do you agree to participate in this research?
If you want to communicate with my university about this research
Contact: Department of Geosciences, Florida Atlantic University, Boca Raton, Florida, 33431, USA.
Telephone: +001 (561) 297 3250.

Survey Questionnaire

"Ethnobotany of Kailash Sacred Landscape, Nepal: Ecology, Ethnography and Ethnomedicine"

Namaste!

I am Ripu Kunwar, a graduate student, pursuing PhD at Florida Atlantic University. I am doing my research on Ethnobotany of Kailash Sacred Landscape, Nepal. Now, I am here in your village to continue my research. I have prepared this questionnaire to collect more information about sociocultural, ecological and spatial/temporal characteristics of ethnobotany with your due help. I do hereby request you to participate in this survey voluntarily. Feel very much free to express whatever you feel appropriate. We assure you that you are not entitled to receive any benefit or suffer any loss due to what you have expressed in this survey. Your information will be encoded and averaged for interpretation in order to secure the confidentiality. If you feel discomfort while participating in this survey, you may discontinue any time.

Researcher *Thanking you!*

Code: *Altitude:* *Lat/Long:* *Village:* *Address:*

1. Personal Info

Name: ***Gender:*** ***Age***

Education: *1 illiterate, 2 School, 3 higher than school;* ***Major Occupation:*** ***Language spoken:***

Residence: How long have you been living here …………yrs *From where you moved from?*

Family members: *Are all in home* *If they are in foreign country:*

Food: food (1. < 6 months, 6-12 months, more than a year); *Other sources of household income:*

Contributed by MAPs (%)

Do you have land……………, your own house: ……………, Livestock: ………(……), ……………(……), ………………(…..), ……………(…..)

Distance from your home to forest *Distance from home to district center* *Distance from home to health center*

2. Traditional medicine and culture

Are you currently working for Traditional medicine? *If yes, how long have you been working for Trad. Healing?*

How did you learn for healing? *Are/were your parents involved in healing?*

Is your any offspring involved in healing?

3. Important medicinal plants collection (mention score *3 mostly, 2 moderate, 1 least, or tick appropriate)*

Where do you often collect MPs from?	*Forest*	*Farmlands*	*Market*
Who often go for collection of med plants	*You*	*Spouse*	*Children*

Is collecting med plants your primary interest or secondary or any? +

If secondary, what is your primary?

Or if any?

+ this gives idea that whether the collection is associated with socio-culture. Secondary (collection while cattle herding, etc.)

4. People consulting for healing *(3 √√√most, 2 √√normal, 1 √least)*

Who often consult you for healing (in general)? Economy:		*Poor family*	*Middle class family*	*Wealthy family*
	Caste:	*Ethnic groups*	*Brahmin, Chhetri and others*	*Dalits*
	Age groups:	*Children*	*Young*	*Elders*
	Gender	*Male*	*Female*	*Others*
	Nativity	*Local*	*Outside district*	*from distant*
	Intensity	*First timer*	*After health center medication*	*Frequent visitor*
	Pattern of patients visit	*Increasing*	*as such*	*Decreasing*

5. Illness/Ailments and healing *(3 most, 2 normal, 1 least, tick appropriate)*

What is the common ailment, health problem in your area?

Which are the ailments patients frequently reach out you to have treatment? 1. *2.* *3.*

Which ailments you healed the most successfully: 1. *2.* *3.*

What are the 3 other imp things you use for healing besides MAPs? 1. *2.* *3.*

How many peer healers are there in your village? Name them and their location

i.

ii.

iii.

6. The information of last patient you taken care : when she/he visited? from where? for what aliment the service was looking for?

2

7. ***Three important plants for five categories of usefulness of plants in your life (Ask/finish column 1 first, and then 2 and so on)***

	For primary health care, culture, ritual, economy, livelihood				
Species	**1**	**2**	**3**	**4**	**5**
The most imp plant in your life[&] for which category/uses					
The primary use of this plant[@], how do you use and why					
Why did you use this plant for in particular?					
Which one of these reasons helped use this plants in particular? (tick one)	Social/Livelihood/Cultural Ecological Therapeutic, plant biology Physiographic	Social/Livelihood/Cultural Ecological Therapeutic, plant biology Physiographic	Social/Livelihood/Cultural Ecological Therapeutic, plant biology Physiographic	Social/Livelihood/Cultural Ecological Therapeutic, plant biology Physiographic	Social/Livelihood/Cultural Ecological Therapeutic, plant biology Physiographic
Plant parts used and how it is being used (mode of preparation/consumption)					
How long have you been using this plant?					
Where do you collect this plant from? *Forest, Ag land or market*					
The nearest place and distance from your home if it is collected# (direction & distance)					
When do you collect this plant?					
*If it is found in forest, where Gf, Cf, Pf, Others ?					
Is this plant cultivated or wild or found in both					
Is there any cultural taboos related this plant?					
Vernacular names (in your language)					
Names of this plant in other language					
Is this plant native or introduced					

3

Availability of this plant	Space !					
	Time					
Availability of this plant in future$						
Secondary use of this plant[2]						
Tertiary use of this plant[2]						
The second plant can be used if your first choice plant is not available*						
The third plant can be used if your first and second choice plants are not available*						
What could be done for sustainability of these plants (any particular)						
Precaution associated with these plants while using						
Besides above						
Major ethnomedicinal plants and their uses						
Major ritual plants and their uses						

Notes:

*Cultural: What is the most imp plant in your culture (**Keystone###**), not necessarily for ethnomedicine*

Imp plant for child birth — *Imp plant for wedding*

Imp plant for funeral ceremony — *Imp plants for any others*

that is identity of your culture and unique from other cultures. (Suppose goat resembles to Khas culture and pig/buffalo to Kirat)

Which knowledge (type of knowledge) has been lost, for ex. the knowledge of weaving and beading, handicraft etc might have lost?
& Score 2, rest other ethnobotanical plants (alternatives) score 1, (useful in cultural index)
@ Major use: 1. Used for (Fuel/Fodder/forage/grass), 2. Medicines, 3. Food, 4. Vegetables and beverages, 5. Social, ritual, religious use, 6. Others (eroosion, ornamental, shade, hedge, handicraft, dye, roof, thatch, agr implements, poisons) (score 2) (Soldati et al., 2016)
^F = forest, T = transition land, ruderal, barren, fallow land, A = agriculture and farms, H = homegardens/kitchen garden,
^G = government, C = community, P = private, O = Others
Score for Preferences: 1 = highly preferred, 0.5 alternate plant of the most preferred.
the knowledge can compare to GPS data and see the relevance/validity of local knowledge; Centroids of five species and the home of healers will be calculated for effective distance; **The diet breadth model** predicts that an increase in food abundance should lead to a greater specialization (Smith 1983; Begossi and Richerson 1993). When resources are abundant the niche should contract, because preferred foods are selected.
$ Less, the same, more;
! Space: Rare, Common, Abundant; Time: More than a year, up to year, less than 6 months;
[2]score 1 for secondary use; 1 for tertiary * score 2 for secondary plant, 2 for tertiary
Plant parts uses: Root/rhizome, Stem/bark/latex, Wood, Leaf, Flowers and inflorescence, Whole plant

- Take pictures and make a list of foods (dinner) you have in villages.
- List livelihood options of respondents.
- Livestock (numbers), distance (hours)
- See the dynamics of knowledge among age groups and generations.

Appendix E. A database of total plants of Baitadi and Darchula districts

SN	Voucher code	Taxonomic reference	Genus Species	Names	Family Name	Use reports (earlier studies)	Use reports (present survey)
1.	RK0127		***Abies pindrow* Royle *Abies spectabilis* (D.Don) Mirb. Syn. Pinus tinctoria Wallich ex D. Don	*Himalayan Silver Fir (E), Gobre Salla (L,N), Talispatra (N,S).*	Pinaceae	Leaves are sniffed for cough and cold (9,3).	Plant is a common wood and it's also considered as cultural.
2.	RK1228		***Buxus rugulosa* Hattus var. *intermedia* Hattus		Buxaceae		
3.	1224RK		***Erysimum benthamii* Monnet		Brassicaceae		
4.	RK129		***Hedysarum kumaonense* Benth. Ex Baker		Fabaceae		
5.	RK127		***Hyoscyamus niger* L.		Solanaceae		
6.	KU 07206		***Ipomoea carnea* Jacq.	*Behay (L), Ajambari, Besram (N)*	Convolvulaceae	Leaf and tender shoot extract is given to treat wounds of cattle (3,7).	
7.	RK-0124		***Lancea tibetica* Hook. f. & Thomson		Phrymaceae		
8.	RK128		***Poa pratensis* L. subsp. *alpigena* (Blytt) Hiitonen		Poaceae		
9.	1225RK		***Salix calyculata* Hook. f. ex Anderss.	*Bains (N)*	Salicaceae		
10.	RK0129		***Saxifraga andersonii* Engl.		Saxifragaceae		
11.	RK0123		***Taraxacum officinale*Wigg.	*Fuli jhar (L)*	Asteraceae	Roots for stomachache (8).	Plant is anticancerous.
12.	RK-113	5, 2	**Juniperus indica* Bertol. Syn. *Juniperus pseudosabina*		Cupressaceae		Plant is cultural. Oil is used for backache, skin allergy and dysentery.
13.	RK115	1, 2, 4	**Rhododendron anthopogon* D.Don	*Sunpati, Muse chimal (L, N)*	Ericaceae		Plant is cultural and used for incense.
14.	RK-124	1	**Ribes glaciale* Wall.	*Sankhdhara (L)*	Grossulariaceae		Fruits are used in supporting producing sound to the children.
15.	RS115	3	*Caragana versicolor* Benth.		Fabaceae		
16.	R 0126, RK 0122	4	*Dactylorhiza hatagirea* (D.Don) Soo	*Hathajadi, Panchaunle (L)*	Orchidaceae	Root juice is applied for cuts and wounds (3).	Plant salep is commonly used in cuts and wounds. Plant is tonic.
17.	RK0125	4, Darchula, 3802m (KM Ghimire and M Adhikari F015)	*Geranium donianum* Sweet.		Geraniaceae		
18.	RK0128	5, 4	*Goodyera repens* (L.) R. Br.		Orchidaceae		
19.	RK-130	4	*Juniperus squamata* Buch.-Ham. ex D. Don		Cupressaceae		
20.	RK121806	2	*Paris polyphylla* Sm.	*Love apple, Paris (E), Satuwa (N), Haimavati, Satuwa (S);*	Melanthiaceae	Root is used in epilepsy, shock, fever, vomiting control. Its paste is applied on snake bite (3,5,6). Rhizome is anthelmintic and for boils (1,2).	Plant root is used for headache, fever, dizziness, diarrhea, indigestion, wounds, gastric, epilepsy and snake bites.
21.	RK1226	2	*Polygonatum cirrhifolium* (Wall.) Royle	*Meda (E), Khiraula (L,N), Meda (S),*	Asparagaceae	Root is appetizing, tonic and aphrodisiac (3,7).	Tender shoots are used as vegetable and appetizer.
22.	RK114	5, 1, 2	*Rhododendron lepidotum* Wall.	*Bhale sunpati (L)*	Ericaceae		
23.	119RK	Darchula, 2980-3180m (PR Shakya, MK Adhikari and MN Subedi 7997;PR Shakya, MK Adhikari and MN Subedi 8006)	*Ribes alpestre* Wall. ex Decne.		Grossulariaceae		
24.	RK-120	1, 2	*Rosa sericea* Lindl.	*Himalayan rose (E), Bhote gulaf, Jangali gulaf , Namkeen (L,N)*	Rosaceae	Flower paste is used in headache. Fruits are edible and useful in abortion (3,7).	
25.	RK-118	1	*Salix denticulata* Andress.	*Jhalari, Belwe bains (L)*	Salicaceae		
26.	RK115	Darchula, 2700-3800m (Subedi, KM Ghimire, J Gurung & S Thapa 3002)	*Sorbus foliolosa* (Wall.) Spach, Syn. *S. himalaica*		Rosaceae		
27.	KU 99/00, RK121808	2, 1	*Taxus contorta, T fauna* Nan Li & R.R. Mill *Syn. T. baccata auct. non.*	*Himalayan Yew (E), Kandeloto (L), Lothsalla (N), Madhuparni (S),*	Taxaceae	Leaf juice is used for cancer and bronchitis (3,9).	Plant wood is cultural, and used as an anticancer wood.
28.	KU 07279, DKU 084, RK-112413	1, 2	*Valeriana jatamansii* Jones	*Valerian (E), Juge jadi, Simme, Samayo (L), Sugandhwal (N), Tagarah, Nataha, Washim (S);*	Caprifoliaceae	Root is anthelmintic and tonic in properties (4,3,5,6). Roots for burns (1,2).	Root is used in throat pain, fever, cough, indigestion and skin and respiratory diseases.
29.			****Arundinaria falcata* Nees	*Malingo, Kalla (L)*	Poaceae		Tender shoots are used as vegetable. Plant is also cultural and used as a good fodder.

30.	RK112204		****Calanthe plantaginea* Lindl.	*Bismaro (L)*	Orchidaceae		Plant is used as antidoting and useful in stomachache and snake bites.
31.			****Desmodium oojeinense* (Roxb.) Ohasi	*Sadan (N)*	Fabaceae		Plant is good for wood and fodder.
32.	RK112206		****Ficus hederacea* Roxb.	*Dudhe belo, Makad belo (L, N)*	Moraceae		Plant juice and milk are used in skin rashes (makada).
33.			****Michelia kisopa* Buch.-Ham ex DC.		Magnoliaceae		Plant is a cultural wood tree.
34.	KU 07234, BKU 176		***Acorus calamus* Linn.	*Sweet flaf, Sweet sage (E), Sutak, Charila (L), Bojho (N), Wacha, Ugragandha (S)*	Acoraceae	Rhizome juice is anthelminthic and pesticidal in properties. The juice is given to stomachache and trunk pain. It is also considered to increase memory longevity (3,4,5,6). Rhizome is anthelmintic and toothache (2) and memory longevity (1). Dried rhizome us used to treat cough and cold (11).	Rhizome is used in cough, fever, hoarse sounds and as an antileech.
35.	RK112202		***Adiantum venustum* D. Don	*Himalayan maiden hair fern (E), Pani liudo (L)*	Pteridaceae		
36.	RK 144 KATH		***Aerva sanguinolenta* (L.) Blume	*Aitinbot (L)*	Amaranthaceae		
37.	RK112414		***Ainsliaea latifolia* (D. Don) Sch.Bip.		Asteraceae		
38.	KU 07210, RK122101		***Angelica archangelica* Linn.	*Angelica (E), Gannano (N)*	Apiaceae	Dried roots are anthelminthic and useful in gastric, and stomachache (3,6,9). Rhizome for abdominal pain (1), and digestion (2). Rhizome is used as spices (10,11).	Root is a good spices and used for cold, cough, constipation, gastric, stomachache and joint pain.
39.	KU 167/00.		***Anisomeles indica* (Linn.) Kuntze, *Syn. A. ovata R* Br.	*Malabar catmint (E), Rato charpate (N)*	Lamiaceae	Leaf extract is useful for urinary complaints (3,9).	
40.	RK121801		***Aristolochia griffithii* Hook. f. & Thomson ex Duch		Aristolochiaceae		
41.	*KU 07249*		***Bauhinia purpurea* Linn.	*Ebony (E), Taki (L,N)*	Fabaceae	Plant is used as fodder. Bark is astringent. Fresh flowers are administered orally to livestock for diarrhea and dysentery (3,7). Seed powder is applied for dog bites (1), Flowers are used as vegetable (10).	Plant inflorescence is used in diarrhea, stomachache, dusentery and indigestion.
42.	KU 07240		***Bauhinia vahlii* Wight & Arn	*Camel's foot climber (E), Malu (L), Bhorla (N), Murva (S)*	Fabaceae	Bark is used in sprain and fracture. Root is tonic (3,4,9). Root and bark for paralysis (2). Cotyledons are eaten (10). Roots and leaves for dysentery (8).	Plant is a good forage and cultural.
43.			***Bauhinia variegata* Linn. Syn. *B. candida Ait.*	*Mountain ebony (E), Koiralo (N), Kachnar, Kovidarah (S).*	Fabaceae	Flower and floral buds are eaten regularly to cure leucorrhoea and mumps (3,4,6 9). Flowers for dysentery (1,2), vegetable (10). Bark for dysentery and cuts and wounds (8). Root is for paralysis (1).	
44.	RK121803		***Botrychium lanuginosum* Wall. ex Hook. and Grev.		Ophioglossaceae		
45.	*KU 07205*		***Butea monosperma* (Lam.) Kuntze	*Flame of forest (E), Dhak (L), Palans (N), Palasha (S)*	Fabaceae	Bark gum is used in diarrhea and dysentery (3,7).	Wood is considered cultural and used to protect evil spirits. Giving wood to anyone is a symbol of departure.
46.	152-15 NHM		***Callicarpa microphylla* Vahl.	*Bhatmyal, Dahijalo, Dahi chamle, Bhatkap (L,N)*	Lamiaceae	Fruits are edible (10) and useful for fever and indigestion (8).	
47.	*120-15 KATH*		***Camellia sinensis* (Linn.) Kuntze		Theaceae		
48.	94-15 KATH		***Carex baccans* Nees		Cyperaceae	Plant is a very good grass (6).	

49.	KU 07270. DKU 027		*******Cedrus deodara* (Roxb. ex D.Don)	*Himalayan cedar (E), Dyar (L), Debdar (N), Devadaru, Suradaru (S)*	Pinaceae	Essential oil from wood is externally used in scabies (3,4,5).	
50.	KU 07303		***Clerodendrum viscosum* Vent.		Lamiaceae	Leaf juice is used in spleen disorders (3).	
51.	*KU 07253*		***Curculigo orchioides* Gaertn.	*Kalo musli (L)*	Hypoxidaceae	Roots is used as tonic and effective in paralysis (3,6).	
52.	RK121807		***Cyrtomium anomophyllum* (Zenker) Fraser-Jenk.	*Satuwa unyu (L)*	Dryopteridaceae		
53.	RK112415		***Elatostemma subincisum* Wedd.	*Latikoili (N)*	Urticaceae		
54.	RK122003		***Eriobotrya elliptica* Lindl.	*Malaya (L)*	Rosaceae		
55.	*111-15 KATH*		***Ficus subincisa* Buch.-Ham ex Sm.	*Berlo, Beldo (L)*	Moraceae	Fruits anthelmintic (1,2), edible (10,11).	
56.	*95-15 KATH*		***Flemingia strobilifera* (Linn.) Ait	*Bhatwasi (L)*	Fabaceae		
57.	KATH 2015		***Himalayacalamus cupreus* Stapleton		Poaceae		
58.	169-15 KATH		***Holboellia latifolia* Wall.	*Gofle (N)*	Lardizabalaceae	Ripe fruits are eaten (11).	
59.	198-15, 149-15 KATH		***Hymenodictyon flaccidum* Wall.		Rubiaceae		
60.	135-15 KATH		***Hypoestes triflora* (Forssk.) Roem. & Schiltz		Acanthaceae		
61.	RK0121		***Incarvillea arguta* (Royle) Royle		Bignoniaceae		
62.	126-15 NHM		***Kalanchoe spathulata* DC.	*Hattikane (N)*	Crassulaceae		
63.	3		***Leucaena leucocephala* S. Watson	*Ipil ipil (N)*	Fabaceae		
64.	90-15 KATH		***Lindenbergia grandiflora* (Buch.-Ham. ex D.Don) Benth		Orobanchaceae		
65.	174-15 KATH		***Litsea doshia* (Buch.-Ham. Ex D. Don) Kosterm		Lauraceae		
66.	RK122002		***Lonicera lanceolata* Wall.	*Bakhre ghas, juhi (L, N)*	Caprifoliaceae		
67.	*106-15 NHM*		***Lygodium flexuasum* (L.) Sw.	*Dherebelo (L)*	Lygodiaceae		
68.	3		***Maesa macrophylla* (Wall.) A. DC.	*Thulo bilaune, Bhogate (L, N)*	Primulaceae		
69.	KU 07200		***Ocimum gratissimum* Linn.	*Bantulasi (L), Ram tulasi, Babari (N)*	Lamiaceae	Fresh leaves are used as tea. Whole plant is taken for diuretic, asthma and rheumatism (3,6,7).	Plant is considered as holy/cultural and used for fever, rheumatism and jaundice with clove (*Syzygium aromaticum*).
70.	234-15 KATH		***Onychium siliculosum* Desv.(C.) Chr.		Pteridaceae		
71.	RK122403		***Picris heiracioodes Linn.*	*Ratpatya (L)*	Asteraceae	Roots for fever (1).	Plant is useful in tetanus, burns and pneumonia, and urine problem of livestock.
72.	97-15		***Pilea cordifolia* Hook.f.		Urticaceae		
73.	*228-15 KATH*		***Pityrogramma calomelanos* (L.) Link.		Pteridaceae		
74.	*KU 07294*		***Pleione humulis* (Sm.) D.Don	*Manidana (L), Bhuisungava (N)*	Orchidaceae	Plant pseudo bulb is used as galactogogue for livestock (3, 6, 7).	
75.	*11--15 NHM*		***Pogostemon benghalensis* (Burm.f.) Kuntze	*Rudilo, rudro (L, N)*	Lamiaceae	Useful in common cold	
76.		1	***Polygala abyssinica* R. Br. ex Fresen	*Luinche (L)*	Polygalaceae		A very common forage.
77.	171-15 KATH		***Polystichum squarossum* (D. Don) Fée		Dryopteridaceae		
78.	*233-15 KATH*		***Pronephrium nudatum (Roxb. ex Griff.) Holtt., Syn. Thelypteris nudata*		Thelypteridaceae		
79.	229-15 KATH		***Pteris biaurita* L.		Pteridaceae		
80.	RK112201, 230-15		***Pteris cretica* subsp. *laeta* (Wall.ex Ettingsh) Fraser-Jenk.	*Hade (N)*	Pteridaceae		
81.	RK101RK		***Quercus glauca* Thunb.		Fagaceae		
82.	108-15 KATH		***Randia tetrasperma* (Roxb.) Benth. & Hook. f. ex Brandis	*Ghanaulo (L)*	Rubiaceae		
83.	RK112406		***Ranunculus cantoniensis* DC.		Ranunculaceae		
84.	3		***Rhaphidophora glauca* (Wall.) Schott	*Haddijor (L), Kanchino (N)*	Araceae	Fruits are aphrodisiac. Tender shoots are used as vegetable (3,7).	
85.	KU 07245		***Rhus parviflora* Roxb.	*Nepal Sumac (E), Bewoti (L), Satibayer (N), Tintideek (S)*	Anacardiaceae	Fruit decoction is taken for diarrhea and dysentery (3,4,6,9).	
86.	183-15 KATH		***Rubus cordifolius,*	*Kalo ainselu (N)*	Rosaceae		

			Syn. *R. paniculatus* Smith				
87.	RK-112419		***Rubus macilentus* Cambess.	*Aisedu (N)*	Rosaceae		
88.	RK121805		***Salix daltoniana* Anderss.	*Bains (N)*	Salicaceae		
89.	*KATH-2016*		***Sarcoccoa salinga* (D.Don) Mull.-Arg.	*Phitphiya (L)*	Buxaceae		
90.	RK112405		***Sarcococca hookeriana* Baill.	*Phitphitiya, Telparo (L, N)*	Buxaceae	Root juice is given to treat fever (3,7).	
91.	116-15 NHM		***Smilax ferox* Wall. ex Kunth.	*Kukurdaina (N), Kupreti (L)*	Smilacaceae		
92.	RK112502		***Solena amplexicaulis* (Lam.) Gandhi	*Kakanbelo (L)*	Cucurbitaceae		
93.	RK122001		***Staphylea emodi* Wall. ex Brandis		Staphylleaceae		
94.	3		***Sterculia villosa* Roxb. Syn. *Firmiana fulgens* (Wall. Ex Master) Corner	*Sterculia, Odaal tree (E), Odaal, Odane (N)*	Malvaceae	Stem bark is considered as an astringent. It is used for cooking breads (3,9).	
95.	RK-KATH		***Tectaria coadunata* (J. Sm.) C. Chr.		Tectariaceae		
96.	180-15 KATH		***Vanda cristata* Lindl.		Orchidaceae		
97.	RK-112401		***Viburnum cylindricum* Buch.-Ham. ex D. Don	*Thulo Hadmalyo (L)*	Adoxaceae		
98.	202-15 NHM		***Viburnum erubescens* Wall.	*Hadmale, Bakalpate (L)*	Adoxaceae	Fruits are edible (11).	
99.	205-15 NHM		***Vicia angustifolia* Linn.	*Kutilkosa (N)*	Fabaceae		
100.	RK-112205		***Viola canescens* Wall.	*Nakkali simme (L)*	Violaceae		
101.	178-15 KATH		***Woodwardia unigemmata* (Mak.) Nakai	*Dhaiya (N)*	Blechnaceae		
102.		1, 2, 3, 4	**Aconogonum rumicifolium* (Royle ex Bab.) Hara, Syn. *Polygonum rumicifolium* Royle ex Bab.	*Khyakjadi, Chaunle, Thotne (L,N)*	Polygonaceae		Roots are useful in fever, stomachache and dysentery.
103.		3,4,5, Baitadi, 1450m (LP Kattel 175)	**Allium pratti* C.H. Wright, Syn. *A victorialis*	*Jimmu (N)*	Amaryllidaceae		Plant is depressant of cold and cough.
104.		5, 1	**Alnus nepalensis* D.Don	*Uttis (N)*	Betulaceae		Bark is used in paralysis.
105.		5	**Aralia cashemirica* Decne	*Panchpate (L)*	Araliaceae		Plant is used in skin diseases, pilo, stomachache, wounds and respiratory problems.
106.	*132-15 NHM*	1	**Clematis montana* Buch.-Ham. ex DC.	*Juge laharo (L, N)*	Ranunculaceae		Flowers are useful in control diarrhea and vomiting. Locally plant is also used a rope.
107.		5; 1	**Eleusine indica* (Linn.) Gaertn.	*Kode ghas, Ban kode (N)*	Poaceae		Seed is digestive and helpful in gastric, diarrhea and constipation.
108.		5	**Eulaliopsis binata* (Retz.) C. E. Hubb.		Poaceae		Plant is cultural, and used as grass and local material for making ropes.
109.		5	**Pennisetum flaccidum* Grieseb.	*Salmo (N)*	Poaceae		Plant is a very common grass.
110.	*198-15 KATH*	2, 3	**Persea odoratissima* (Nees) Kosterm.	*Kaulo (L,N)*	Lauraceae		Plant is a good fodder and useful in paralysis.
111.		2	**Pinus wallichiana* A.B. Jackson	*Gobre salla (L,N)*	Pinaceae		Plant is a good fuelwood and wood species. It is also used in gastric.
112.	112RK	Darchula, 2100-2700m (PR Shakya, MK Adhikari and MN Subedi 7902; KR Rajbhandari & KJ Malla 5694),	**Prunus cornuta* (Wall. ex Royle) Steud.	*Aarato (L)*	Rosaceae		Root juice is used for paralysis, dysentery and livestock wounds.
113.	*197-15 KATH, 112-15*	5	**Quercus incana* Bartram, Syn. *Q. leucotricophora* A. Camus	*Tikhayz, Falant (L,N)*	Fagaceae		Plant is good as fodder, fuelwood and agriculture implements.
114.	*RK112408*	1	**Quercus semecarpifolia* Sm.	*Khasru, Dhinde kahsru (L,N)*	Fagaceae		Plant is good as fodder, fuelwood and agriculture implements.
115.		1	**Rheum australe* D. Don, R emodi	*Dolu, Chulethi, Chirchey (L,N)*	Polygonaceae		Plant root is used for backache, sprain and appendicitis.
116.		1	*Abies densa* W.Griff.		Pinaceae		
117.	*KU 07209*		*Abrus precatorius* Linn.	*Crab's eye (E), Ratigedi (N), Gunja (S)*	Fabaceae	Fruits are used in catarrhal diseases (3,6,7).	Fruits are used in eye complaints, cancer and ratuwa, pilo, skin rashes.
118.			*Acacia catechu* (Linn.f.) Willd. Syn. *A. catechoides (Roxb.)*	*Cutch tree (E), Khair (N), Khadirah (S).*	Fabaceae	Wood is used as local tea for cough and cold (3,9).	
119.		1	*Acanthospermum hispidum* DC.		Asteraceae		
120.		1	*Acer campbelli* Hook.f. & Thoms.		Sapindaceae		
121.		1, 3	*Acer oblongum* Wall. ex DC.	*Firfire (N)*	Sapindaceae		
122.		Darchula, 2930 m (PR Shakya, MK Adhikari & MN Subedi 7993)	*Acer pectinatum* Wall. ex G.Nicholson		Sapindaceae		

123.		Darchula, 2700-3800m (CK Subedi, KM Ghimire, J Gurung & S Thapa 52)	*Acer thomsonii* Miq.		Sapindaceae		
124.	KU 07223, BKU 098	2	*Achyranthes aspera* Linn., Syn. *Achyranthes bidentata* Blume	*Prickly chaff flower (E), Bipya kuro (L), Apamarga, Dattiwan (N), Apamarga, Thulokuro, Bipyakuro, Kharamanjari (S)*	Amaranthaceae	Root juice is used for cough, common cold, diarrhea and dysentery (3,4,5,6). Root for common cold and fever (2). Plant is diuretic, roots for toothache, asthma and indigestion (8). Root powder for stomatitis and cold (1).	Root extract is antidysenteric and useful in indigestion.
125.		4	*Aconitum ferox* Wall. Ex Seringe		Ranunculaceae		
126.		Darchula, 9500ft (TB Shrestha 4209)	*Aconitum laeve* Royle		Ranunculaceae		
127.	KU 07233.	5, 4	*Aconitum spicatum* (Bruhl) Stapf. Syn. *A. ferox var. spicata Bruhl*	*Nepalese Aconite (E), Bikh (N), Bish (S)*	Ranunculaceae	Root juice is antipyretic and analgesic (3,9).	
128.		Darchula, 2700-3800m (CK Subedi, KM Ghimire, J Gurung & S Thapa 56a)	*Actaea spicata* L.		Ranunculaceae		
129.	KU 07224	1, 2	*Adiantum cappillus-veneris* Linn.	*Maidenhair fern (E), Gophale, Rasyada (N)*	Pteridaceae	Root juice is taken in migraine, snake bite and scorpion sting. Plant is useful in diarrhea, spleen disorders (3,6, 9).	
130.		1	*Adiantum caudatum* Klotz.		Pteridaceae		
131.			*Adina cordifolia* (Willd. ex Roxb.) Benth. & Hook. f. ex Brandis		Rubiaceae		
132.	KU 07213 BBU 097	2	*Aegle marmelos* (L.) Correa	*Bengal quince, Holy fruit tree, Stone apple (E), Gudu (L), Bilba, Bael (N), Shreephal, Malur (S)*	Rutaceae	Fruit juice is useful in digestion. Root bark has antipyretic properties. A decoction of plant leaves and fruit is used in dysentery, diarrhea, respiratory tract infections and heart ailments (3,4,5). Ripe fruits are eaten raw (10). Root for fever and fruits are digestive (8).	Fruits are digestive. Plant is cultural.
133.	KU 07225	5	*Aesandra butyracea* (Roxb.) Baehni, Syn. *Diploknema butyracea* (Roxb.) H.J.Lam	*Butter tree (E), Chiura (L), Chiuri, Chiura (N)*	Sapotaceae	Oil cake is used to escape out snake, and it can be used as fish poisoning. Oil or ghee is taken to cure cracked heels and lips. Root juice is useful in dysentery (3,6,9). Seed ghee for cracked foots and toes (1,2). Fruits are eaten (10) for headache, boils, burns and rheumatism (8)	Fruits are edible. Plant is also a good source of fodder, fuelwood and oil.
134.	KU 563/00	5, 1	*Aesculus indica* (Colebr. ex Cambess.) Hook.	*Horse chesnut (E), Panger, Karu (N), Naaru (S), Hode pangro (L)*	Sapindaceae	Seed oil is valued for joint pain and skin problems (3,6,9). Seed for boils, paralysis and ringworm (1,2). Cotyledons are eaten (10).	Fruits and seeds are used in inflammation, foot injury, headache, cough, cold and anthelmintic. Fruit also eases urination of livestock.
135.		10	*Agaricus species*		Agaricaceae	Plants are edible, vegetable (10).	
136.			*Agave cantala* Roxb.	*Ram Bans (L), Ketuki (N)*	Asparagaceae	Plant is insecticidal (3).	Plant is good for fiber and making ropes. This is also piscicidal in properties.
137.			*Ageratina adenophora* (Spreng.) King & H.Rob.	*Banmara, Kalo ganya (L, N)*	Asteraceae	Leaf extract is used for bleeding control (3,6). Leaf for cuts and wounds (2,11).	Plant extract is used in cuts and wounds.
138.		Heng 8512	*Ageratum conyzoides* Linn.	*Goat weed (E), Gandhe, Nilgandhe (L), Kalo jhar (N), Visamusti, Osari (S)*	Asteraceae	Stem juice is useful in bleeding control (3,4,6,9). Leaves for cuts, wounds (11) and leprosy (8).	
139.			*Agrimonia pilosa* (D.Don) Nakai.	*Hairy agrimony, Couch grass (E), Kathlange, Nakai (N)*	Rosaceae	Plant is used to cure dysentery and root juice is used as antidote for snake bite (3,9).	
140.		5	*Agrostis munroana* Aitch & Hesml		Poaceae		
141.		5	*Agrostis pilosula* Trin.		Poaceae		

142.	KU 07235. RK112414	2	*Ainsliaea aptera* DC.	*Bippe kuro (L,N)*	Asteraceae	Root juice is taken for stomach pain (3).	
143.		5	*Ajuga bracteosa* Wall.	*Nilophul, Ratpate (L, N)*	Lamiaceae		
144.		2	*Albizia procera* (Roxb.) Benth.	*Sero siris (N)*	Fabaceae		
145.		5, 1, 4	*Aletris pauciflora* (Klotzsch) Hand-Mazz.		Nartheciaceae		
146.		1	*Aleuritopteris rufa (*D. Don) Ching, Syn. *Cheilanthes rufa*	*Ranisinka (N), Duperbado (L)*	Pteridaceae	Plant powder for cuts and wounds (1).	
147.		5, 2	*Allium wallichii* Kunth.	*Sekwa (L), Ban lasun (N)*	Amaryllidaceae	Leafs are used as vegetable (10,11). Bulbs are for diarrhea and cholera (8).	Rhizome is used in arthritis, backache, dysentery and gastric complaints.
148.		Darchula (KR Rajbhandari and KJ Malla 5569)	*Alnus nitida* (Spach) Endl.		Betulaceae		
149.		Gentry 22717	*Aloe vera* (Linn.) Burm .f.	*Indian aloe (E), Hattibar (L), Ghiukumari (N), Ghritkumari (S)*	Asphodelaceae	Plant leaf is used to get relief from burning (3,6,7).	Plant juice is applied on burns and scalds and useful in diabetes.
150.	KU 07230. BKU 033	2	*Alstonia scholaris* (Linn.) R.Br.	*Devils tree, Dita bark tree (E), Chhatiwan (N), Saptaparna (S)*	Apocynaceae	The infusion of stem bark relieves fever and headache. Milk is used in asthma disease (3,5).	
151.		2	*Amaranthus lividus* Linn.	*Latte, sagauti, Thado marshi, Lude sag (L, N)*	Amaranthaceae	Vegetable (10,11).	
152.		5, 1	*Amaranthus spinosus* Linn.	*Kanya marshi, Kade lude, ban lude (L, N)*	Amaranthaceae	Vegetable (10,11).	
153.		10	*Amaranthus viridis* Linn.	*Amaranth, Chinese spinach, thorny pigweed (E), Chuwa, Ghiya marsi, Range sag (L), Lunde (N)*	Amaranthaceae	Tender leaves are used as vegetable and taken for diarrhea (3,7). Vegetable (10,11).	
154.		2	*Amomum aromaticum* Roxb.		Zingiberaceae	Fruits for intestinal disorders (2).	
155.		1	*Ampelocissus divaricata* (Wall. ex Lawson) Planch	*Pureni (N)*	Vitaceae		
156.		Darchula, 1050-1330m (MM Amatya and PM Regmi W685/82)	*Anaphalis adnata* DC.		Asteraceae		
157.		2	*Anaphalis busua* (Buch.-Ham. ex D.Don) DC.	*Gubo, Bhuko (L, N)*	Asteraceae		
158.		4, Darchula, 2500m (KR Rajbhandari and KJ Malla 5649)	*Anaphalis contorta* (D. Don) Hook. f.		Asteraceae		
159.		5	*Anaphalis margaritacea* (Lin.) Benth.		Asteraceae		
160.		4	*Anaphalis royleana* DC.		Asteraceae		
161.		5, 3, 4	*Anaphalis triplinervis* (Sims.) C.B. Clarke, *A nepalensis*	*Phosrosan (L)*	Asteraceae		
162.		4	*Anaphalis xylorhiza* Sch. Bip ex Hook		Asteraceae		
163.		*3, 4*	*Androsace lehmanni* Wall.		Primulaceae		
164.		Darchula, 12000ft (JDA Stainton 4957), 3	*Androsace muscoidea* Duby		Primulaceae		
165.		Darchula, 2700-3800m (CK Subedi, KM Ghimire, J Gurung & S Thapa 3009)	*Androsace sarmentosa* Wall.		Primulaceae		
166.		4	*Androsace strigillosa* Franch.		Primulaceae		
167.		4, Darchula, 2700-3800m (CK Subedi, KM Ghimire, J Gurung & S Thapa 88)	*Anemone demissa* Hook. f. & Thomson.		Ranunculaceae		
168.		Darchula, 9500ft (TB Shrestha 4183)	*Anemone elongata* D.Don		Ranunculaceae		
169.		1, 5, 2	*Anemone obtusiloba* D.Don	*Bhedakhaja (L)*	Ranunculaceae		
170.		1	*Anemone rivularis* Buch.-Ham. ex DC.	*Hattipaile (L)*	Ranunculaceae		
171.		Darchula, 9500- 10,000ft (TB Shrestha 4226; JDA Stainton 4944)	*Anemone rupicola* Cambess.		Ranunculaceae		
172.		4, Darchula, 2700-3800m (CK Subedi, KM Ghimire, J Gurung & S Thapa 1)	*Anemone tetrasepala* Royle., Syn. *Anemonastru tetrasephalum*		Ranunculaceae		
173.		5, 1	*Anemone vitifolia* Buch.-Ham. ex DC.	*Kapase, Maure maulo (L, N)*	Ranunculaceae		
174.		4	*Arenaria glanduligera* Edgew ex. Edgew & Hook. f.		Caryophyllaceae		
175.		1	*Arenaria serpyllifolia* Linn.		Caryophyllaceae		

176.		Darchula, 1660-850m (MM Amatya & PM Regmi W628/82)	*Argostemma sarmentosum* Wall.		Rubiaceae		
177.		5, 1	*Arisaema consanguineum* Schott		Araceae		
178.	KU 562/00.	1, 2	*Arisaema flavum* (Forsk.) Schott	*Banko (N)*	Araceae	Rhizome juice is applied on earache and skin diseases. Young shoots are cooked as vegetable (3,6,9,11).	
179.		4	*Arisaema jacquemontii* Blume		Araceae		
180.		5, 1, 2	*Arisaema tortuosum* (Wall.) Schott		Araceae	Boiled tubers are used as vegetables (11).	
181.		Darchula, 2700-3800m (CK Subedi, KM Ghimire, J Gurung & S Thapa 50)	*Arnebia benthamii* (Wall. ex G. Don) I. M. Johnst.	*Balsamjadi (L)*	Boraginaceae		
182.	KU 07214		*Artemisia dubia* Wall. ex Besser, Syn A. vulgaris, *Artemisia indica* Willd.	*Mug wort (E), Kurje pati (L), Titepati (N), Surparnaa, Nakuli, Nagadamni, Damanaka (S)*	Asteraceae	Plant is used in headache, fever and it is also used as insecticide. Leaves are used in skin itching and scabies (3,4,9). Leaf for cuts, skin and wounds (1,2). A indica is anthelmintic, and applied for cuts and wounds (8). Plant is cultural (11).	Plant leaves are insecticidal, and useful in cuts, fever, and headache, piles and skin diseases. Plant is also cultural.
183.	*Anedon 108*	5, 2	*Artemisia gmelinii* Web. ex Stechm.		Asteraceae		
184.		3	*Artemisia sieversiana* Willd.		Asteraceae		
185.		1,5	*Asclepias curassavica* Linn.		Apocynaceae		
186.	KU 07221. BBU 065, 06-15 NHM	2	*Asparagus racemosus* Willd.	*Asparagus (E), Jhirjhirine (L), Kurilo, Satawari (N), Abhiru, Satmuli (S)*	Asparagaceae	Roots are for urinary and liver problems (4). Roots are used for milking cattle, fermenting and local brewing (3,5). Root for tonic (2), vegetable (10,11). Roots are aphrodisiac, astringent (8).	Roots are useful in fever and typhoid, gastric, jaundice and useful as an agent for lactation and escaping away the evil spirits.
187.		4	*Asplenium trichomanes* L.		Aspleniaceae		
188.		4, Darchula, 2700-3800m (CK Subedi, KM Ghimire, J Gurung & S Thapa 55)	*Aster diplostephioides* (DC.) C. B. Clarke		Asteraceae		
189.		4	*Aster flaccidus* Bunge		Asteraceae		
190.		4	*Aster himalaicus* C.B. Clarke		Asteraceae		
191.	KU 07231, 179-15 KATH, RK121901	1	*Astilbe rivularis* Buch.-Ham. ex D.Don	*Astilbe (E), Sutkeribelo (L), Thulo okhati, Budhookhato (N)*	Saxifragaceae	Root juice is used for easy delivery during child birth. It is valued for diarrhea, dysentery and hemorrhage (3,6,9).	
192.		1, 4	*Astragalus candolleanus* Royle		Fabaceae		
193.		Darchula, 3701m (KM Ghimire and M Adhikari F001)	*Astragalus sikkimensis* Bunge		Fabaceae		
194.		Darchula, 2700-3800m (CK Subedi, KM Ghimire, J Gurung & S Thapa 2101)	*Astragalus strictus* Graham ex Benth.		Fabaceae		
195.		1	*Athyrium acrostichoides* (Sw.) Diels		Woodsiaceae		
196.		1, 4	*Athyrium wallichianum* Ching.		Woodsiaceae		
197.			*Azadirachta indica* A. Juss. Syn. *Melia azadirachta* L.	*Neem tree, Margosa tree (E), Neem (N), Aristha, Nimbah (S)*	Meliaceae	Both raw and dried leaves are used for fever and blood disorders (3,6,9).	Leaves are used in diarrhea and fever.
198.	172-15 NHM, 112404 KATH	1,5	*Cornus capitata* Wall. Syn. *Benthamidia capitata* (Wall.) Hara	*Dimmer, Damir, Damaru (L,N)*	Cornaceae	Fruits for fever (1).	
199.	121RK	1	*Berberis aristata* DC.	*Kirmado (L)*	Berberidaceae	Fruits are eaten, used for dye, diarrhea and piles (11).	Fruits are edible. Bark is useful in paralysis, cough, cuts and wounds.
200.	DKU 034, 112201RK	1	*Berberis asiatica* Roxb. ex DC.	*Barberry (E), Kirmada (L), Chutro, Rasanjan (N), Daruharidra, Darwi (S)*	Berberidaceae	Root and stem bark paste is used to cure eye diseases and control worms (4,5). Root antihelmintic (1,2). Fruits are edible (10,11). Bark for eye itching (8).	Edible fruits are useful in jaundice, fever and diabetes.
201.		4	*Berberis kumaonensis* C.K. Schneid.		Berberidaceae		

202.		1	*Berberis thomsoniana* Schneid		Berberidaceae		
203.	KU 07252 DKU 124	2	*Bergenia ciliata* (Haw.) Sternb.f. ciliata.	*Rock foil (E), Silphode, Vedaite (L), Pakhanved, Dhungephool (N), Asmahan, Asyavedak, Pashanveda (S)*	Saxifragaceae	Rhizome and root is used in diarrhea, dysentery, gallstone and gastritis (4,5) and useful in bleeding control (3,6). Rhizome for abdominal pain and kidney stone (1,2).	Root is used in stomachache, gastric, indigestion, fracture, cough, diarrhea, gall stone, constipation and nausea.
204.		Baitadi (AP Singh & CM Joshi 213)	*Bergenia pacumbis* (Buch.-Ham. ex D. Don) C.Y. Wu & J.T. Pan. Syn *B. ciliata ligulata*		Saxifragaceae		
205.		1, 2	*Betula alnoides* Buch.-Ham. ex D. Don	*Kalo bhuj (L)*	Betulaceae		
206.	KU 556/00	5, 1	*Betula utilis* D.Don Syn. *B. bhojpattra* Lindl.	*Himalayan Birch (E), Bhuj pat (L), Bhojpatra (N), Bhurjah, Lekhyapatrak (S)*	Betulaceae	Bark decoction is useful for sore throat (3,9).	Plant bark and wood are used in storing grains. People considered that the stored grains in bhojpatra are medicinal.
207.		Darchula, 1720m (I Sharma, R Joshi, R Uprety and I Pandey 452)	*Bidens bipinnata* L.	*Kurro (L)*	Asteraceae		
208.		2	*Bidens biternata* (Lour.) Merr. & Sherff		Asteraceae		
209.		Darchula, 1200-1900m (I Sharma, R Joshi, R Uprety and I Pandey 600)	*Bidens formosa* (Bonato) Sch. Bip.		Asteraceae		
210.		5, 1	*Bidens pilosa* Linn.	*Kalo kurro (L)*	Asteraceae	Plant juice is for cuts and wounds (8).	
211.		1, 3, 4	*Bistorta affinis* (D.Don) Greene		Polygonaceae		
212.		5, 1, 3	*Bistorta amplexicaulis* (D.Don) Greene		Polygonaceae		
213.		2	*Bistorta macrophylla* (D.Don) Sojak	*Ranb, Monza (L, N)*	Polygonaceae		
214.		Darchula, 4426m (1216109)	*Bistorta perpusilla* (Hook. f.) Greene		Polygonaceae		
215.		1, 4	*Bistorta vivipara* (L.) S.F. Gray, Polygonum vaviparum		Polygonaceae		
216.		5	*Boehmeria platyphylla* D.Don; Syn. B. macrostachya Wedd.	*Chinese grass (E), Kamle (L), Gargalo (N)*	Urticaceae	Root paste is applied on control bleeding (3,4 9,).	
217.		5	*Boehmeria rugulosa* Wedd.	*Githi*	Urticaceae	Bark is useful in making breads (10). Bark is also useful for cuts and blood clot (8).	
218.		1	*Boehmeria ternifolia* D.Don		Urticaceae		
219.	189-15 NHM	1	*Boenninghausenia albiflora* (Hook.) Reichenb. & Meissn.	*Ankuri, Upetoko, Makhemauro, Dampate (L, N)*	Rutaceae	Shoot extract is sprayed for bed bugs (1).	
220.		5,2	*Boerhavia diffusa* Linn.	*Punarnava (N)*	Nyctaginaceae		
221.	BBU 105.	2	*Bombax ceiba* Linn.	*Silk cotton tree (E), Simal (N), Moca, Salmali (S)*	Malvaceae	Flowers and seeds are used in dysentery. Root, bark and seeds are emetic and stimulant (3,4,5,6). Root, Leaf for dysentery and burns (1,2), Flowers are vegetable (10,11). Seed is antidysentric and bark for stomachache (8).	
222.		4	*Botrychium lunaria* (L.) Sm.		Ophioglossaceae		
223.		1	*Brachypodium sylvaticum* (Huds.) Beauvois		Poaceae		
224.		Darchula, 3640m (JB Tyson 46)	*Braya oxycarpus* Hook.f. & Thomson		Brassicaceae		
225.			*Bridelia pubescens* Kurz.	*Gayo (N)*	Phyllanthaceae		
226.		Darchula, 3800m (KM Ghimire & M Adhikari F203)	*Briza media* L.		Poaceae		
227.		4	*Bromus potphyrantheos* Cope		Poaceae		
228.		5	*Buchnera hispida* Buch.-Ham ex D.Don		Orobanchaceae		
229.			*Buddleja paniculata* Wall.	*Bhimsen pati (N)*	Loganiaceae	Ritual plant	
230.		Darchula, 3827m (KM Ghimire and M Adhikari F017)	*Bupleurum candollei* Wallich ex de Candolle	*Chandu (N)*	Apiaceae		
231.		4	*Bupleurum dalhousieanum* (C.B. Clarke) Kozo-Pojl		Apiaceae		
232.		Darchula, 2050 m (PR Shakya, MK Adhikari & MN Subedi 7908)	*Buxus wallichiana* Baill.		Buxaceae		

233.		2	*Caesalpinia decapetala* (Roth.) Alston.	*Black bonduc, Fever nut (E), Ulto Kanda, Arile Kanda (N), Lata karanja (S)*	Fabaceae	Bark is poisonous and used in fish poisoning (3,9).	
234.		5	*Calamagrostis lahulensis* G.Singh		Poaceae		
235.	KU 07258	2	*Callicarpa arborea* Roxb.	*Urn fruit, Beauty berry (E), Gotmelo (L), Dahikamlo, Daya (N), Gandhaphali (S)*	Lamiaceae	Fruits are edible and help in indigestion (3,9). Fruits are edible (10). Roots for boils (8).	
236.	KU 07264, BBU 054	2	*Calotropis gigantea* (Linn.) Dryand.	*Giant milkweed, Crown plant (E), Aak (N), Ark, Alarka (S)*	Apocynaceae	Latex is useful in arthritis, inflammation and keeping out thorns from wounds. It is also applied on wasp sting (4,5,6). Latex is used for sprains, boils and inflammation (8).	Plant milk is used for sprain, joint pain. Leaf powder is used in snakebite. Plant is taken as cultural.
237.		5, 1, 4	*Caltha palustris* Linn.		Ranunculaceae		
238.		1, 4	*Campanula aristata* Wall.		Campanulaceae		
239.		4	*Campanula latifolia* L.		Campanulaceae		
240.		Baitadi, 1800 m (LP Kattel 816; I Sharma, R Joshi, R Uprety and I Pandey)	*Campanula pallida* Wall.	*Nepali bish, Gano buti (N)*	Campanulaceae		
241.	*Heng 9806*	2	*Cannabis sativa* Linn. Syn. *C. indica* Lam.	*Hemp (E), Ganja (N), Bhango (L), Bhang (S).*	Cannabaceae	Leaf juice is applied to control bleeding (3,9). Plant for tonic, cuts and indigestion (1,2). Roasted seeds used for making pickle (10,11). Seeds are antihelmintic (8).	Plant is used in cattle complaint *tila*. Plant seeds are used for constipation and analgesic.
242.		5	*Capillipedium assimile* (Steudel) A.Camus	*Kharu (N)*	Poaceae		
243.		5, 1, 2	*Capsella bursa-pastoris* (Linn.) Medikus	*Chalne, Swale, Burga, Chamsure jhar (L, N)*	Brassicaceae		
244.		1	*Cardamine flexuosa* Withering, C scutata	*Chamsure (L)*	Brassicaceae		
245.		1	*Cardamine loxostemonoides* O.E. Schiltz	*Cuckoo flower (E), Chamsure (L)*	Brassicaceae		
246.		5, 1	*Cardiocrinum giganteum* (Wall.) Makina	*Himalayan Lily (E), Ghiu pat, Tille (L)*	Liliaceae		
247.		4	*Carex atratiformis* Britton		Cyperaceae		
248.		1	*Carex filicina* Nees	*Sindurpang (L)*	Cyperaceae		
249.		4, Darchula, 3702m (KM Ghimire and M AdhikariF049)	*Carex haematostoma* Nees		Cyperaceae		
250.		1	*Carex microgrochin* Wahlenb.		Cyperaceae		
251.		5	*Carex myosurus* Nees		Cyperaceae		
252.		5, 1	*Carex nivalis* Boott		Cyperaceae		
253.		1	*Carex nubigena* D.Don		Cyperaceae		
254.		1	*Carex setigera* D.Don		Cyperaceae		
255.		3	*Carex stracheyi* Boott ex C.B.Clarke		Cyperaceae		
256.		5	*Carpesium nepalense* Less.	*Padke ghans (L)*	Asteraceae		
257.		2	*Carum carvi* Linn.	*Caraway (E), Jangali jira (L), Kalo jira (N). Syn. Apium carvi L.*	Apiaceae	Fruits are applied against swelling of breast and testicles (9b) and useful in cold, cough and fever (3,6).	Plant seeds are helpful in easing respiration.
258.	RK112410	1	*Caryopteris bicolor* (Roxb. ex Hardwicke) Mabberly	*Agada (L)*	Lamiaceae		
259.	*KU 07204*	2	*Cassia fistula* Linn.	*Indian laburnum (E), Amaltas (L), Rajbriksha (N), Suvarnakha (S)*	Fabaceae	Fruit pulp is used as diuretics (3,7).	
260.		Darchula, 1100-2060m (KR Rajbhandari and KJ Malla 5523; MM Amatya and PM Regmi W663/82)	*Cassia mimosoides* L.		Fabaceae		
261.			*Cassia species*	*Irru (L)*	Fabaceae		
262.		5, 1, 2, 4	*Cassiope fastigiata* (Wall.) D.Don	*Madhuparni, Phalu (L, N)*	Ericaceae		
263.		2	*Castanopsis tribuloides* (Sm.) A.DC.	*Musure katus (N)*	Fagaceae	Bark for snakebites (1,2). Fruits are edible (10).	Plant is a good wood and fodder tree. Bark for snakebites.
264.			*Celtis australis* Linn.		Ulmaceae		

265.	KU 07276 DBU 006	2	*Centella asiatica* (Linn.) Urb.	*Penny wort (E), Khochade (L), Ghodtapre, (N), Brahmi, Maduka parni (S);*	Apiaceae	Leaf juice is used in urinary problems and cuts and wounds (3,4,5,6). Leaf for cuts, wounds and skin diseases (2), memory and hiccups (1).	Plant juice is used in conjuntivitis, cuts, wounds, skin diseases, acnes, cold, fever, cattle urine degradation, jaundice, pilo and makada.
266.		3,5, Baitadi, 890m (PR Shakya, MK Adhikari and MN Subedi 7851)	*Centranthera nepalensis* D. Don		Orobanchaceae		
267.		1	*Cerastium fontanum* Baumg.	*Common chikweed (E)*	Caryophyllaceae		
268.		3	*Ceropegia longiofolia* Wall.		Apocynaceae		
269.		3	*Ceropegia pubescens Wall.*		Apocynaceae		
270.		1	*Chamabainia cuspidata* Wight		Urticaceae		
271.		5	*Chamaecrista nomane* (Sieb.) H. Ohba		Fabaceae		
272.			*Cheilanthes tenuifolius* *C. albimarginat*a C.B. Clarke.	*Deers tongue (E), Dubekando (N)*	Pteridaceae	Plant powder for cuts and wounds (2) and peptic ulcer (8).	
273.		5, 1	*Chenopodium ambrosioides* L.	*Goose foot, Pigweed (E), Bethe, Bethu (L, N), Vastukah (S)*	Amaranthaceae	Whole plant is useful in constipation and indigestion (4,9), vegetable (10).	
274.		5, 3	*Chirita bifolia* D.Don		Gesneriaceae		
275.		3	*Chirita pumila* D.Don.		Gesneriaceae		
276.		2	*Choerospondias axillaris* (Roxb.) Burt. & Hill	*Nepalese Hog plum (E), Lapsi (L,N)*	Anacardiaceae	Fruits are edible and used to make pickles. They are rich in vitamin C (3,7).	
277.		3	*Chonemorpha fragarans* (Moon) Alston		Apocynaceae		
278.			*Chromolaena odorata* (L.) R.M. King & H. Rob.	*Kalo ganya (L)*	Asteraceae	Plant juice for cuts and wounds (8).	
279.		3	*Cinnamomum bejolghota* (Buch.-Ham.) Sweet		Lauraceae		
280.	KU 07215 BBU 095	1, 2	*Cinnamomum tamala* (Buch.-Ham.) Nees & Eberm.	*Cinnamomum (E), Tejpat (N), Bahugandh, Tachula, Patra (S)*	Lauraceae	Leaf is used in gastric problems. Bark is useful in checking nausea and vomiting (3,4,5,6). Bark for spices (10), fever and insomnia (1). Bark and leaves are used to treat colic and diarrhea (8). Bark and leaves for blood and fever (2).	Bark and leaves are used as spices and useful in cold, cough, arthritis and toothache.
281.	KU 07222	2	*Cirsium verutum* (D.Don) Spreng.	*Creeping thistle (E), Thakil, Dhande kanda (L), Thakailo (Ni), Thakailo*	Asteraceae	Root is used as refresher and for calmness. It is also applied for stomachache and abdominal pain (3,4,6,9). Root for abdominal pain (1,2).	Root is useful in dehydration, cough, fever and urine complaints.
282.	BKU 023, 96-15 NHM	1, 2	*Cissampelos pareira* Linn.	*False pareira, Brava (E), Batulpate, Gurjegano, Tito belo, Muse belo (N), Ambashtha (S)*	Menispermaceae	Root is anthelminthic and antipyretic. Root juice cures headache, stomachache, asthma and urinary problems of livestock (3,4,5,6).	
283.	KU 07211	2	*Cissus repens* Lam.	*Wild grape (E), Pureni, Charchare laharo (N), Asthisamharaka (S)*	Vitaceae	Stem juice is useful in eye redness (3,4,9).	
284.			*Citrus limon* (Linn.) Burm.f.	*Nibuwa (N)*	Rutaceae	Fruits are edible (10).	
285.			*Citrus medica* Linn	*Adam's apple, Citron (E), Bimiro (N), Mahulunga (S)*	Rutaceae	Leaf is antipyretic and used as insect or pest repellant (3,9).	
286.			*Citrus species*	*Matkakadi* (L)	Rutaceae	Fruits are edible (10).	
287.		5, 1	*Clematis barbellata* Edgew.		Ranunculaceae		
288.		1	*Clematis buchnaniana* DC.	*Bokebelo (L), Jungwe lahara (L)*	Ranunculaceae	Bark, Leafes for wounds (1,2).	
289.		1	*Clematis connata* DC.	*Himalayan clematis (E), Bhainse laharo (L)*	Ranunculaceae		
290.		Darchula, 9500ft (TB Shrestha 4227)	*Clematis orientalis* L.		Ranunculaceae		
291.		3	*Clerodendrum chinense* (Obbeck) Mabbery		Lamiaceae		
292.		1	*Clinopodium umbrosum* (M. Bieb.) C. Koch	*Bilajor (L)*	Lamiaceae		
293.		5, 1	*Clintonia udensis* Trautv. & Meyer		Liliaceae		

294.		2	*Coccinia grandis* (Linn.) Voigt.	*Ivy Guard (E), Golkakadi (L), Golkankri (N), Bimbika (S)*	Cucurbitaceae	Root juice is useful in uterine discharge and fruits in jaundice (3,7). Fruits are edible (10,11) and useful in diabetes (8).	
295.		5, 1	*Cocculus laurifolius* DC.	*Tilphora (L)*	Menispermaceae		
296.	RK 163	3	*Coelogyne cristata* Lindl.		Orchidaceae		
297.	KU 07232	5, 2	*Colebrookea oppositifolia* Sm.	*Bedmauri (L), Dhursool (N), Bedlauri, Vadmyol*	Lamiaceae	Leaf juice is used for skin diseases (3,4,9).	
298.		Darchula, 1050-1330m (MM Amatya & PM Regmi W655/82)	*Coleus forskohlii* (Willd.) Briq.	*Gandhe jhar (N)*	Lamiaceae		
299.			*Colocasia esculenta* (Linn.) Schott	*Taro (E), Gabo, Dgangalya (L)*	Araceae	Leaves are vegetable (10,11).	
300.		1,3	*Colquhounia coccinea* Wall.	*Himalayan mint shrub (E), Dhuchu (L)*	Lamiaceae		
301.		4	*Comastoma falcatum* (Turc. Exd Kar & Kir) Toyok		Gentianaceae		
302.		3	*Commelina benghalensis* Linn.	*Kanya sag (L) benghal day flower (E)*	Commelinaceae	Young leaves are used as vegetable (10,11). Root juice is given for indigestion (8).	
303.		3	*Corallodiscus lanuginosus* (Wall. Ex DC.) Burtt		Gesneriaceae		
304.		Darchula, 840m (MM Amatya and PM Regmi W485/82)	*Corchorus aestuans* Linn.		Malvaceae		
305.	KU 07247, RK112407	1, 2,	*Coriaria napalensis* Wall.	*Musoorie berry (E), Dahikamlo, Bhojinsi (L), Machhaino, Maidalo (N), Masuri (S)*	Coriariaceae	Bark is valued for scalds and burns (3,4,9).	Fruits are edible and applied on burns and scalds.
306.		1, 2, 4	*Cortia depressa* (D.Don) C. Norman	*Bajari (L)*	Apiaceae		
307.		1	*Corydalis calycina* Liden		Papaveraceae		
308.		1	*Corydalis casimiriana* Royle		Papaveraceae		
309.		3, Darchula, 1720-1910m (I Sharma, R Joshi, R Uprety and I Pandey 489)	*Corydalis chaerophylla* DC.		Papaveraceae		
310.		5, 1	*Corydalis cornuta* Royle		Papaveraceae		
311.		5, 1	*Corydalis elegans* Wall.		Papaveraceae		
312.		5	*Corydalis filiformis* Royle		Papaveraceae		
313.		4	*Corydalis govaniana* Wall.		Papaveraceae		
314.		4	*Corydalis juncea* Wall		Papaveraceae		
315.		5, 1, 4	*Corydalis meifolia* Wall.		Papaveraceae		
316.		1	*Corydalis pseudojuncea* Lundlow		Papaveraceae		
317.		Darchula, 3600-3900m (PR Shakya, MK Adhikari & MN Subedi 8022, 8044, 8076)	*Corydalis shakyae* Lidén		Fumariaceae		
318.		4	*Corydalis trifoliata* Franch.		Papaveraceae		
319.			*Costus speciosus* (Koenig) Sm.	*Kauchho, Kachur (L, N)*	Costaceae	Rhizome for eye infection (1,2).	
320.		5	*Cotoneaster frigidus* Wall.	*Ruis, Chabra (L), Tree cotoneaster (E)*	Rosaceae		
321.		1, 4	*Cotoneaster microphyllus* Wall.	*Bele gangado Khareto (L, N)*	Rosaceae	Seeds for burn and skin diseases (1,2).	
322.		5, 3	*Cotoneaster nitidus* Jacq.		Rosaceae		
323.		5	*Craniotome furcata* (Link.) Kuntze	*Batule silam (L)*	Lamiaceae		
324.		5, 1	*Crassocephalum crepidoides* (Benth.) S. Moore	*Anikale jhar (L)*	Asteraceae		
325.		Darchula, 2550-3600m (PR Shakya, MK Adhikari and MN Subedi 8034; KR Rajbhandari and KJ Malla 5706)	*Cremanthodium arnicoides* (DC ex Royle) R Good		Asteraceae		
326.		1	*Cremanthodium ellisii* (Hook.f) Kitam		Asteraceae		
327.		Darchula, 4040m (PR Shakya, MK Adhikari and MN Subedi 8080)	*Cremanthodium reniforme* (DC.) Benth.		Asteraceae		
328.	RK0130	3	*Cremanthodium retusum* (Wall. Ex Hook.f.) R. Good		Asteraceae		
329.		Darchula, 2700-3800m (CK Subedi, KM Ghimire, J Gurung & S Thapa 14)	*Crotalaria psoralioides* D. Don. *Syn. C cytisoides*		Fabaceae		
330.		4, Darchula, 3827m (KM Ghimire and M Adhikari F004)	*Crucihimalaya himalaica* (Edgeworth) Al-Shehbaz		Brassicaceae		

331.		Darchula, 3302m (1216066)	*Crucihimalaya lasiocarpa* (Hook.f. & Thomson) Al-Shehbaz		Brassicaceae		
332.		Darchula, 2183m (1216036)	*Crucihimalaya stricta* (Cambess.) Al-Shehbaz, O'Kane & R.A.Price		Brassicaceae		
333.		1, 4	*Cryptogramma brunoniana* Wallich ex Hooker & Greville		Pteridaceae		
334.		4	*Cryptogramma stelleri* (Gmel.) Prantl		Pteridaceae		
335.	*139-15 NHM, 148-15-NHM*	1,	*Cryptolepis buchananii* Roem. & Schultes	*Badikhoko (L)*	Apocynaceae		
336.			*Cucumis sativus* Linn.	*Airalo (L)*	Cucurbitaceae	Fruits are useful in chronic fever (7). Fruits are eaten (10).	
337.		5	*Cupressus torulosa* D.Don	*Raj sallo (L)*	Cupressaceae		
338.	KU 07259.	5, 2	*Curcuma angustifolia* Roxb. *Syn. C. longa L.*	*Zeodory, Haldi (N) Ban haldi, Haridra, Harita (S), Saro, Sathi, Kachur, bakhre saro*	Zingiberaceae	Rhizome paste is externally applied for paralysis (6,9). Curcuma rhizome for fever and common cold (1,2).	Rhizome is used in cough, inflammation, stomachache, fracture and skin diseases.
339.	KU 07265, BKU 053	5, 2	*Cuscuta reflexa* Roxb.	*Dodder (E), Aakasbeli, Megh (N), Amaruela (S)*	Convolvulaceae	Plant paste is effective for headache, Jaundice, bodyache and itches (3,5,6). Plant juice treat jaundice (8). Plant is sued to prepare medicine for livestock health (11).	Plant is used in skin diseases, jaundice and conjunctivitis. Shoot is also used for pneumonia and cough of cattle. Plant is sometimes used as antifertility ingredients.
340.		4	*Cyananthus lobatus* Wall.		Campanulaceae		
341.		Darchula, 3802m(KM Ghimire and M Adhikari F013)	*Cyananthus microphyllus* Edgew.		Campanulaceae		
342.		1	*Cyathula capitata* Moq.		Amaranthaceae		
343.		5, 1	*Cyathula tomentosa* (Roth) Moq.		Amaranthaceae		
344.		3	*Cynanchum auriculatum Royle ex Wight*		Apocynaceae		
345.		1	*Cynodon dactylon* (Linn) Pers.	*Bermuda, Dog's teeth grass (E), Dubi (L), Dubo (N), Durva (S)*	Poaceae	Plant paste is effective on sprain (4). Inflorescence is grinded with water and applied for earache, paralysis (9). Leaf for paralysis and injuries (1,2). Plant juice for indigestion, cuts, wounds and fractures (8).	Plant is cultural. It is used with honey for fracture, jaundice and snakebite
346.		Darchula, 2700-3800m (CK Subedi, KM Ghimire, J Gurung & S Thapa 3010)	*Cynoglossum amabile* Stapf & Drumm.		Boraginaceae		
347.		5	*Cynoglossum glochidiatum* Wall.	*Tejraj (L)*	Boraginaceae		
348.		Darchula, 4000m (KM Ghimire and M Adhikari F008)	*Cynoglossum wallichii* G. Don.		Boraginaceae		
349.	*KU 07203*	5, 4	*Cynoglossum zeylanicum* Thunb. ex. Lehm., Syn. *C. furcatum* Wall.	*Kodakuro, Musekudo(L), Chakchira, Bhedekuro (N)*	Boraginaceae	Plant is used for healing wounds and cuts (3,7).	Plant root is useful in pneumonia, fever, cough and joint pain. Flowers are used to reduce blood pressure.
350.		5	*Cyperus corymbosus* Rottb. *Syn.* C. scariosus	*Nagarmotha (N)*	Cyperaceae		
351.		1	*Cyperus niveus* Retz.		Cyperaceae		
352.	BBU 096.	2	*Cyperus rotundus* Linn.	*Mothe, Nut grass (E), Nagarmothe, Siru (N), Nagarmusta (S)*	Cyperaceae	Rhizomes extract is used in fever, diarrhea, dysentery and blood disorders (3,4,5). Root paste for diarrhea (1).	
353.		4	*Cypripedium himalaicum* Rolfe aupd Hemsl		Orchidaceae		
354.		1	*Cystopteris fragilis* (L.) Bernh.		Cystopteridaceae		
355.		5, 1	*Dactylis glomerata* Linn.		Poaceae		
356.		Baitadi, 890m (PR Shakya, MK Adhikari and MN Subedi 7855)	*Dalbergia sericea* G. Don.		Fabaceae		
357.		Baitadi, 830m(PR Shakya , MK Adhikari and MN Subedi 7840)	*Dalbergia sissoo* Roxb. ex DC		Fabaceae		
358.		4	*Danthonia cumminsi* Hook.f.		Poaceae		

359.	*TUCH-MO-117*	5, 2	*Daphne bholua* Buch.-Ham. ex D.Don. *Syn. D. cannabina Lour. ex Wall.*	*Nepali paper plant (E), Gore, Baruwa (L), Lokta, Kagaj pate (N)*	Thymelaeaceae	Seeds are taken for stomachache and anthelmintic (3,4,9).	
360.		Darchula, 2700-3800m (CK Subedi, KM Ghimire, J Gurung & S Thapa 2106)	*Daphne papyracea* Wall. ex G. Don.		Thymelaeaceae		
361.		5	*Daphne retusa* Hemsl.		Thymeleaceae		
362.			*Daphniphyllum himalense* (Benth.)Mull.-Arg		Daphniphyllaceae		
363.		2	*Datura metel* Linn.		Solanaceae	Seeds for boil and cuts (1,2).	
364.	DKU 094	5, 1, 2	*Datura stramonium* Linn.	*Devil's apple, Thorns apple, (E), Seto Dhatura (N), Kanak, Dhatura (S)*	Solanaceae	Fruits are used as sedative. Seed paste is employed in boils (3,4,5,6).	
365.	*Heng 8548*	2	*Debregaesia longifolia (*Burm. f.) Wedd	*Wild rhea (E), Githi, Tushari (L), Daar (N)*	Urticaceae	Wood is used to prepare wooden pots for storing milk and youghurt, which is supposed to be useful for indigestion. Tender shoots are used as vegetable (3,6 7).	Plant wood is used for storing milk products. Plant wood is also used for fracture and sprain.
366.		1	*Debregaesia saeneb* (Forssk.) Hepper & Wood		Urticaceae		
367.	KU 508/00	1, 2, 4	*Delphinium brunonianum* Royle	*Rocket larkspur (E), Bisadi, Maure (L,N)*	Ranunculaceae	Dried roots are valued in toothache (3,6,7).	
368.			*Delphinium denudatum* Wall ex Hook.f. & Thoms.	*Nirmasi (L, N)*	Ranunculaceae		
369.		5, 2	*Delphinium himalayai* Munz	*Atis (L, N)*	Ranunculaceae	Root is medicinal (3).	Root is antidiarrhoec and antidoting.
370.		Darchula, 2640-2820m (MM Amatya & PM Regmi W793A/82)	*Delphinium scabriflorum* D. Don		Ranunculaceae		
371.		3, Darchula, 2390-2640m (MM Amatya & PM Regmi W723/82)	*Delphinium stapeliosum* Bruhl ex Huth.		Ranunculaceae		
372.		4	*Delphinium vestitum* Wall ex. Royle		Ranunculaceae		
373.			*Dendrocalamus hamiltonii* Nees & Arn. Var ndulatus	*Bans (L,N)*	Poaceae	Young shoots are used as vegetable (10).	Plant is cultural and a good fodder.
374.		1	*Deschampsia caespitosa* (Linn.) Beauvois		Poaceae		
375.		1, 2	*Desmodium elegans* DC.		Fabaceae		
376.		Darchula, 1330-2060m (MM Amatya and PM Regmi W686/82)	*Desmodium heterocarpon* (L.) DC.		Fabaceae		
377.	KU 07268		*Desmostachys bipinata* (Linn.) Stapf.	*Kush (L), Khas (N), Usirah, Sugandhimulah (S)*	Icacinaceae	Root juice is useful in purifying blood and cough and cold (6).	Plant is cultural, and used medicinally for heart attack, and reduce blood pressure.
378.		1	*Deutzia compacta* Craib		Hydrangeaceae		
379.		Baitadi, 2140m (Shakya and Joshi 489),	*Deutzia staminea* R.Br. ex Wall.		Hydrangeaceae		
380.		4, Darchula, 3810m (KM Ghimire & M Adhikari F208)	*Deyeuxia scabrescens* (Griseb.) Munro ex Duthie		Poaceae		
381.			*Dichroa febrifuga* Lour.		Hydrangeaceae		
382.		Darchula, 3600-3650m (PR Shakya, M Adhikari and MN Subedi 8017; CM Joshi 27186)	*Dicranostigma lactucoides* Hook.f. & Thomson		Papaveraceae		
383.	KU 07216	2	*Didymocarpus albicalyx* C. B. Clarke	*Kumkum (N)*	Gesneriaceae	Leaf infusion and dust are useful in respiratory problem of children and chronic asthma (3,4,9).	Plant leaf and roots are used in fracture, sprains, skin diseases, respiratory diseases, dudhe rog, sool and increasing fertility.
384.		3	*Didymocarpus cinereus* D.Don		Gesneriaceae		
385.		5	*Digitaria cruciata* (Nees ex Steudel) A Camus		Poaceae		
386.		Darchula, 1800-2500m (KR Rajbhandari and KJ Malla 5894; KR Rajbhandari and KJ Malla 5685)	*Digitaria sanguinalis (*L.) Scop.		Poaceae	Good forage	
387.		2	*Dioscorea bulbifera* Linn.	*Githo (L, N)*	Dioscoreaceae	Tubers and bulbils are eaten (10,11).	

388.		2	*Dioscorea deltoidea* Wall.	*Deltoid yam (E), Vyakur (L), Gittha (N), Brahmakanda, Varahi (S)*	Dioscoreaceae	Yam is used as pesticide and anthelmintic (3,9). Tubers and bulbils are eaten as vegetable (10,11) for gastric and dysentery (8).	
389.		3, Darchula, 1330-3700m (MM Amatya and PM Regmi W671/82;KR Rajbhandari and KJ Malla 5636; KM Ghimire and M Adhikari F043)	*Dipsacus inermis Wall.*	*Mulapat (L)*	Caprifoliaceae		
390.		5	*Doronicum roylei* DC.		Asteraceae		
391.		Darchula, 3330-3640m (JF Duthie 5358)	*Draba amoena* O.E.Schulz		Brassicaceae		
392.		4	*Draba eleta* Hook.f. & Thoms.		Asteraceae		
393.		1	*Draba lichiangensis* W. W. Smith		Brassicaceae		
394.		4	*Dracocephalum heterophyllum* Benth.		Lamiaceae		
395.		Baitadi, 1210m (JB Tyson 133), Darchula, 1540m (PR Shakya, MK Adhikari & MN Subedi 7879)	*Drosera peltata* Thunb.		Droseraceae		
396.	Hoffmeister 78a	2	*Drymaria cordata* (Linn.) Willd. ex Roem. & Schult.	*Lightening weed (E), Abijalo (N)*	Caryophyllaceae	Leaf is used as calmness, fresh and for cough (3,4,6,9).	
397.		1	*Dryopteris barbigera* (T. Moore ex Hook.) Kuntze		Dryopteridaceae		
398.		2	*Dryopteris cochleata* (Buch.-Ham. ex D. Don) C. Chr.	*Liudo (L)*	Dryopteridaceae	Tender shoots are used as vegetable (10,11) for diarrhea nd dysentery (8).	
399.		Darchula, 2700-3800m (CK Subedi, KM Ghimire, J Gurung & S Thapa 1609)	*Dubyaea hispida* DC.		Asteraceae		
400.		5, 1, Baitadi, 1210m (JB Tyson 134)	*Duchesnea indica* (Andr.) Focke	*Bhui ainselu (L)*	Rosaceae	Fruits for headache (1,2).	
401.		5	*Echinochloa crus-galli* (Linn.) P. Beauv.	*Samo ghas (N)*	Poaceae		
402.		5	*Echinops nivieus* Wall.		Asteraceae		
403.	KU 07226, BKU 055	2	*Eclipta prostrata* Linn.	*Eclipta, False daisy (E), Bhringraj, Sasaranjan, Bhringraj (S)*	Asteraceae	Leaf juice is given for dyspepsia and is applied for scorpion sting. Root is used as tonic for liver (3,5,6).	
404.		1	*Elatostema integrifolium* (D.Don) Wedd.	*Lipe jhar (L)*	Urticaceae		
405.		1	*Elatostema monoandrum* (Buch.-Ham. ex D.Don) Hara		Urticaceae		
406.		1	*Elatostema sessile* J.R. & G Forst.	*Gagleto (N)*	Urticaceae		
407.	E246	2	*Eleagnus parvifolia* Wall ex Royle	*Guyenlo (N), Mallido (L)*	Elaeagnaceae	Fruits are edible (3,11). Bark for boils (1,2).	Fruits are edible and useful in dysentery.
408.		5, 1	*Eleocharis palustris (*Linn.) Roem. & Schult.		Cyperaceae		
409.	*KU 07208*	2	*Elephantopus scaber* Linn.	*Prickly leaved elephants foot (E), Gomukhi, Sahasra buti (L,N), Satamulika (S)*	Asteraceae	Root is given to control vomiting (3,6,7).	
410.		5	*Elsholtzia ciliata* (thunb.) Hyland	*Lenja (L)*	Lamiaceae		
411.		5, 1, 4	*Elsholtzia eriostachya* Benth.	*Bhote pati (L)*	Lamiaceae		
412.		5, 3	*Elsholtzia flava* Benth.	*Ban silam (N)*	Lamiaceae		
413.		Darchula, 850-2060m (MM Amatya and PM Regmi W641/82; MM Amatya and PM Regmi W669/82)	*Emilia sonchifolia* (L.) DC.	*Mulapate, Chaulane jhar (N)*	Asteraceae		
414.			*Engelhardtia spicata* Leschen. ex Blume. Syn. E. colebrookeana Lindl. ex Wall.	*Mahuwa (N)*	Juglandaceae	Flower juice is drunk for abdominal pain (3,4,9). Flowers for abdominal pain and dysentery (1,2).	
415.	KU 07236	2	*Entada phaseoloides* (Linn.) Merr.	*Mackay bean, Ladynut (E), Pangra (L, N), Kakavali, Gilagaccha (S)*	Fabaceae	Fruits are used in cuts and wounds, and body pain (3,9).	
416.		2, 4	*Ephedra gerardiana* Wall ex Stapf.	*Gerard's Jointfir (E), Kag charo, Somlata, Tutgatha (L,N)*	Ephedraceae	Fruits are edible (3).	
417.		4	*Epilobium brevofolium* D.Don		Onagraceae		

418.		1	*Epilobium chitralense* P.H.Raven		Onagraceae		
419.		1, 4	*Epilobium latifolium* Linn.		Onagraceae		
420.		Darchula, 3902m (KM Ghimire and M Adhikari F011)	*Epilobium royleanum* Hausskn.		Onagraceae		
421.		5	*Epilobium sikkimense* Hausskn.		Onagraceae		
422.		4	*Epilobium wallichianum* Hausskn.		Onagraceae		
423.	KU 555/00	2	*Equisetum arvense* L., *subsp diffusum* D. Don	*Spreading horsetail (E), Ankhle jhar (L), Kurkure (N)*	Equisetaceae	Plant stem juice is given for gonorrhea (3,9).	
424.		5	*Erianthus rufipilus* (Steudel) Grieseb., Syn. *Saccharum rufipilum*		Poaceae		
425.		5, 1	*Erigeron karvinskianus* DC.	*Fule (N)*	Asteraceae		
426.		5	*Eriophorum comosum* (Wall.) Wall. ex C. B. Clarke	*Furke jhar (L)*	Cyperaceae		
427.		1	*Erioscirpus comosus* (Nees) Palla		Cyperaceae		
428.		4	*Eritrichium canum* (Benth.) Kitam.		Boraginaceae		
429.		4	*Eritrichium minimum* (A Brand) Hara		Boraginaceae		
430.			*Eryngium aquaticum* Linn. Syn. *E. foetidium*	*Ban dhaniya (L)*	Apiaceae	Stomachache, indigestion, Asthma (6).	Plant and seeds are used in diarrhea, lactation and human fertility.
431.	*KU 07202*	2	*Erythrina arborescens* Roxb.	*Coral tree (E), Aejingo (L), Phaledo (N)*	Fabaceae	Plant bark extract is anthelmintic, given to livestock as fodder (3,7).	
432.		2	*Eulophia dabia* (D.Don) Hochr.	*Kaladana (L)*	Orchidaceae		
433.		Darchula, 2700-3800m (CK Subedi, KM Ghimire, J Gurung & S Thapa 1801)	*Euonymus fimbriatus* Wall..	*Rugum (L)*	Celastraceae		
434.		1	*Euonymus porphyreus* Loesen.		Celastraceae		
435.		1, 2	*Euphorbia hirta* Linn. Syn. *E. pilulifera* Linn., Syn. *Chamaesyce hirta* (Linn.) Millsp.	*Snake weed, Asthma weed (E), Dudhi jhar (N), Pusitoba (S)*	Euphorbiaceae	Plant latex is applied for cuts (4). Plant juice is applied in asthma and diarrhea (3,9). Latex for cuts (1,2) and sprains, fractures (8).	
436.		5, 1, 2	*Euphorbia royleana* Bioss.	*Siudi (Local, N), Snuhi (S), Cactus spurge (E)*	Euphorbiaceae	Stem latex is used in joint pain/leg pain (3,4,9) and eye complaints (6). Latex for sprains, boils, pimples and mumps (8).	Milk is used for joint pain.
437.		5	*Euphorbia sikkimensis* Bioss.		Euphorbiaceae		
438.		1, 4	*Euphorbia stracheyi* Bioss.	*Sangme (L)*	Euphorbiaceae		
439.		Baitadi, 1900m (LP Khattel 835)	*Euphorbia wallichii* Hook. f. .	*Dhuk (L)*	Euphorbiaceae		
440.		4	*Euphrasia himalayica* Wettst.		Euphorbiaceae		
441.	RK112402	Baitadi, 1500m (I Sharma, R Joshi, R Uprety and I Pandey)	*Eurya acuminata* DC.		Pentaphyllaceae		
442.	KU 581/00	5, 2, 3	*Evolvulus alsinoides (L.)* Linn.	*Aankuri phul (N), Sankhapuspi, Visnukravita (S)*	Convolvulaceae	Decoction of plant is taken for increase memory (3,9).	
443.		5, 1	*Excoecaria acerifolia* F.F. Didrichsen		Euphorbiaceae		
444.		1, 2	*Fagopyrum dibotrys* (D.Don) Hara	*Ban bhade, Ban phapar (N)*	Polygonaceae		
445.	*RK7292*	3	*Fagopyrum esculentum* Moench.	*Buckwheat (E), Phapar(L,N)*	Polygonaceae	Tender shoots are used as vegetable. Leaves are useful in skin diseases (3, 7). Vegetable and edible (10).	
446.		1	*Festuca leptopogon* Stapf.		Poaceae		
447.		4	*Festuca polycoela* Stapf.		Poaceae		
448.		5, 2	*Ficus auriculata* Lour.	*Eve's apron (E), Timila Nimaro(N)*	Moraceae	Stem juice is considered effective against diarrhea and fruits are consumed for dysentery (4,9). Latex for diarrhea, cholera and vomitting (1,2), Fruits are eaten (10) for diarrhea and dysentery (8).	Plant is a good fodder tree.
449.	*KU 07287*	2	*Ficus benghalensis* Linn.	*Banyan tree (E), Bar (L,N), Vatah (S)*	Moraceae	Bark juice is applied on pains and rheumatism. Bark decoction is used in skin diseases of livestock (3,7). Fruits are eaten (10). Bark is useful in diabetes (8).	Plant is cultural. Bark is useful in skin diseases.

450.	*KU 07288*	2	*Ficus hispida* Linn.f.	*Khasreti (L,N), Malayu (S)*	Moraceae	Fruits are edible and astringent (3,7). Fruits are eaten (10).	
451.			*Ficus lacor* Buch.-Ham.	*Kapro (L)*	Moraceae	Young buds for used for vegetables and pickles (10).	
452.			*Ficus neriifolia* Sm.	*Dudhi (N)*	Moraceae	Fruits are eaten (10,11).	Plant is a good fodder tree.
453.	*BBU 095, 153-15 KATH*	2	*Ficus palmata* Forssk., Syn. F. virgata Wall.	*Bedu (L, N)*	Moraceae	Plant milk is useful for taking out the thorns from wounds (3,4,9). Ripe fruits for dysentery (1,2). Young leaves are vegetable (10). Latex for taking out the spinces and thorns (8).	Plant is used as vegetable and it helps to remove thorns. Tender buds are used as vegetable.
454.		2	*Ficus racemosa* Linn.	*Gullar, Umaro, Dumri (L,N)*	Moraceae	Plant is a good fodder and edible (3). Fruits are eaten (10).	
455.		2,	*Ficus religiosa* Linn.	*Peepal tree (E), Pipal (N), Aswatha (S)*	Moraceae	Bark juice is applied for paralysis (3,4,9). Bark for paralysis (2) and ear pain (1). Fruits are eaten (10) as laxative (8).	Plant is highly cultural.
456.		5	*Ficus sarmentosa* Buch.-Ham ex Sm.	*Ban timila (N)*	Moraceae		
457.	*KU 07286*	2	*Ficus semicordata* Buch.-Ham. ex D.Don	*Fodder fig (E), Khinyau (L,N)*	Moraceae	Fruits are edible and astringent. Plant is used as fodder (3,7). Fruits are eaten (10) for constipation (8).	Plant is a good fodder tree.
458.		Darchula, 3702m (KM Ghimire and M Adhikari F041)	*Filipendula vestita* (Wall. ex G. Don) Maxim.		Rosaceae		
459.	*KU 07300*	2	*Fimbristylis dichotoma* (L.) Vahl	*Mat rush (E), Jire jhar (L), Pani mothe, Dubi Kahamdo (N)*	Cyperaceae	Plant extract is useful in pimples, boils and wounds (3,4,7).	
460.	KU 07242.	1, 2, 4	*Fragaria nubicola* Lindl., Syn. *Fragaria vesca* Linn.	*Alpine strawberry (E), Bhuikafal, Kappu (N)*	Rosaceae	Fruit paste heals skin diseases and wounds (3,6,9). Fruits are eaten (10) to treat tongue rashes (8).	
461.		2	*Fraxinus floribunda Wall*	*Lakuri (N)*	Oleaceae		
462.		4	*Fritillaria cirrhosa* D.Don		Liliaceae		
463.		1	*Galinsoga parviflora* Cav.		Asteraceae		
464.		1	*Galinsoga quadriradiata* Ruiz & Pav.		Asteraceae		
465.		Darchula, 160-850m (MM Amatya & PM Regmi W616/82)	*Galium aparine* L.		Rubiaceae		
466.		1	*Galium asperuloides* Edgew.		Rubiaceae		
467.		1	*Galium elegans* Wall. ex Roxb.		Rubiaceae		
468.		4	*Galium megacyttarion* R.R. Mill.		Rubiaceae		
469.		1	*Galium paradoxum* Maxim.		Rubiaceae		
470.	115-15 NHM	1	*Gamochaeta pensylvanica* (Willd.) A.L. Cabrera, Syn. *Gnaphalium purpureum*	*Bado (L)*	Asteraceae		
471.		2	*Garuga pinnata Roxb*	*Garuga (E), Ramsin (L), Dabdabe, Jhenga (N)*	Burseraceae	Barks of three plants *G pinnata, Erythrina arborescens and Ficus semicordata* squeezed and the extract is useful in stomach disorder. Plant is used as fodder (3,7).	
472.		5	*Gaultheria fragrantissima* Wall.	*Dashingre (N)*	Ericaceae		
473.		Darchula, 2600m-11000ft. (KR Rajbhandari and kJ Malla 5676; Dorothy Mierow)	*Gaultheria nummularioides* D. Don		Ericaceae		
474.		5, 1, 4	*Gaultheria trichophylla* Royle	*Kali gedi (L)*	Ericaceae		
475.		5	*Geniosporum coloratum* (D.Don) Kuntze		Lamiaceae		
476.	RK121906	4	*Gentiana capitata* Buch.-Ham. ex D.Don		Gentianaceae		
477.		Baitadi, 7000ft.-2300m(AP Singh 132-84; P Pradhan, RK Uprety, N Pradhan and N Dabadi 1330)	*Gentiana decemfida* Buch.-Ham. ex D.Don		Gentianaceae		
478.		Baitadi, 1600m (P Pradhan, RK Uprety, N Pradhan and N Dabadi	*Gentiana pedicellata* (D. Don) Omer		Gentianaceae		

		1342), Darchula, 2000m (Shakya and Joshi 447)					
479.		4	*Gentiana stipitata* Edgew.		Gentianaceae		
480.		4	*Gentiana tubiflora* (G.Don) Giesb.		Gentianaceae		
481.		Darchula 3900m (PR Shakya, MK Adhikari and MN Subedi 8075)	*Gentiana venusta* (G.Don) Grieseb		Gentianaceae		
482.		4	*Gentianella paludosa* (Hook.) H.Sm.		Gentianaceae		
483.		Darchula, 3702m (KM Ghimire and M Adhikari F042)	*Geranium collinum* Steph. ex Willd.		Geraniaceae		
484.		1	*Geranium nepalense* Sweet		Geraniaceae		
485.		5,2,3	*Gerbera nivea* (DC.) Sch. Bip.	*Panda, Jhulo (L,N)*	Asteraceae		
486.		5, 1, 4	*Geum elatum* Wall. ex G. Don	*Bohey (L)*	Rosaceae		
487.		1, 2	*Girardinia diversifolia* (Link) Friis, Syn. *G. heterophylla*	*Large nettle (E), Chalne sisnu (L), Allo (N)*	Urticaceae	Tender shoots are cooked as vegetable. It is also useful in headache and joint pain (3,7). Tender shoots are cooked as vegetable (10) and also used for fever and headache (8) and carbuncle (1).	Plant is useful in fracture.
488.		1	*Glaphyropteridopsis erubescens (Wall. ex Hook.) Ching,* Syn. *Thelypteris erubescens*		Thelypteridaceae		
489.		5	*Glochidion velutinum* Wight.		Phyllanthaceae		
490.		Baitadi, 600m (PR Shakya, MK Adhikari & MN Subedi 7834)	*Gloriosa superba* Linn.		Colchicaceae		
491.		1	*Glyceria tongluensis* C. B. Clarke		Poaceae		
492.		5	*Gnaphalium hypoleucum* DC.	*Sorka (L)*	Asteraceae		
493.		5	*Goldfussia capitata* Nees		Acanthaceae		
494.			*Grewia optiva* J.R. Drumm. ex Burret	*Viywal (L), Syalpuchre (N)*	Malvaceae	Root juice is taken as expectorant. Wood paste is applied for skin diseases (4,9). Bark for skin diseases (1,2).	Plant is a good fodder and fibre tree. Plant fiber is used in making ropes.
495.		4	*Gypsophila cerastioides* D.Don		Caryophyllaceae		
496.		5, 1	*Habenaria arietina* Hook.f.		Orchidaceae		
497.		5, 4	*Hackelia uncinata* (Royle ex Benth) C.E.C. Fischer		Boraginaceae		
498.		Baitadi, 1500m (I Sharma, R Joshi, R Uprety and I Pandey 642)	*Hackelochloa granularis* (L.) Kuntze		Poaceae		
499.		Darchula, 2630-3800m (PR Shakya, MK Adhikari and MN Subedi 7978; CK Subedi, KM Ghimire, J Gurung & S Thapa 1703)	*Halenia elliptica* D.Don		Gentianaceae		
500.	*RK112207*	5, 3	*Hedera nepalensis* K.Koch	*Dudela, Kathe laharo (L)*	Araliaceae	Stem and leaf are crushed for stomatitis (1).	
501.		1	*Hedychium ellipticum* Buch.-Ham. ex Sm.	*Panisaro (N)*	Zingiberaceae		
502.		1	*Heliotropium strigosum* Willd.		Boraginaceae		
503.		1	*Helixanthera ligustrina* (Wall.) Danser		Loranthaceae		
504.	RK112412	1	*Hemiphragma heterophyllum* Wall.		Plantaginaceae		
505.		Darchula, 2430m (PR Shakya, MK Adhikari & MN Subedi 7970)	*Hemipilia cordifolia* Lindl.		Orchidaceae		
506.		4	*Heracleum nepalense* D.Don		Apiaceae		
507.		4	*Heracleum wallichii* DC.		Apiaceae		
508.		5	*Herminium duthei* Hook. f.		Orchidaceae		
509.		5, 3, 4	*Herminium josephii* Rchb. f.		Orchidaceae		
510.		5, 3	*Herminium monophyllum* (D.Don) P.F. Hunt & Summerh.		Orchidaceae		
511.		4	*Hierochloe laxa R.Br. Sy. Anthoxanthum laxum*		Poaceae		
512.		Darchula, 3840m (H Tabata, DP Joshi, K Tsuchiya, N Fujita, E Suzuki, Y Shimizu, F Koike, K Matusui and T Yomoto 20586)	*Hippolytia dolicophylla* (Kitam.) K. Bremer & Humphries		Asteraceae		

513.	169-15, 1227 RK	5, 2, 3	*Hippophae salicifolia* D.Don	*Dalechuk, Chungo (L,N)*	Elaeagnaceae		
514.	KU 07248, BKU 093	2	*Holarrhena pubescens* (Buch.-Ham.) Wall.	*Easter tree, Ivory tree, Conessi bark, Kurchi (E), Bankhirra, Desikhirra (L), Indrajau (N), Indrabriksha, Kutaj, Watsak (S)*	Apocynaceae	Bark is antidiarrhoeic, antipyretic and anthelmintic. Seed powder is useful in fever (3,5).	
515.		1	*Hoya lanceolata* Wall. ex D.Don		Apocynaceae		
516.		1	*Hydrangea anomala* D.Don		Hydrangeaceae		
517.		1	*Hydrangea heteromalla* D.Don		Hydrangeaceae		
518.	*KU 07228*	2	*Hydrocotyle javanica* Thunb, Syn *H. nepalensis* Hook.	*Hyssop (E), Khochade (L), Sano ghortapre (N), Zupha (S)*	Araliaceae	Leaf for urinary problem, cuts and wounds. Plant is mixed with *Coccinia grandis* for treatment of piles. Leaf juice is given to livestock for urinary problems (3,7).	Plant is used in cuts and wounds and snakebite.
519.		Darchula, 3903m (KM Ghimire and M Adhikari F009)	*Hypericum elodeoides* Choisy	*Jibre ghans, Tikua (L)*	Hypericaceae		
520.		1	*Hypericum patulum* CP Thung. ex A Murray, Syn. *H. oblongifolium*	*Pyauli, Bhede ghas (L)*	Hypericaceae		
521.		1	*Hypodematium crenatum* (Forsk.) Kuhn		Hypodematiaceae		
522.		1	*Hypoxis aurea* Lour.		Hypoxidaceae		
523.		1	*Hystrix duthei* (Stapf ex Hook. f.) Bor		Poaceae		
524.		Darchula (KR Rajbhandari and KJ Malla 5885)	*Ilex dipyrena* Wall.	*Seto Kharsu (L)*	Aquifoliaceae		
525.			*Ilex excelsa* (Wall.) Hook.f.		Aquifoliaceae		
526.	*KU* 570/00, RK121804	2	*Impatiens balsamina* Linn.	*Patpate (L), Tiri (N)*	Balsaminaceae	Plant extract is used as hair growth promoter (3,7).	
527.		Darchula, 3703m (KM Ghimire and M Adhikari F028)	*Impatiens racemosa* DC.		Balsaminaceae		
528.		4	*Impatiens sulcata* Wall.		Balsaminaceae		
529.		1, 2	*Imperata cylindrica* (L.) Beauvois.	*Cogon grass (E), Siru (L, N), Sarba (S).*	Poaceae	Rhizome paste is applied for urinary problems (3,4,9). Roots for headache (1,2), diarrhea and dysentery (8).	Plant rhizome juice is used in urine problem.
530.		1	*Incarvillea mairei* (H. Lev.) Grierson		Bignoniaceae		
531.		Darchula, 1050-2000m (MM Amatya and PM Regmi W656/82; PR Shakya and DP Joshi 442)	*Indigofera dosua* Buch.-Ham. ex D. Don		Fabaceae		
532.		1	*Indigofera hebepetala* Benth.		Fabaceae		
533.	*113-15 NHM*	1, 2	*Indigofera heterantha* Wall. ex Brandia	*Sakhino (L,N)*	Fabaceae	Tender buds are used as vegetable (3,7). Tender shoots are cooked as vegetable (10).	
534.	KU 07254, 192-15 NHM	2	*Inula cappa* (Buch.-Ham. ex D. Don) DC.	*Elecampane (E), Rithaula (L), Puskarmul (N), Puskaram (S), Rithaula, hadchuda*	Asteraceae	Root extract is useful in severe stomachache, dysentery (4) and for blood pressure (3,9).	
535.		1	*Iphigenia indica* (Linn.) Kunth.		Colchicaceae		
536.		3	*Ipomoea nil* (L.) Roth.		Convolvulaceae		
537.		Darchula, 3900m (KM Ghimire & M Adhikari F213)	*Iris decora* Wall.		Iridaceae	Plant is antidysenteric.	
538.		1	*Isolepis setacea* (Linn.) R.Br.		Cyperaceae		
539.		1	*Ixeris polycephala* Cass.		Asteraceae		
540.	122301RK	1	*Jasminum dispersum* Wall.		Oleaceae		
541.		Darchula, 2000m (1216042)	*Jasminum grandiflorum* L.		Oleaceae		
542.	*KU 07293*	5, 1, 2	*Jasminum humile* Linn.	*Yellow jasmine (E), Jai (N)*	Oleaceae	Flowers and leaves are astringent. Tender shoots and leaves are used as tea (3,7).	
543.		1	*Jasminum nepalense* Spreng.	*Ban jai (L)*	Oleaceae		
544.	KU 07260, BBU 056	2	*Jatropha curcas* Linn.	*Arim, Physic nut (E), Inna (L), Sajiwan (N), Vyaghra eranda (S)*	Euphorbiaceae	Seed oil is applied for arthritis and boils (4). Bark juice is useful in wounds, scabies and	Young shoots are used in toothache, snake bites and polio.

						ringworm (3,5,6). Seed is emetic and applied for boils (8).	
545.	KU 07272, DBU 099	5, 2	*Juglans regia* Linn.	*Walnut (E), Okhar (N), Akshotaka (S)*	Juglandaceae	Bark is used in scabies, toothache, allergy (3,5,6). Root, bark for dental diseases (1,2). Fruits are edible (10), oil is useful in headache (8).	Fruits are edible. Root is used as toothache and bodyache. Leaf is antileeching and used in antihairfall.
546.		1	*Juncus benghalensis* Kunth.		Juncaceae		
547.		5, 4	*Juncus himalensis* Klotzsch		Juncaceae		
548.		4	*Juncus membranaceous* Royle ex		Juncaceae		
549.		4	*Juncus thomsonii* Buchenau		Juncaceae		
550.	KU 07266.	2	*Jurinea dolomiea* Bioss. Syn. Carduus macrocephalus Wall.	*Dhup, Bhutkes (N)*	Asteraceae	Root decoction is taken in stomachache and diarrhea (3,9).	
551.	KU 07273 RBU 057	2	*Justicia adhatoda* Linn.	*Malabar nut (E), Vasakha, Basing (L), Asuro (N), Basa, Brisha (S)*	Acanthaceae	Leaf juice is used to cure diarrhea and dysentery (3,4,5). Root for skin diseases (1,2). Leaves are for cough, asthma and fever (8).	
552.		5, 1	*Kobresia duthei* C.B. Clarke		Cyperaceae		
553.		1	*Kobresia esenbeckii* (Kunth.) Noltie		Cyperaceae		
554.		1, 4	*Kobresia nepalensis* (Nees) Kuke.		Cyperaceae		
555.		1	*Koenigia delicatula* (Meisn.) Hara		Polygonaceae		
556.		4	*Koenigia islandica* Linn.		Polygonaceae		
557.		5, 1	*Koenigia nepalensis* D. Don		Polygonaceae		
558.		3	*Koenigia nummularifolia* (Meisn.) Mesicek & Sojak		Polygonaceae		
559.		Baitadi, 1900m (LP Khattel 1259), Bajhang, 2040m (PR Shakya, MK Adhikari and MN Subedi 8298)	*Korthalsella japonica* (Thunb.) Engl.		Santalaceae		
560.		1	*Kyllingia brevifolia* Rottb.		Cyperaceae		
561.			*Lagerstroemia indica* Roxb.		Lythraceae		
562.		5, 1	*Lamium album* Linn.		Lamiaceae		
563.			*Lannea coromandelica* (Houtt.) Merr.		Anacardiaceae		
564.	Weigend 5370	1, 2	*Lantana camara* Linn.	*Kande (L), Banmasa (N)*	Verbenaceae	Leaves extract for bleeding control and useful in fever (3,6).	
565.		3, Baitadi, 1200m (CM Joshi 153/95)	*Lavatera kashemiriana* Cambess.		Malvaceae		
566.		1	*Lecanthus peduncularis* (Royle) Wedd.		Urticaceae		
567.		Darchula, 1650-850m (PR Shakya, MK Adhikari and MN Subedi 78893; MM Amatya and PM Regmi W 611/82)	*Leea asiatica* (L.) Ridsdale	*Galeno, Kaknasika (L,N)*	Vitaceae	Leaf extract is useful in indigestion and spleen disorders (3).	
568.		5	*Leontopodium himalayanum* DC.		Asteraceae		
569.		1	*Leontopodium jacotianum* Beauv.		Asteraceae		
570.		5, 1	*Leonurus cardiaca* Linn.		Lamiaceae		
571.		Baitadi, 660m (PR Shakya, MK Adhikari and MN Subedi 7825)	*Leptodermis lanceolata* Wall.		Rubiaceae		
572.		1	*Leptodermis stafiana* H. Winkler		Rubiaceae		
573.		Baitadi, 1900m (LP Kattel 1250)	*Leptorhabdos parviflora* (Benth.) Benth.		Orobanchaceae		
574.		Darchula, 3702m (KM Ghimire and M Adhikari F040)	*Leucas ciliata* Benth		Lamiaceae		
575.		2	*Leucas lanata* Benth.	*Pipeso jhar (L)*	Lamiaceae	Plant for cuts and wounds (1, 2).	
576.		Darchula, 2700-3800m (CK Subedi, KM Ghimire, J Gurung & S Thapa 43)	*Leucosceptrum canum* Sm.		Lamiaceae		
577.	KU 07267.		*Lichen species*	*Lichen (E), Jhyau (N),*	Lichens	Lichen extract and decoction is applied to treat moles (3,9).	
578.		5, 1	*Ligularia fischerii* (Ledeb.) Turcz.		Asteraceae		
579.		4	*Ligularia virgurea* (Maxim.) Mattef.		Asteraceae		
580.			*Ligustrum indicum* (Lour.) Merr.	*Keri (L)*	Oleaceae		
581.		1, 4	*Lilium nanum* forma *flavidum* Klotz.		Liliaceae		
582.		5,3,1	*Lilium nepalense* D. Don		Liliaceae		

583.		1	*Lindenbergia indica* (Linn.) Vatke		Orobanchaceae		
584.			*Lindera neesiana* (Wall ex Nees) Kurz.		Lauraceae		
585.		3, Darchula, 840m (MM Amatya and PM Regmi W982/82)	*Lindernia crustacea* (L.) F. Muell.		Linderniaceae		
586.	*KU07195*	2	*Litsea monopetala* (Roxb.) Pers.	*Kutmiro (L,N)*	Lauraceae	Plant is used as fodder. Bark decoction is given for inflammation (3,7).	
587.	RK0131	4	*Lloydia longiscapa* Hook. f.		Liliaceae		
588.	KU 569/00	2	*Lobelia pyramidalis* Wall. Syn. *L. nicotianaefolia Roth*	*Lobelia (E), Aklebir (N), Eklebir (S)*	Campanulaceae	Juice of leaves and flowers is rubbed on body parts during bodyache (3,9).	
589.		4	*Lomatogonium carinthiacum* (Wulf.) Riech.		Gentianaceae	Plant is antipyretic (ICIMOD 2017)	
590.		4	*Lonicera hispida* Pall. Ex Willd.		Caprifoliaceae		
591.			*Loranthus odoratus* Wall.	*Aijedu (L)*	Loranthaceae	Fruits are eaten (10,11).	
592.		5, 3	*Luisia zeylanica* Lindl., Syn. *L tristis*		Orchidaceae		
593.		4	*Lycopodium selago* L.		Lycopodiaceae		
594.		5, 2	*Lyonia ovalifolia* (Wall.) Drude	*Aayanr (L), Angeree (N)*	Ericaceae	Tender shoots are applied for skin diseases of livestock (3,7).	Bark is applied in skin diseases. Plant is also used as wood and fuel.
595.		5	*Lyonia villosa* (Hook.f.) Hand.-Mazz.	*Aayanr (L), Angeree (N)*	Ericaceae		
596.		Baitadi, 1500m (I Sharma, R Joshi, R Uprety and I Pandey	*Lysimachia alternifolia* Wall.		Primulaceae		
597.		2	*Maesa chisia* Buch.-Ham. ex D.Don,	*Belaune (L, N)*	Primulaceae	Root juice is used as diuretics (3,7).	
598.		Darchula, 1396m (1218028)	*Maesa montana* A. DC.		Primulaceae		
599.		Darchula, 3600m (PR Shakya, MK Adhikari & MN Subedi 8021)	*Maharanga bicolor* (Wall. ex G.Don) A.DC.		Boraginaceae		
600.		2	*Mahonia napaleunsis* DC.	*Mirja, Madaro, Jamane mandro (L, N)*	Berberidaceae	Bark for eye itching (1,2).	
601.		Darchula, 2700-3800m (CK Subedi, KM Ghimire, J Gurung & S Thapa 16)	*Maianthemum fuscum* (Wall.) LaFrankie		Asparagaceae		
602.		5, 3	*Malaxis cylindrostachya* (Lindl.) Kuntze, Syn. *Dienia cylindrostachya*		Orchidaceae		
603.		4	*Malaxis muscifera* (Lindl.) Kuntz.		Orchidaceae		
604.	KU 07261., BKU 092	1, 2	*Mallotus philippensis* (Lam.) Mull.-Arg.	*Kamala (E), Rohina (L), Sindure (N), Kampillak (S)*	Euphorbiaceae	Fruits are valued for scabies (3,4,5).	
605.			*Mangifera india* Linn.	*Aanp (L,N)*	Anacardiaceae	Fruits are eaten (10) as laxative (8).	Plant is cultural and bark juice is used in gastric and hydrocele.
606.		Darchula, 840-1810m (MM Amatya and PM Regmi W512/82)	*Maoutia puya* (Hook.) Wedd.	*Khole jhar (L)*	Urticaceae		
607.		Darchula, 1660-1810m (MM Amatya and PM Regmi W603/82)	*Mazus surculosus* D. Don		Mazaceae		
608.		1	*Meconopsis peniculata* Prain	*Gyasur (L)*	Papveraceae		
609.		1	*Meizotropis pellita* (Hook. f. ex Prain) Sanj.		Fabaceae		
610.		2	*Melia azedarach* Linn	*Bead tree, Persean lilac (E), Bakaina, Betraina (L, N), Mahanimba (S)*	Meliaceae	Bark and leaf juice is useful in spleen disorders (3,4,9). Fruits and barks for bone fracture (1).	Barks are antipyretic and anthelmintic. Fruits are useful in cattle complaints.
611.		5	*Melica scaberrima* Nees ex Steudel		Poaceae		
612.		Baitadi, 4000 ft	*Meliosma simplicifolia* (Roxb.) Walp.		Sabiaceae		
613.	BKU 058	1, 2	*Mentha spicata* Linn.	*Spearmint (E), Pudina (L), Tulsi pate (N), Putitha (S)*	Lamiaceae	Plant is used for freshness, asthma and urinary complaints (3,4,5,6). Vegetable (10) and useful in dysentery and blils (8).	
614.		1	*Micromeria biflora* (Buch.-Ham. ex D.Don) Benth.	*Singati, Sukkati, Pinase jhar (L, N)*	Lamiaceae	Leaf and roots for retention of urine and stool (1,2).	
615.		2	*Millettia extensa* (Benth) Baker	*Milletia (E), Gaujo (N)*	Fabaceae	Root is useful as insecticide and piscicide (3, 9).	
616.	KU 07299	110-15	*Mimosa rubicaulis* subsp himalayan Lam.	*Sensitive plant (E), Lajjabati (N), Lajja, Saptaparni (S), Katreti*	Fabaceae	Leaves are used in skin diseases (3,9).	

617.		5	*Mimulus nepalensis* var. *nepalensis* Benth.		Phrymaceae		
618.		1	*Mollugo pentaphylla* Linn.		Molluginaceae		
619.		1	*Monochoria vaginalis* (Birm.f.) C. Presl		Pontederiaceae		
620.	KU 07243	2	*Morchella esculenta* (Linn.) Pers.	*Morel mushroom (E), Mathyaura (L), Guchhi chyau (N)*	Helvellaceae	Plant stalk and cap are aphrodisiac in properties and used as tonic and immunostimulant (3, 9). Plant stalk are used as vegetable (10).	
621.		5, 1	*Morina longifolia* Wall. ex DC.	*Kandru (L)*	Caprifoliaceae		
622.		4	*Morina polyphylla* Wall.		Caprifoliaceae		
623.		2	*Morus serrata* Roxb.	*Himalayan mulberry (E), Kimbu (L,N)*	Moraceae	Root juice is anthelmintic. Fruits are edible (3,7,11).	
624.		3, Baitadi, 770m (PR Shakya, MK Adhikari and MN Subedi 7838)	*Mucuna nigricans* (Lour.) Steud.	*Kauso (N)*	Fabaceae		
625.	KU 07227, BKU 059	5, 2	*Mucuna pruriens* (Linn.) DC.	*Cowhage, Velvetbean (E), Kauchho (N), Kapikachhu (S)*	Fabaceae	Roots are tonic and stimulant (5,3,6).	
626.		5, 1	*Muhlenbergia himalayensis* Hackel		Poaceae		
627.	KU 07217 BBU 091	2	*Murraya koenigii* (Linn.) Spreng.	*Curry leaf tree (E), Ganiuele, Ganuele, Mechiya sag (L), Desi neem, Mitha neem, Kari patta (N), Maharista, Mahanimba (S)*	Rutaceae	Leaves and roots are anthelminthic and are useful in blood disorders (4). Root extract is applied for skin diseases (3,5). Leaves are used as flavoring vegetable (10) and useful for diarrhea and dysentery (8).	
628.			*Musa species*	*Ban kera (L, N)*	Musaceae	Fruits are eaten (10).	
629.		5	*Myriactis nepalensis* Less.	*Thuke phool (L)*	Asteraceae		
630.	KU 567/00	2	*Myrica esculenta* Buch.-Ham. ex D.Don	*Box myrtle Bay berry, (E), Kafal (N), Kumbhi, Kaidaryama (S)*	Myricaceae	Fruits are eaten for dysentery and bark decoction is given for bronchitis (3,9). Bark for indigestion (1,2), fruits are edible (10).	Plant bark is used in jaundice, paralysis, and to improve fertility. It also removes skin scars and eases burns and scalds.
631.		Darchula, 2700-3800m (CK Subedi, KM Ghimire, J Gurung & S Thapa 2102)	*Myricaria squamosa* Desv.		Tamaricaceae		
632.	RK121904	5	*Myrsine africana* L.	*Sete kath, ghodebello (L)*	Primulaceae		
633.	KU 07218, DBU 060	1, 2, 4	*Nardostachys grandiflora* DC.	*Spikenard, Vulte, Jatamansi*	Caprifoliaceae	Oil is useful in headache. Root and rhizome is useful in epilepsy and mental weakness (3,5).	Plant is used in stomachache, heart disease and dysentery.
634.		Darchula, 2100m (PR Shakya & MK Adhikari 7899)	*Neohymenopogon parasiticus* (Wall.) Bennet		Rubiaceae		
635.		1	*Neolitsea pallens* (D.Don) Momiyama & Hara		Lauraceae		
636.		Darchula, 2090m (PR Shakya, MK Adhikari and MN Subedi 7903)	*Neolitsea umbrosa* (Nees) Gamble		Lauraceae		
637.	DKU 090.	5, 1, 2, 4	*Neopicrorhiza scrophularifolia* (Pennel) Hong	*Gentian, Hellobore (E), Katuko (L), Kutki (N), Aristha, Katuka, Matsyapitta (S)*	Plantaginaceae	Roots are considered to use for fever and stomachache (3,5).	Roots are useful in indigestion, fever, TB and respiratory problems.
638.		Darchula, 3902m (KM Ghimire and M Adhikari F026)	*Nepeta laevigata* (D. Don) Hand.-Mazz		Lamiaceae		
639.		Darchula, 2700-3800m (CK Subedi, KM Ghimire, J Gurung & S Thapa 1912)	*Nepeta lamiopsis* Benth. ex Hook. f.		Lamiaceae		
640.	Heng 8615		*Nephrolepis cordifolia* (Linn.) K. Presl	*Pani amala (N), Rasmada (L)*	Davalliaceae	Refresher, galactogogue (6). Fruits are eaten (10).	
641.		5, 1	*Nicandra physalodes* (L.) Geartn.		Solanaceae		
642.		Baitadi, 1500-1900m (LP Kattel 1229; LP Kattel 824; I Sharma, R Joshi, R Uprety and I Pandey 609), JDA Stainton, 5000ft. (JDA Stainton 4831)	*Oenothera rosea* L'Her. ex Aiton		Onagraceae		
643.		5	*Olea glandulifera* Wall. Ex G. Don	*Jaitun (N)*	Oleaceae		
644.		5	*Onosma bracteatum* Wall.		Boraginaceae		

645.	KU 07241	2	*Ophiocordyceps sinensis* (Berk.) H Sung.	*Caterpillar fungus (E), Jara (L), Yarsagumba (N), Sanjiwani (S)*	Clavicipitaceae	Whole plant is tonic and aphrodisiac and useful in increase memory and immune system (3,9).	Plant is highly tonic and used in fever and cough.
646.		1	*Oreocnide fructesense* (Thunb.) Miq.		Urticaceae		
647.		Darchula, 2880m (JDA Stainton 3949)	*Oreorchis foliosa* (Lindl.) Lindl.		Orchidaceae		
648.		5, 2	*Origanum vulgare* Linn.	*Ram tulasi, Sajiwan (L)*	Lamiaceae		
649.	KU 07238 BKU 061	2	*Oroxylum indicum* (Linn.) Kurz	*Trumpet flower (E), Sanna, Tatelo (N), Shyonaka (S)*	Bignoniaceae	Root decoction is used in diarrhea and dysentery. Seeds are digestive (3,4,5,6).	Plant is a fodder tree and useful in tila pareko.
650.		5	*Oryzopsis gracilis* (Mez) Pilg.		Poaceae		
651.			*Osbeckia stellata* Buch.-Ham. ex D. Don	*Gauraphool, Rato chulsi (L,N)*	Melastomataceae	Root for indigestion (1,2).	
652.	KU 07244.	5, 2, 3	*Osmanthus fragrans* Lour. *Syn. O. acuminatus (Wall.) Nakai*	*Tree Jasmine (E), Siringe (L), Silinge (N)*	Oleaceae	Leaf juice is taken for fever and cold (3,9). Bark for arthritis (1).	
653.	27-15 KATH	2	*Osyris wighitiana* Wall. ex Wight	*Wild tea (E), Nundhikya (L), Jhuri, Nundhiki, Nun dhiki (N)*	Santalaceae	Bark infusion is given to stop bleeding. Leaf and bark decoction is used in sprains and fractures (3, 9). Bark for bone fracture (2).	
654.	Anderson 399	1, 2	*Oxalis corniculata* Linn.	*Creeping sorrel (E), Chalmado (L), Chari amilo (N), Changeri, Amla patrika (S)*	Oxalidaceae	Leaves are stomachic and useful for throat pain (3,4,6,9). Leaf for ringworm (2), redness of eye (1), plants is used for making pickle (10).	
655.			*Oxalis corymbosa* DC.	*Chalmado (L)*	Oxalidaceae		
656.		4	*Oxygraphis polypetala* (Royle) Hook.f. Thoms.		Ranunculaceae		
657.		1, 3, 4	*Oxyria digyna* (Linn.) Hill		Polygonaceae		
658.		1, 3	*Paeonia emodi* Wall. ex Royle		Paeoniaceae		
659.		5, 3	*Papaver dubium* var *dubium* Linn.		Papaveraceae		
660.		Darchula, 2700-3800m (CK Subedi, KM Ghimire, J Gurung & S Thapa 1707)	*Parasenecio chenopodifolius* (DC.) Grierson,		Asteraceae		
661.		1	*Parietaria micrantha* Ledeb.		Urticaceae		
662.		1	*Parnassia kumaonica* Nekrassova		Celastraceae		
663.	KU 205/00	2, 4	*Parnassia nubicola* Wall.	*Mamira (N)*	Celastraceae	Root paste is applied for eye inflammation (3 9).	
664.		1	*Parochetus communis* Buch.-Ham. ex D. Don		Fabaceae		
665.		1	*Paspalum scrobiculatum* Linn.	*Kode ghas, janai jhar (L, N)*	Poaceae		
666.		4	*Pedicularis bicornuta* Klotzsch		Orobanchaceae		
667.		5, 3	*Pedicularis bifida* (Buch.-Ham. ex D.Don) Pennell		Orobanchaceae		
668.		Darchula, 3330-3640m (JF Duthie 5836)	*Pedicularis brevifolia* D. Don		Orobanchaceae		
669.		Darchula, 2150m (PR Shakya, MK Adhikari and MN Subedi 7952)	*Pedicularis chamissonoides* T. Yamaz.		Orobanchaceae		
670.		Darchula, 3714m (KM Ghimire and M Adhikari F024)	*Pedicularis cheilanthifolia* Schrenk		Orobanchaceae		
671.		1	*Pedicularis heteroglossa*		Orobanchaceae		
672.		1	*Pedicularis hoffmeisterii* Klotz.		Orobanchaceae		
673.		1	*Pedicularis klotzschii* Hurus.		Orobanchaceae		
674.		4	*Pedicularis roylei* Maxim		Orobanchaceae		
675.		1, 4	*Pedicularis siphonantha* D. Don		Orobanchaceae		
676.		Darchula, 899m (1217002)	*Pentasacme wallichii* Wight		Apocynaceae		
677.		3, Baitadi, 1500m (I Sharma, R Joshi, R Uprety and I Pandey 6240)	*Peperomia pellucida* (L.) Kunth		Piperaceae		
678.			*Perilla frutescens* (Linn.) Britton	*Silam, Bhangiro, Bhangkaper (L,N)*	Lamiaceae	Fruits for pickle (10,11). Leaves for cut and wounds (8).	Plant is used in fever, cough and cold. Plant leaf is applied to make an amulet for children for easing their respiration.

679.		5, Baitadi, 600m (PR Shakya, MK Adhikari & MN Subedi 7833)	*Peristylus constrictus* (Lindl.) Lindl.		Orchidaceae		
680.		5, Darchula, 2850m (KR Rajbhandari and KJ Malla 5858)	*Peristylus elisabethae* (Duthie) R. K. Gupta		Orchidaceae		
681.			*Persea duthiei* (King ex Hook.f.) Kosterm		Lauraceae		
682.		1, 2, Baitadi, 890m(PR Shakya, MK Adhikari and MN Subedi 7848)	*Persicaria barbata* (Linn.) Hara; Syn. *P. barbatum*	*Pirrhe (N)*	Polygonaceae	Stem juice is useful for boils and pimples (9).	
683.		1	*Persicaria capitata* (Buch.-Ham. ex D.Don) H. Gross		Polygonaceae		
684.		1	*Persicaria chinensis* (Linn.) H.Gross		Polygonaceae		
685.		Baitadi, 1800m LP Kattel 821)	*Persicaria microcephala* (D. Don) H. Gross	*Masino thotne (N)*	Polygonaceae		
686.		1	*Persicaria nepalensis* (Meisn.) H. Gross		Polygonaceae		
687.		5	*Phaseolus vulgaris* Linn.		Fabaceae		
688.		1	*Philadelphus tomentus* Wall.		Hydrangeaceae		
689.		5, 1, 4	*Phleum alpinum* Linn.		Poaceae		
690.		5, 1	*Phlomis bracteosa* Royle ex Benth.		Lamiaceae		
691.		1	*Phlomis macrophylla* Wall. ex Benth.		Lamiaceae		
692.		Darchula, 2200m (PR Shakya, MK Adhikari and MN Subedi 7932)	*Phlomis setigera* Falc. ex Benth.		Lamiaceae		
693.	KU 07282	2	*Phoenix sylvestris* Roxb.	*Sugar palm (E), Khajur (L,N)*	Arecaceae	Root powder is used as food and useful in toothache (3,7). Fruits are eaten (10,11). Leaves are used for toothache (8).	
694.		5	*Pholidota articulata* Lindl.		Orchidaceae		
695.		1	*Phryma leptostchya* Linn.		Phrymaceae		
696.		1	*Phyla nodiflora* (Linn.) Green	*Bhringraj (N)*	Verbenaceae	Bark for headache (1, 2).	
697.	KU 07262 BKU 135	2	*Phyllanthus emblica* Linn.	*Gooseberry (E), Aunla (L), Amala, Rikhiya (N), Dhatri, Aadiphala (S)*	Phyllanthaceae	Fresh fruits are diuretic and laxative and are considered for cold and cough (3,4,5). Fruits for asthma, hair tonic and burns (1,2), diarrhea and dysentery (8). Fruits are edible (10).	Plant is cultural, and fruits are used as medicinal for cough, gastric, indigestion, skin diseases, hair growth and removing skin scars.
698.		5	*Phyllanthus urinaria* Linn.	*Ajata, Khantad (L)*	Phyllanthaceae		
699.		1, 2	*Phytolacca acinosa* Roxb. *Syn. P. latbenia* (Moq.) H. Walter	*Pokeberry (E), Jaringo (N)., Hokling (L)*	Phytolacaceae	Vegetable is consumed for body ache (3,9).	Plant is used as vegetable for jaundice and cold.
700.		Darchula, 2200m (PR Shakya, MK Adhikari and MN Subedi 7929)	*Pilea racemosa* (Royle) Tuyama		Urticaceae		
701.		1	*Pilea scripta* (Buch.-Ham. Ex D. Don) Wedd.		Urticaceae		
702.		5	*Pilea symmeria* Wedd.		Urticaceae		
703.		1	*Pilea umbrosa* Blume		Urticaceae		
704.		2	*Pinus roxburghii* Sarg.	*Chir pine (E), Khote salla, Chir, (L), Rani salla (N), Sarala (S)*	Pinaceae	Bark paste is used in burns and scalds. Resin is applied on boils and scalds (3,4,5). Resin for boils, cuts and bone fracture (1,2,8). Roasted cones are eaten (10).	Plant resin is used in wounds, fracture and inflammation. This is also a common wood in village.
705.		2	*Piper longum* Linn.	*Pipla, Gadpan (N)*	Piperaceae	Fruits are consumed as spices (10) and eaten cough and cold (8).	
706.		1, 2	*Piptanthus nepalensis* (Hook) D.Don	*Solsaino (L)*	Fabaceae	Decoction of bark is useful in taking out the thorns from wounds (3, 7).	
707.	*114-15 NHM*	2	*Pistacia chinensis* Bunge	*Kakadi (L)*	Anacardiaceae	Gall used to treat snake and scorpion stings (11).	
708.		1	*Plantago erosa* Wall.	*Blond psyllium (E), Ishabgol (N), Ashvagola, Snigdhabija (S)*	Plantaginaceae	Plant seeds are useful in diarrhea, dysentery and indigestion (3,9).	
709.		5	*Platanthera clavigera* Lindl.		Orchidaceae		

710.		Darchula, 2000-2430m (PR Shakya, MK Adhikari & MN Subedi 7895; PR Shakya, MK Adhikari & MN Subedi 7968)	*Platanthera edgeworthii* (Hook. f. ex Collett) R. K. Gupta		Orchidaceae		
711.	KU 07274, BBU 089	2, 3	*Plumbago zeylanica* Linn.	*Frangipani, Ceylon leadwort (E), Chhittu (N), Agnimata, Chitrak (S)*	Plumbaginaceae	Leaf juice cures skin diseases. Root paste is effective against scabies (3,5).	
712.		2	*Plumeria rubra* Linn.	*Pagoda tree (E), Choya phool (L), Galaincha phool (N), Kshirchampaka, Swetachampa (S)*	Apocynaceae	Flowers are useful in indigestion and cholera (3,9).	
713.		Darchula 3702m (KM Ghimire and M Adhikari)	*Poa stapfiana* Bor		Poaceae		
714.	KU 583/00.	5	*Podophyllum hexandrum* Royle *Syn. P. emodi Wall. ex Hook. f. & Thomson*	*Podophyllum, May apple (E), Laghupatra (N), Hatkaudo (L), Hansapadi, Laghupatra (S)*	Berberidaceae	Root juice is taken for liver complaints (9).	
715.		5, 2	*Pogonatherum crinitum* (Thunb.) Kunth	*Kharuko (N)*	Poaceae	Useful in anaemia (3).	
716.		1	*Polygala crotalarioides* Buch.-Ham. ex DC		Polygalaceae		
717.		Baitadi, 1500m (I Sharma, R Joshi, R Uprety and I Pandey 637), Bajhang, 1200m (MS Bista and DP Joshi 770)	*Polygala furcata* Royle		Polygalaceae		
718.		4, Darchula, 3703m (KM Ghimire and M AdhikariF036)	*Polygonatum hookeri* Baker		Asparagaceae		
719.		3, Darchula 850-1050m (MM Amatya & PM Regmi W636/82)	*Polygonum posumbu* Buch.-Ham. ex D. Don,; Persicaria posumbu		Polygonaceae		
720.		1	*Polygonum recumbens* Royle ex Bab.		Polygonaceae		
721.		4	*Polystichum dutheii* (C.Chope) C.Chr		Dryopteridaceae		
722.		1	*Polystichum prescottianum* (Wall. ex Mett.) T. Moore		Dryopteridaceae		
723.		5	*Porana paniculata* Roxb.		Convolvulaceae		
724.		1	*Portulaca oleracea* Linn.		Portulacaceae		
725.		3, Darchula, 3600-3800m (PR Shakya, MK Adhikari and MN Subedi 8025; (CK Subedi, KM Ghimire, J Gurung & S Thapa 75)	*Potentilla agrophylla var atrosanguinea* Lodd.		Rosaceae		
726.		4	*Potentilla anserina* Linn		Rosaceae		
727.		5, 1	*Potentilla argyrophylla* var agrophylla Wall.		Rosaceae		
728.		1	*Potentilla cuneata* Wall. Ex Lehm.		Rosaceae		
729.		3, Darchula, 3640m (PR Shakya, MK Adhikari and MN Subedi 8043)	*Potentilla eriocarpa* Wall. ex Lehm.		Rosaceae		
730.		3, 4	*Potentilla fruticosa* Linn. Rigida		Rosaceae		
731.	KU 93/00.	2	*Potentilla fulgens* Wall. Ex Hook. Syn. P. siemersiana Lehm.	*Himalayan Cinquefoil (E), Phosre (L), Bajradanti (N), Kanthamun (S)*	Rosaceae	Dried roots are eaten as dentifrice (3,9).	
732.		Darchula, 2250m (PR Shakya, MK Adhikari and MN Subedi 7945, 7951)	*Potentilla griffithii* Hook.f.		Rosaceae		
733.		5, 1, 3	*Potentilla kleniana* Wight	*Tilpila (L)*	Rosaceae		
734.		1, 4	*Potentilla microphylla* var. *microphylla* D. Don		Rosaceae		
735.		Darchula, 2700-3800m (CK Subedi, KM Ghimire, J Gurung & S Thapa 3012)	*Potentilla monanthes* Lindl. ex Lehm.		Rosaceae		
736.		1	*Potentilla polyphylla* Wall. ex Lehm.		Rosaceae		
737.		1	*Potentilla tristis* Sojak		Rosaceae		
738.		5, 1	*Pouzolzia hirta* (Bl.) Hassk.	*Chiple lahara, Aditya, Aterno(L,N)*	Urticaceae	Root decoction for fever (1).	Root extract is useful in skin diseases.
739.		1	*Pouzolzia zeylanica* (Linn.) J Bennett & Brown		Urticaceae		
740.		Darchula, 2700-3800m (CK Subedi, KM Ghimire, J Gurung & S Thapa 1901)	*Prenanthes brunoniana* Wall.		Asteraceae		

741.		4, Darchula, 3600m (CA Pendry, S Baral, S Noshiro, S Rajbhandari, PP Kurmi, B Del and B Adhikari 8048)	*Primula atrodentata* W.W. Sm.		Primulaceae		
742.		3	*Primula drummondiana* Craib		Primulaceae		
743.		1	*Primula elliptica* Royle, P denticulata,		Primulaceae		
744.		1	*Primula floribunda* Wall.		Primulaceae		
745.	RK121802	4	*Primula glomerata* Pax.		Primulaceae		
746.		1	*Primula involucrata* Wall., Syn. *Primula munroi*		Primulaceae		
747.		1, 4	*Primula macrophylla* D.Don		Primulaceae		
748.		1	*Primula reptans* Hook. f. ex Watt		Primulaceae		
749.	KU 07229 BKU 136	2	*Prinsepia utilis* Royle	*Dhatyal (L), Dhatelo (N)*	Rosaceae	Seed oil is used in cough and cold (3,5). Fruits for warts (1,2).	Oil is applied for backache, sprain, bath rog and cuts and wounds.
750.		1, 3	*Prunella vulgaris* Linn.		Lamiaceae		
751.			*Prunus cerasifera* Ehrh.	*Aluokhada (L)*	Rosaceae	Fruits are laxative (8).	
752.		2	*Prunus cerasoides* D. Don	*Painyu (N)*	Rosaceae	Fruits are astringent (8) and used for kidney stone (2).	Plant is a good in fodder and cultural values. Bark is used in paralysis.
753.		Darchula, 2700-3800m (CK Subedi, KM Ghimire, J Gurung & S Thapa 26)	*Prunus napaulensis* (Ser.) Steud.		Rosaceae		
754.		1	*Prunus persica* (Linn.) Batsch		Rosaceae		
755.		Darchula, 2270m (PR Shakya, MK Adhikari and MN Subedi 7918)	*Prunus undulata* Buch.-Ham. ex D. Don		Rosaceae		
756.		3	*Pseudognaphalium hypoleucum* DC. Hillard & Burtt.		Asteraceae		
757.			*Psidium guajava* Linn.	*Guava (E), Ambak (L), Amba, Belauti (N), Amratphala, Peruk, Mamsala (S)*	Myrtaceae	Fruit is laxative, colic, astringent to bowls and beneficial to constipation (3,6,9). Fruits are eaten (10).	
758.	232-15 KAH	1	*Pteris vittata* L.		Pteridaceae		
759.		1	*Pteris wallichiana* J. Agardh		Pteridaceae		
760.		5	*Pterocephalus hookeri* (C.B. Clarke) Diels		Caprifoliaceae		
761.	KU 07239 DKU 088	2	*Punica granatum* Linn.	*Dadim (L), Pomegranate (E), Anar, Darim (N), Dadim (S)*	Lythraceae	Bark of root and stem is anthelminthic and effective to tapeworms (3,5). Bark and fruits for cold and cough (1,2).	
762.	*173-15 NHM*	1, 2	*Pyracantha crenulata* (D. Don) M. Roem.	*Nepali white thorn (E), Ghangaru (N)*	Rosaceae	Fruits are eaten for dysentery (9). Fruits are eaten (10) for dysentery (8).	
763.	*KU 07201*	1, 2	*Pyrus pashia* Buch. -Ham. ex D.Don,	*Wild pear (E), Mael (L,N)*	Rosaceae	Grinded fruits flour is given to cattle for more milking (3, 7). Bark for skin diseases (1, 2), fruits are eaten (10) and given to animals to treat conjunctivitis (8).	
764.	*170-15 KATH*	5	*Quercus floribunda* Lindl.	*Moru (L)*	Fagaceae		
765.	*175-15 KATH*	5, 2	*Quercus lanata* Sm. *Syn. Q. lanuginosa D.Don*	*Wooly oak (E), Latyaz (L), Baanjh (N)*	Fagaceae	Heart wood is taken as tea and it is laxative in nature (3,6,9). Bark and seeds for cough and scorpoin sting (1,2).	Plant bark and resin is used for indigestion, cough, cold and pain relief.
766.		5	*Rabdosia ternifolia* (D.Don) Hara, *Isodon ternifolius*		Lamiaceae		
767.		1, 4	*Ranunculus diffusus* DC.		Ranunculaceae		
768.		1, 3	*Ranunculus hirtellus* Royle ex D. Don		Ranunculaceae		
769.		1	*Ranunculus laetus* Wall. ex D. Don	*Aado, Aiduwa (L, N)*	Ranunculaceae	Roots for cough and cold (1,2).	
770.		5, 1	*Ranunculus munroanus* J. R. Drumm. ex Dunn		Ranunculaceae		
771.			*Reinwardtia indica* Dumort.	*Pyauli (L, N)*	Linaceae	Leaf and roots for cuts and wounds (1,2) and wasp stings (8), Young leaves are vegetable (10).	
772.		1	*Rhamnus nepalensis* (Wall.) M. A. Lawson		Rhamnaceae		

773.		Darchula, 2700m (KR Rajbhandari & B Roy 3523)	*Rhamnus procumbens* Edgew.		Rhamnaceae		
774.		1, 2, 4	*Rheum moorcroftianum* Royle		Polygonaceae		
775.		1, 4	*Rhodiola bupleuroides* (Wall. ex Hook.f. & Thoms.) Fu		Crassulaceae		
776.		1	*Rhodiola chrysanthemifolia* (H. Lev.) S. H. Fu		Crassulaceae		
777.		1, 4	*Rhodiola coccinea, R Fastigiata* (Hook. F. & Thimson) Nakai		Crassulaceae		
778.		5, 4	*Rhodiola himalensis* (D. Don.) S. H. Fu		Crassulaceae		
779.		Darchula, 2700-3800m (CK Subedi, KM Ghimire, J Gurung & S Thapa 89)	*Rhodiola sinuata* (Royle ex Edgew.) S. H. Fu		Crassulaceae		
780.		5, 1, 4	*Rhodiola wallichinna* (Hook.) S. H. Fu		Crassulaceae		
781.	DBU 063	1, 2	*Rhododendron arboreum* Sm.	*Rhododendron (E), Laliguras (N), Pollasa, Raktakarni yara (S)*	Ericaceae	Flower juice is used to treat dysentery (3,5). Leaf for headache (1,2), fruits is eaten (10).	Wood is used in making pots for storing milk and products. Flowers are useful dysentery, blood purification and easing swallowing.
782.		1	*Rhododendron barbatum* Wall.		Ericaceae		
783.	KU 89/00	2, 4	*Rhododendron campanulatum* D.Don; Syn. R. wallichii Hook.f.	*Nilo Chimal (N)*	Ericaceae	Flowers are used in body ache and throat pain. Seeds aid digestion (3,9).	
784.		2	*Rhus javanica* Miller	*Vakimlo (L)*	Anacardiaceae	Ripe fruits are used as appetizer for both human and livestock (3,7).	
785.		1	*Rhus wallichii* Hook.f.	*Bhalayo (N)*	Anacardiaceae		
786.		Baitadi, 1500-1900m (I Sharma, R Joshi, R Uprety, I Pandey 630)	*Rhynchoglossum obliquum* Blume		Gesneriaceae		
787.		5, 1	*Ribes acuminatum,* Syn. *Ribes takare*		Grossulariaceae		
788.		1	*Ribes luridum* (Hook.f. & Thoms.		Grossulariaceae		
789.		Darchula (JF Duthie 5557)	*Ribes orientale* Desf.		Grossulariaceae		
790.		2	*Ricinus communis* Linn.	*Castor bean (E), Indeya, Enno (L), Ader, Arandi (N), Eranda (S)*	Euphorbiaceae	Root juice is analgesic and seed is used in constipation (3,4,9). Seeds for abdominal disorders and otitis. Seeds for abdominal disorders and otitis (1,2).	
791.		1, 2	*Rorrippa indica* (Linn.) Hiern	*Rugi sag (L)*	Brassicaceae		
792.		Baitadi, 1800m (LP Kattel 823), Darchula, 1720-2500m (I Sharma, R Joshi, R Uprety and I Pandey 498; KR Rajbhandari & KJ Malla 5868)	*Rosa brunonii* Lindl.	*Namkeen (L)*	Rosaceae		
793.			*Rosa laevigata* Michx.		Rosaceae		
794.		5, 1	*Rosa microphylla* Lindl.	*Bhainsi kada, Namkin (L, N)*	Rosaceae		
795.		Darchula, 2700-3800m (CK Subedi, KM Ghimire, J Gurung & S Thapa 1902)	*Roscoea alpina* Royle		Zingiberaceae		
796.		5, 1	*Roscoea purpurea* Smith		Zingiberaceae		
797.		3	*Rotheca serrata* (L.) Steane & Mabb.		Lamiaceae		
798.	*RK100-15 NHM*	2, 3	*Rotheca serrata* (L.) Steane & Mabb., Syn. Clerodendrum serratum (Linn.) Moon,	*Vath (L)*	Lamiaceae		
799.		5	*Rottboellia exaltata* (Linn.) L.f.		Poaceae		
800.	RK121902	2	*Rubia wallichiana* Decne	*Indian madder (E), Majitho (N), Mijitthi, Majistha (S)*	Rubiaceae	Fruits and stem decoction is used to treat wounds (4). Root is digestive and used in leprosy (3,5). Root for common cold and indigestion (2).	Stem juice is used in diarrhea, paralysis, cough and inflammation. It is also useful in inflammation of cattle.
801.		2	*Rubus ellipticus* Sm.	*Golden raspberry (E), Ainselu (N), Gauriphala (S)*	Rosaceae	Root juice is given for relieving fever and diarrhea and dysentery (3,9). Fruits are eaten (10) for colic, fever and sore throat (8).	Fruits are edible. Plant root extract is alcoholic and useful in diarrhea, indigestion, stomachache, typhoid, burns and epilepsy. Tender leaf buds

							are used in paralysis. It is also useful in skin wounds.
802.		2	*Rubus foliolosus* D.Don	*Kalo ainselu (L)*	Rosaceae	Fruits are eaten (10) for headaches (8).	
803.		5, 3	*Rubus nepalensis* (Hook.f.) Kuntze	*Bhui ainselu (L)*	Rosaceae		
804.			*Rubus niveus* Thunb.	*Rato aiselu (L)*	Rosaceae	Root for abdominal disorders (1,2). Fruits are eaten (10).	
805.		1, 4	*Rumex acetosa* Linn.	*Sim jada, Hale (L, N)*	Polygonaceae	Fever, Cold and cough, Stomachache (6).	
806.		1, 2	*Rumex hastatus* D. Don	*Almado, Rakte bhuj, kapu, charimal (L)*	Polygonaceae		
807.		1, 2, 4	*Rumex nepalensis* Spreng.	*Ban haldi, halhale (L), Amaltseva (S)*	Polygonaceae	Root extract is applied in joint pain and paralysis (3, 9). Root paste for scabies (1).	Plant is vegetable and useful in scabies.
808.	KU 07281	5, 2	*Saccharun spontaneum* Linn.	*Thatch grass (E), Kans (L,N), Kasah (S)*	Poaceae	Root extract is anthelmintic (3,7). Root paste for dysentery (1).	
809.		1	*Salix disperma* Roxb. Ex D.Don		Salicaceae		
810.		5, 1, 4	*Salix hylematica* C. K. Schneid.		Salicaceae		
811.		1	*Salix karelini* Turcz. & Stschegleew		Salicaceae		
812.		5, 1, 4	*Salix lindleyana* Wall.		Salicaceae		
813.		1	*Salix ovatomicrophylla* K. S. Hao		Salicaceae		
814.		Darchula, 2700-3800m (CK Subedi, KM Ghimire, J Gurung & S Thapa 3007)	*Salix tetrasperma* Roxb.		Salicaceae		
815.		5	*Sambucus adnata* Wall. ex DC.	*Chari bhango,Moti phool (L, N), Asian dwarf elder (E)*	Adoxaceae		
816.		Baitadi, 1500m (I Sharma, R Joshi, R Uprety and I Pandey 624A)	*Sambucus hookeri* Rehder		Adoxaceae		
817.		*3*	*Sanicula elata* Buch.-Ham ex D.Don		Apiaceae		
818.	KU 07257, DKU 087	1, 2	*Sapindus mukorossi* Gaertn.	*Soap nut (E), Rithha (N), Aristhaka, Phenila (S)*	Sapindaceae	Fruits are useful in snake bite, scorpion sting, and scalp off dandruff (3,4,5). Fruits for burns and boils (1,2,8). Rittha fruits are used in hair treatment.	
819.		2	*Sapium insigne* (Royle) Benth. ex. Hook. f.	*Tallow tree (E), Khirro (N)*	Euphorbiaceae	Milky latex is skin irritant and sprayed as fish poison in stream and tributaries (3,9).	
820.		5	*Satyrium nepalense* D. Don		Orchidaceae		
821.			*Saurauria nepaulensis* DC.	*Gogan (N)*	Actinidiaceae	Fruits are eaten (10).	
822.		Darchula, 2700-3800m (CK Subedi, KM Ghimire, J Gurung & S Thapa 1611)	*Saussurea fastuosa* (Decne.) Sch. Bip.		Asteraceae		
823.		5, 2	*Saussurea gossipiphora* D.Don		Asteraceae		
824.		5, 1, 4	*Saussurea graminifolia* Wall.		Asteraceae		
825.		4	*Saussurea nepalensis* Spreng		Asteraceae		
826.		5, 1	*Saussurea obvallata* (DC.) Edgew.		Asteraceae		
827.		Darchula, 3600m (PR Shakya, MK Adhikari & MN Subedi; JF Duthie 5536)	*Saxifraga asarifolia* Sternb.		Saxifragaceae		
828.		4	*Saxifraga brunonis* Wall. Ex Seringe		Saxifragaceae		
829.		4	*Saxifraga mucronulata* Royle		Saxifragaceae		
830.		2	*Schleichera oleosa* (Lour.) Oken Syn. S. trijuga Willd	*Macassar tree, Honey tree, Lac host tree (E), Kusum (N)*	Sapindaceae	Fruits are eaten as an anthelmintic (3,9).	
831.		3	*Schoenoplectus fuscorubens* T Koyama		Cyperaceae		
832.		1	*Schoenoplectus juncoides* (Roxb.) Palla		Cyperaceae		
833.		1	*Schoenoplectus mucronatus* (Linn.) Palla		Cyperaceae		
834.		5	*Scrophularia elatior* Benth.		Scrophulariaceae		
835.		5	*Scrophularia laportifolia* T. Yamaz.		Scrophulariaceae		
836.		4, Darchula, 12000ft, (JDA Stainton 4956)	*Scrophularia pauciflora* Benth.		Scrophulariaceae		

837.		1	*Scurrula elata* (Edgew.) Danser	*Ainjeru (L)*	Loranthaceae		
838.	KU 07263.	2	*Scutellaria discolor* Colebr, Syn. *S. indica* Blume.	*Ratpatya (L), Dampate (N)*	Lamiaceae	Whole plant and leaf paste is useful for cuts and wounds (3,9).	
839.	RK-112302	5	*Scutelleria scandens* Buch.-Ham. ex D. Don		Lamiaceae		
840.		2, 4	*Selinum walliachianum*, Syn. *S tenuifolium* Wall.	*Bhutkesh, Songre kayar (L,N)*	Apiaceae	Root for fever (1, 2).	Plant is used to escape away the evil spirits.
841.	KU 07269, BBU 066	2	*Semecarpus anacardium* Linn.f.	*Marking nut (E), Bheul, Bhalla (L), Bhalayo (N), Bhellataka (S)*	Anacardiaceae	The mixture of its fruits and cow dung escapes out snake and acts as an ant repellant (3,5).	
842.		3	*Senecio analogus DC.*, Syn. *Senecio laetus*				
843.		5, 4	*Senecio chrysanthemoides* DC.		Asteraceae		
844.		2	*Senna tora* (Linn.) Roxb.	*Sickle pod (E), Tinkosi, Chakramandi (L), Tapre (N), Ayadham, Chakramardha (S),*	Fabaceae	Plant relieves bronchitis and its juice is anthelmintic, antiseptic (3,9). Roots for ringworms (8).	
845.		2	*Setak chini*	*Singru, Setak chini (L)*	Moringaceae	Raw fruit is valued for liver disorders (3,5).	Plant fruit is edible and used for indigestion and diarrhea.
846.		2	*Setaria italica* (Linn.) Beauvois	*Foxtail millet (E), Kaguno (L,N), Kangu (S)*	Poaceae	Fruit is consumed as food (3,7).	
847.		3	*Setaria pumila* (Poir.) Rocm & Schult.		Poaceae		
848.		5	*Setaria verticillata* (L.) Beauvois	*Banso (N)*	Poaceae		
849.		2	*Shorea robusta* Gaertn.		Dipterocarpaceae	Seeds for skin diseases (8).	Plant is a good wood and fodder tree.
850.		5, 1, 4	*Sibbaldia cuneata* Hornem. ex Kuntz		Rosaceae		
851.		1	*Sibbaldia micropetala* (D. Don) Hand.-Mazz		Rosaceae		
852.		5, 1, 4	*Sibbaldia purpurea* Royle		Rosaceae		
853.		5, 3	*Sida acuta* Burf.f.	*Balu (N)*	Malvaceae		
854.		Darchula, 1000m (KR Rajbhandari and KJ Malla 5532)	*Sida cordifolia* L.	*Balu (N)*	Malvaceae		
855.		5, 1	*Siegesbeckia orientalis* Linn.	*common St. Paul's wort (E)*	Asteraceae		
856.		4	*Silene gonosperma* subsp. himalayensis (Rohrb.) Bocquet		Caryophyllaceae		
857.		Darchula, 3700m (KM Ghimire & M Adhikari 313)	*Silene laxantha* Majumdar		Caryophyllaceae		
858.		4	*Silene setisperma* Majumder		Caryophyllaceae		
859.		Darchula, 2700-3800m (CK Subedi, KM Ghimire, J Gurung & S Thapa 1913)	*Silene stracheyi* Edgew.		Caryophyllaceae		
860.		4, Darchula, 2700-3800m (CK Subedi, KM Ghimire, J Gurung & S Thapa 1602)	*Sinopodophyllum hexandrum* (Royle) T.S. Ying	*Laghupatra (N)*	Berberidaceae		
861.	RK121903	5, 2	*Skimmia arborescens* T. Anders ex Gamble	*Chillo pate (L), Nayar, Narpati (N)*	Rutaceae	Leaf infusion is taken for headache and for freshness (3, 9).	
862.	KU 101/00, RK-112203, RK-121907	1, 2	*Smilax aspera* Linn.	*Rough birdweed (E), Chopchini (L), Kukurdaina (N)*	Smilacaceae	Root decoction is used for venereal disease (3, 9). Tender shoots are used for vegetable (10) and snake bite (1).	
863.	190-15 KATH	5, 3	*Solanum erianthum* D. Don		Solanaceae		
864.	*119-15 NHM*	5, 2	*Solanum nigrum* Linn.	*Black nightshade (E), Bihi, Kalikuiya, Nipeni (L,N), Kakamachi (S)*	Solanaceae	Berries are used in heart diseases and dysentery (3,6,7). Fruits are eaten (10) for fever and ringworms (8).	
865.	DKU 086.	2	*Solanum surattense* Burm.f.	*Jhyaure bhanta, Jware baigan (L), Kantakari (N), Kantakari (S)*	Solanaceae	Seed infusion is taken for toothache (3,5,6). Plant ash for cough and burns (1,2), fruits for toothache and asthma (8).	Plant seeds are infused for toothache.
866.		Darchula, 840m (MM Amatya and PM Regmi W490/82)	*Solanum virginianum* L.		Solanaceae		
867.	143-15 KATH	1, 2	*Solena heterophylla* Lour. *Syn. Melothria heterophylla L.*	*Ban kankri (N)*	Cucurbitaceae	Fruits are eaten for common cold and pneumonia of child (3,9).	
868.		1	*Sonchus wightianus* DC. S asper???	*Dudher, titepati, kandetite (L, N)*	Asteraceae	Bark for burns and paralysis (1).	

869.	KU 07275	2	*Sophora mollis* (Royle) Baker	*Himalayan laburnum (E), Chunnjado (N)*	Fabaceae	Root paste is considered in cold and rheumatism (3,9).	
870.		Darchula, 11000ft (TB Shrestha 4219)	*Sorbus arachnoides* Koehne, Repert. Spec. Nov. Regni Veg. 10:514 (1912).		Rosaceae		
871.		1	*Sorbus cuspidata* (Spach) Hedl.		Rosaceae		
872.			*Sorbus microphylla* Wenzing		Rosaceae		
873.		5, 3	*Sorbus vestita* (Wall. ex G. Don) Lodd.	*Paumel (L)*	Rosaceae		
874.			*Spatholobos parviflorus* (Roxb.) Kuntze	*Debre (N)*	Fabaceae		
875.		Darchula, 3902m (KM Ghimire and M Adhikari F007)	*Spergula depauperata* (Gay) Pedersen		Caryophyllaceae		
876.		Darchula, 2700-3800m (CK Subedi, KM Ghimire, J Gurung & S Thapa 1809)	*Spermadictyon suaveolens* Roxb.		Rubiaceae		
877.	Henry 12260		*Spilanthes calva* (DC) CB Clarke, *Acmella calva* (DC.) Jansen,	*Marethi (L,N)*	Asteraceae	Plant paste is used against snakebite. Flower cap is used as appetizer (3,6,7).	
878.		Darchula, 2700-3800m (CK Subedi, KM Ghimire, J Gurung & S Thapa 73)	*Spiraea bella* Sims	*Padhani (L)*	Rosaceae		
879.	RK121908	Darchula, 2150m (PR Shakya, MK Adhikari and MN Subedi 7913)	*Spiraea canescens* D. Don	*Sani Padhani (L)*	Rosaceae		
880.		5, 3	*Spiranthes sinensis* (Pers.) Ames	*Pirre (L)*	Orchidaceae		
881.		2	*Spondias pinnata* (Linn.f.) Kurtz, Syn. S. mangifera Willd.	*Bile tree, Wild mango (E), Amaro (L), Pitavraksha (S)*	Anacardiaceae	Plant latex is applied for wounds and cuts (3,4,9).	
882.		1	*Sporobolus diander* (Retz.) Beauvois		Poaceae		
883.		5, 1	*Sporobolus piliferus* (Trin.) Kunth		Poaceae		
884.		1	*Stachys mellisaefolia* Benth.		Lamiaceae		
885.		4	*Stellaria congestiflora* Hara		Caryophyllaceae		
886.			*Stellaria media* (Linn.) Vill.	*Olimaouro (L)*	Caryophyllaceae	Plant paste for fractures (8).	
887.		Darchula, 3600m (PR Shakya, MK Adhikari & MN Subedi 8037)	*Stellaria patens* D. Don		Caryophyllaceae		
888.		1	*Stelleria monosperma* Buch.-Ham. ex D.Don	*Mahajadi (L)*	Caryophyllaceae	Rhizome for blood disorders (1).	
889.		1	*Stephania glabra* (Roxb.) Miers	*Musebelo, Batulpate (L)*	Menispermaceae	Leaf stem for headache and cuts (1,2).	
890.		Baitadi, 9000ft. (TB Shrestha 5084), Bajhang, 4000m (MS Bista & DP Joshi 495)	*Streptopus simplex* D. Don.		Liliaceae		
891.			*Strobilanthes attenuatus* (Jacq. ex Nees) Nees, *Syn. Pteracanthus urticifolius* (D.Don) Bremek.		Acanthaceae		
892.	*141-15, 161-15, KATH*	3	*Strobilanthes capitata* (Nees.) T. Anders.		Acanthaceae		
893.		Darchula, 3702m (KM Ghimire and M Adhikari F038)	*Strobilanthes penstemonoides* (Nees) T. Anderson		Acanthaceae		
894.		5, 2	*Swertia angustifolia* Buch.-Ham. ex D.Don	*Lek tite (L)*	Gentianaceae	Root juice is used in promptly reduce the body temperature and is useful in asthma (3,7). Plant for fever and abdominal disorders (2).	
895.		Darchula, 3608m (KM Ghimire and M Adhikari F002)	*Swertia bimaculata* (Sieb. & Zucc.) C. B. Clarke		Gentianaceae		
896.	KU 07277, DBU 067	5	*Swertia chirayita* (Roxb. ex Fleming) Karstrn	*Chiretta (E), Lek tite (N), Kirat, Bhunimwa (S)*	Gentianaceae	Whole plant is used for cough and fever (3,4,5,6). Plant for fever and cough (1,2).	Root is antidiarrhoic, and useful in cough, cold, indigestion, fever, TB, reducing blood pressure. This is also useful in livestock throat pain.
897.		4, Darchula, 3702m (KM Ghimire and M Adhikari F045)	*Swertia ciliata* (D. Don ex G. Don) B. L. Burtt		Gentianaceae		
898.		Darchula, 3903m (KM Ghimire and M Adhikari F023)	*Swertia hookeri* C. B. Clarke		Gentianaceae		
899.		Darchula, 3900m(PR Shakya, MK Adhikari and MN Subedi 8072)	*Swertia koingii* Hook. f.		Gentianaceae		

900.		4	*Swertia multicaulis* D.Don	*Tite (L)*	Gentianaceae		
901.			*Swertia nervosa* (G.Don) C.B. Clarke	*Lek tite (L)*	Gentianaceae	Plant for fever and abdominal disorders (2).	
902.		3, Darchula, 2200-2500m (KR Rajbhandari and KJ Malla 5869; KR Rajbhandari and KJ Malla 5712)	*Swertia paniculata* Wall.	*Tite (L)*	Gentianaceae		
903.		4	*Swertia petiolata* D.Don		Gentianaceae		
904.	202-15 NHM	2	*Swertia racemosa* (Grieseb.) C.B. Clarke	*Chiretin (E), Chirayito (L,N)*	Gentianaceae	Root juice is used in promptly reduce the body temperature and is useful in asthma (7). Fever and abdominal pain (2).	
905.		Darchula, 3703m (KM Ghimire and M Adhikari F035)	*Swertia speciosa* D. Don		Gentianaceae		
906.		5, 1	*Swida macrophylla* (Wall.) Sojak		Cornaceae		
907.		1	*Symplocos cochinchinensis* (Loour.) S. Moore		Symplocaceae		
908.		1	*Syringa emodi* Wall. ex Royle		Oleaceae		
909.	KU 07283, BBU 085	2	*Syzygium cumini* (Linn.) Skeels	*Black berry, Java plum (E), Jamun (N), Brahaspati, Jambhu (S)*	Myrtaceae	Seed powder and bark decoction is used in diarrhea, dysentery (4), diabetes and inflammatory activity (3,5,6). Fruit, leaf bark for abdominal disorders and boils (1,2). Fruits are eaten (10) fir diabetes (8).	Fruits are useful in diabetes and diarrhea. Plant is cultural.
910.			*Syzygium operculatus* Roxb. Syn. *Cleistocalyx operculatus*	*Kyamuna (N)*	Myrtaceae	Fruits are eaten (10).	
911.			*Tamarindus indica* Linn.	*Imili (N)*	Fabaceae	Fruits and pods are digestive and blood purifier (6). Fruits are eaten (10).	
912.		4	*Taraxacum eriopodum* DC.		Asteraceae		
913.		5	*Taraxacum nepalense* Vam Soest		Asteraceae		
914.		Darchula, 3700m (KM Ghimire & M Adhikari F218)	*Tenaxia cachemyriana* (Jaub. & Spach) N.P.Barker & H.P.Linder		Poaceae		
915.		1	*Terminalia alata* Heyne ex Roth, *T tomentossa*	*Saj, Indian laurel (L, N)*	Combretaceae	Bark juice for anti-dandruff (8).	Plant is a good wood and fodder tree.
916.	*KU 07280*	2	*Terminalia bellerica* (Gaertn.) Roxb,	*Bustard myrobalan (E), Barrdo (N), Aksha (S)*	Combretaceae	Fruits are tonic (4), useful in stomach disorders and cough. If taken excessive, cause vomiting. Fruit decoction is given to livestock for diarrhea (3,6). Fruits are eaten as tonic, cough and cold (2,10,11), antihelmintic (8).	
917.	KU 07278, BKU 068	2	*Terminalia chebula* Retz.	*Chebulic myrobalan (E), Sele, Harado (L), Harra (N), Avaya, Haritaki (S)*	Combretaceae	Infusion of fruits is useful in cough and cold (4,5,3,6). Fruits and bark are laxative, diuretic (8), and useful in cough and asthma (1,2,11), Fruits are eaten (10).	Fruits are used in cough, cold, gastric and fever.
918.		1	*Tetrastigma obtectum* (Wall. ex Lawson) Planch. Ex Franch.		Vitaceae		
919.		1	*Tetrastigma serrulatum* (Roxb.) Planch		Vitaceae		
920.		Darchula, 3703m (KM Ghimire, M Adhikari F030)	*Teucrium laxum* D. Don		Lamiaceae		
921.		4	*Thalictrum alpinum* Linn		Ranunculaceae		
922.		5	*Thalictrum chelidonii* DC.		Ranunculaceae		
923.	KU 07284, 107-15-NHM	5, 2, 4	*Thalictrum cultratum* Wall.	*Meadow rue (E), Peljadi (L), Dampate (N), Peet ranga (S)*	Ranunculaceae	Root juice is commonly used in stomachache and dysentery (3,9).	
924.		5	*Thalictrum dalzelli* Hook.		Ranunculaceae		
925.	*107-15 NHM*	1	*Thalictrum foliolosum* DC.	*Jukejado, Dampate (L,N)*	Ranunculaceae	Leaf for intestinal disorders (1,2).	Plant root is valued for fever, gastric and jaundice.

926.		Darchula, 2640m (MM Amatya & PM Regmi W770/82)	*Thalictrum virgatum* Hook. f. & Thomson		Ranunculaceae		
927.		1	*Themeda quadrivalis* (L.) Kuntze		Poaceae		
928.		1	*Theropogon pallidus* (Kunth.) Maxim		Liliaceae		
929.		1, 2	*Thymus linearis* Benth.	*Ghodamarcha (N)*	Lamiaceae	Plant tea is useful in indigestion.	
930.		2	*Thysanolaena maxima* (Roxb.) Kuntze	*Amriso (N), Olse (L)*	Poaceae	Plant paste for boils (8). Ricinus and Thysano leaves are boiled for hernia (1). Root juice is useful in eye complaints.	
931.	DKU 088	2	*Tinospora sinensis* (Lour.) Merr. Syn. T. cordifolia auct. non L.	*Heart leaved Moonseed (E), Gurjo (N), Guduchi, Amritavali (S)*	Menispermaceae	Dilute stem juice is drunk for diabetes (3,4,6,9). Leaf and stem for tonic and blood disorders (1,2).	
932.		3, Darchula, 900-1300m (KR Rajbhandari and KJ Malla 5535; PR Shakya, MK Adhikari, MN Subedi 7866)	*Toona ciliata* M. Roem.	*Tuni (N)*	Meliaceae		
933.		5, 1	*Toona serrata* (Royle) M Roem. Syn. Cedrela toona, t ciliata	*Dallo (L)*	Meliaceae	Bark for boils and dysentery (8).	Plant is used for wood.
934.		5, 1	*Toricellia tilifolia* DC.		Cornaceae		
935.		1	*Trachelospermum lucidum* (D.Don) K. Schum.		Apocynaceae		
936.			*Tribulus terrestris* L.	*Gokhur (L)*	Zygophyllaceae	Leaves are used in purifying blood (3).	
937.		2	*Trichosanthes tricuspidata* Lour.	*Indreni , Yeralu (L,N)*	Cucurbitaceae	Fruit juice is useful in otitis and rhinitis (3,6,7). Roots for abdominal pain (1).	Fruit is considered as digestive and applied in paralysis, gastric and tila of cattle.
938.		2	*Trifolium repens* Linn.		Fabaceae		
939.		5, 1	*Triglochin palustris* Linn.		Juncaginaceae		
940.		1	*Trigonella emodi* Benth.		Fabaceae		
941.		5	*Trigonotis multicaulis* (Dc.) Benth. ex C.B. Clarke		Boraginaceae		
942.		5, 1, 3	*Trigonotis rotundifolia* (Wall. ex Benth.) Benth.		Boraginaceae		
943.	125RK	Darchula, 3250m (PR Shakya and DP Joshi 558)	*Trillidium govanianum* (Wall. ex Royle)	*Sano satuwa, Tin pate satuwa (L)*	Liliaceae		
944.		5, 1, 3	*Triosteum himalayanum* Wall.		Caprifoliaceae		
945.		Darchula, 2700-3800m (CK Subedi, KM Ghimire, J Gurung & S Thapa 3018)	*Trollius acaulis* Lindl.		Ranunculaceae		
946.		1	*Tsuga dumosa* (D.Don) Eichler		Pinaceae		
947.		1	*Tylophora hirsuta* (Wall.) Wight		Apocynaceae		
948.		1, 2	*Ulmus wallichiana* Planch.		Ulmaceae		
949.		1	*Urochloa panicoides* Beauv.		Poaceae		
950.		1	*Urtica ardens* Link		Urticaceae		
951.	KU 07290	5, 2	*Urtica dioica* Linn.	*Stinging neetle (E), Sisnu (N), Sinno (L), Agni damani (S)*	Urticaceae	Root juice is given for gastric problems and maintaining blood pressure (3,6,9). Root, leaf for body pain and fracture (1,2). Tender shoots are used as vegetable (10) and useful for cuts, wounds and boils (8).	Root is used in rheumatism, paralysis, inflammation, fracture, sprain, and pida.
952.		1	*Valeriana hardwickii* Wall.		Caprifoliaceae		
953.		5, 1, 2	*Verbascum thapsus* Linn.	*Badar laurie (L)*	Scrophulariaceae		
954.		5	*Vernonia cinerea* (Linn.) Less.	*Marcha jhar, Jhujhure (L)*	Asteraceae		
955.		Darchula, 2700-3800m (CK Subedi, KM Ghimire, J Gurung, S Thapa 2105)	*Veronica cana* Wall. ex Benth.		Plantaginaceae		
956.		1	*Veronica ciliata* Fischer, *V cephaloides* Pennell		Plantaginaceae		
957.		4	*Veronica ciliata* subsp. *cephaloides* (Pennell) D.Y. Hong,		Plantaginaceae		
958.		1	*Viburnum cotinifolium D.Don.*	*Bakalpate, Oddhlaye (L)*	Adoxaceae	Bark and root paste for cuts (1).	

959.			*Viburnum nervosum* D.Don		Adixaceae		
960.		1	*Vicia bakeri* Ali		Fabaceae		
961.		1, 2, 4	*Viola biflora* Linn.		Violaceae		
962.		5	*Viola pilosa* Blume	*Bhatte ghas (L, N)*	Violaceae	Plants for biols (1).	
963.	204-15 KATH, 150-NHM	2,	*Viscum album* Linn.	*Mistletoe, Devil's fuge (E), Hadchur, Rojo (L), Ainjeru (N)*	Santalaceae	Plant is used in fractures and sprains (3,9).	Plant is useful in fracture and sprains.
964.		2	*Viscum articulatum* Burm.f.		Santalaceae		
965.		2	*Viscum loranthii Elmer*		Santalaceae		
966.	*RK-102*	5, 2	*Vitex negundo* Linn. Syn. V. cannabilifolia Sieb. & Zucc.	*Negunda Chaste tree (E), Simali (N), Nirgundhi (L), Shephali (S)*	Lamiaceae	Leaf juice is useful in stomachache (3,9).	Leaf juice is used in headache.
967.		1	*Vitis flexuosa, V parvifolia* Roxb.		Vitaceae		
968.		Darchula, 1450m (PR Shakya, MK Adhikari and MN Subedi 7874)	*Vitis lanata* Roxb.		Vitaceae		
969.		1	*Wikstroemia canescens* Meisn.		Thymelaeaceae		
970.		2	*Woodfordia fruticosa* (Limm.) Kurz	*Fire flame bush, Shiranjitea (E), Dhula, Dhuniya (L), Dhainyaro (N), Agnijwala, Tamra pushpi, Dhataki (S)*	Lythraceae	Flowers are antipyretic and used in dysentery (3,4,5,6). Flowers and roots are antidysenteric (1,2) and used in fever and menstruation (8).	Flowers are useful in burns, scalds, and indigestion and control diarrhea. They are also useful in making the sound better.
971.		4	*Woodsia alpina* (Balton) Gray		Woodsiaceae		
972.	D'Arcy 341a	2	*Xanthium strumarium* Linn.	*Sheep burr, Bur weed (E), Musekuro, Sangekuro (L), Bhede kuro (N), Sankesvara, Arista (S)*	Asteraceae	Seed powder is useful in earache, dysentery and skin diseases (3,6,9).	
973.	KU 07291 DKU 069	2	*Zanthoxylum armatum* DC.	*Prickly ash peeper, Nepali peeper (E), Timur (N), Gandhalu, Tejwobati, Tumbaru (S)*	Rutaceae	Fruits are used in cold and cough, toothache (4). Bark is used to stupefying fish (3,5). Fruits are antihelmintic, useful in gastritis (1,2), toothache (8). Fruits are used as spices (10).	Seeds are good in cough, fever, cold, toothache, asthma and indigestion.
974.		Baitadi, 2330m (PR Shakya, MK Adhikari and MN Subedi 8328)	*Zanthoxylum oxyphyllum* Edgew.	*Bhainse timur, Solamukh (L)*	Rutaceae		
975.	BKU 082	1, 2	*Zizyphus mauritiana* Lam. (Z jujuba)	*Chinese date, Jujube (E), Bewari (L), Bayer (N), Badar (S)*	Rhamnaceae	Root paste is applied for diarrhea, dysentery and vomiting (4). Fruits are useful in fever and digestion (3,5,6). Root for indigestion (1,2) and peptic ulcer (8). Fruits are edible (10).	Edible fruits are used in diarrhea, dysentery, jaundice and fermentation.

Taxonomic reference: (Column 3 - Elliott 2012 = 1, Uprety et al 2016 = 2, Pandey et al 2016 = 3, Thapa 2017 = 4, Chaudhary et al = 5)
Ethnobotanical reference: (Column 7 - Devkota & Karmacharya 2003 = 1, Pant & Panta 2004 = 2, Kunwar et al. 2015 = 3, Burlakoti & Kunwar 2008 = 4, Kunwar et al., 2009 = 5, Kunwar et al 2016 = 6, Kunwar et al 2012 = 7, Joshi 2008 = 8, Kunwar et al 2010 = 9, Pant et al. 2005 = 10, Aryal et al. 2018 = 11); Names: E = English, L = local, N = Nepali, S = Sanskrit; * New record of use report, ** New record of species, *** New record of species and use report

Appendix F. Fidelity level of useful plant species at respective use categories

		Digestive & metabolism	Nervous	Circulatory, Blood	Respiratory	Skin	Muskulo-skeletal	Repro	Genito-urinary	Immune	endocrine	Infection	Pain Inflammation	Sensory	Poisoning	Food	Social	Household Economy	Cultural	Livestock
Species name	Number of participants mentioned	Diarrhea, dysentery, stomachache, nausea, anthelmintic, appendicitis, indigestion, gastric	Paralysis, memory longevity, dizziness, antidepressant, chita pareko (epilepsy)	BP, heart disease, jaundice	Pneumonia, cold, cough, larynx-sound	Acne, scabies, foot cracks, hair fall, makada, pilo, pitka (skin rashes)	Fracture, Sprain, joint pain, backache, bath (rheumatism),	Lactation, fertility, conceive, abortion, dudhelo, thunelo (mammary gland complication)	Urine infection, hydrocele, piles,	Immune, anticancer, nutrition, appetite, growth, tonic	Gall bladder, diabetes, gall stone	Fever, typhoid, TB, tetanus, Leprosy, Polio	Cuts, wounds, burn, injury, analgesic, toothache headache, swelling	Eye, ear	Snake bite, antidoting, scorpion sting, antileech, insecticidal, piscicidal	Vegetable, edible, spices	Wood, fuel, fodder, forage, rope, bedding, grass, agriculture implements	Dye, oil, resin	Ritual, religious, evil spirits, good luck	Livestock health (veterinary)
Prunus cornuta	3	33.33	33.33																	33.33
Calotropis gigantea	4						50								25				25	
Mangifera indica	28	3.57							3.57										92.85	
*Lyonia ovalifolia**	2					100														
Rubus ellipticus	15	20	13.33			6.66						20	26.66		6.66	6.66				
Viscum album	3						66.66					33.33								
Cuscuta reflexa	17			58.82	5.88	5.88		5.88				5.88	5.88	5.88						5.88
*Achyranthes aspera**	3	100																		
Girardinea diversifolia	4					25	75													
Phyllanthus emblica	30	13.33			3.33	6.66												10	66.66	
*Pouzolzia hirta**	3					100														
*Delphinium himalayaii**	4														100					
Eulaliopsis binata	7																85.71		14.28	
Ficus benghalensis	3					33.33										33.33			33.33	
Melia azedarach	5	20													20		40			20
Nardostachys grandiflora DC.	8	50		12.5								25	12.5							
Allium wallichii	20	85					15													
*Eleusine indica **	4	100																		
*Ageratina adenophora**	4												100							
Eryngium foetidum	3	33.33						66.66												
Quercus lanata	30	3.33			20								6.66				70			
Ziziphus mauritiana	4	25		50											25					
Ficus palmata	4												75			25				

Dendrocalamus hamiltonii	5																20		80	
Aegle marmelos	7	14.28																	85.71	
Cannabis sativa	3	33.33											33.33							33.33
Perilla frutescens	12				41.66							58.33								
Cynoglossum zeylanicum	5			20	40		20					20								
Calanthe plantaginea	7	28.57													71.42					
*Betula utilis**	3																100			
Acorus calamus	8			12.5	50		12.5					12.5			12.5					
*Selinum wallichianum**	4																		100	
Aconogonum rumicifolium	8	62.5										25				12.5				
Diploknema butyracea	10															10	20	40		30
Swertia chirayita	61	6.55		1.63	13.11							73.77	3.27							1.63
Berberis aristata	5		20	20	20								40							
Berberis asiatica	6										16.66	16.66				66.66				
Clematis montana	5	80															20			
Rheum australe	8	12.5					50												37.5	
Cinnamomum tamala	17				52.94		5.88						5.88			29.41		5.88		
*Toona serrata**	17																100			
Woodfordia fruticosa	4	25			50								25							
Prinsepia utilis	5						80						20							
Cynodon dactylon	6			16.66			33.33								16.66				33.33	
*Ficus neriifolia**	3																100			
Juniperus indica	9					11.11	22.22						22.22						44.44	
*Quercus incana**	4																100			
Angelica archangelica	40	82.5			7.5		2.5									7.5				
Debregaesia longifolia	4						75										25			
Aloe vera	4										25		75							
Rhododendron arboreum	20	5		5													85			5
Curcuma angustifolia	7	14.28			14.28	28.57	28.57						14.28							
Rumex nepalensis	5					20	20									60				
Terminalia chebula	10	10			50							20					20			
Hydrocotyle javanica	3												66.66		33.33					
Jatropha curcas	3											33.33	33.33		33.33					
Trichosanthes tricuspidata	4	50	25																	25
Allium prattii	4		25		50											25				
Phytolaca acinosa	3			33.33	33.33											33.33				
Syzygium cumini	13	7.69		7.69															84.61	
Myrica esculenta	25		8	8		4		8					8			32	24	4		4
Carum carvii	8				62.5					12.5					12.5	12.5				
*Solanum surattense**	3												100							
Persea odoratissima	4		50														25	25		
Polygonatum cirrhifolium	3									66.66						33.33				
*Castanopsis hystrix**	4																100			
Quercus semecarpifolia	18																100			

Ficus semicordata	4															25	75			
Centella asiatica	29	27.58	3.44	3.44	3.44	13.79			24.13			6.89	6.89	3.44	3.44					3.44
Bauhinea purpurea	7	71.42														14.28	14.28			
Didymocarpus albicalyx	11	18.18			9.09	36.36	9.09	18.18											9.09	
Asparagus racemosus	10	10		10				30				30				10			10	
Artemisia indica	22			4.54		4.545			4.54			4.54	27.27		4.54				50	
Vetiveria zizanoides	15			6.66															93.33	
Neopicrorhiza scrophulariflora	31	3.22			6.45							90.32								
*Polygala abyssinica***	27																100			
Taxus contorta	10						10			30							40		20	
Coriaria nepalensis	3												66.66				33.33			
Elaeagnus parvifolia	5	20														80				
Bauhinia vahlii	3																33.33		66.66	
Rubia wallichiana	8	37.5	12.5				25													25
*Ficus hederacea**	6					100														
Azadirachta indica	3	33.33										66.66								
Drepanostachym falcatum	12															25	66.66		8.33	
Juglans regia	22					9.09	18.18						27.27			27.27	18.18			
Aesculus indica	9	11.11	11.11		11.11	11.11							22.22			11.11	11.11			11.11
Aralia cachemirica	9	22.22			11.11	55.55							11.11							
Dactylorhiza hatagirea	23	4.34								4.34		4.34	86.95							
*Butea monosperma**	5																		100	
Prunus cerasoides	48		4.16														16.66		79.16	
Thalictrum cultratum	4	25		25								50								
*Ficus religiosa***	32																		100	
Agave cantala	3		33.33												33.33		33.33			
Picris heiracioodes	7		14.28		14.28					14.28		14.28	14.28							28.57
Abrus precatorius	3					33.33				33.33				33.33						
*Desmoum oojeniense**	5																100			
Abies pindrow	35																97.14		2.85	
Pinus roxburghii	20						10						20				45	20		5
Pinus wallichiana	4	25															75			
*Shorea robusta**	11																100			
*Terminalia alata**	5																100			
Polygonatum verticillatum	3	100															0			
*Chrysopogon aciculatus***	32																100			
Ribes glaciale	4	25			75															
Paris polyphylla	56	57.14	3.57									8.92	12.5		16.07	1.78				
Magnolia kisopa	5																20		80	
Imperata cylindrical	10								10								90			
Urtica dioica	18		5.55	5.55			72.22						5.55			11.11				
*Euphorbia royleana**	3						100													
Valeriana jatamansii	22	68.18			18.18	4.54				4.54		4.54								
*Rhododendron anthopogon**	3																		100	

Vitex negundo	3	33.33											66.66							
*Taraxacum officinale**	3									100										
Oroxylum indicum	3	66.66																		33.33
Cirsium verutum	14	57.14			14.28				14.28			7.14								7.14
Zanthoxylum armatum	20	35			20							10	20			5	5		5	
Ficus auriculata	5	40															20		40	
Ocimum gratissimum	8			12.5			12.5	12.5				12.5							50	
Alnus nepalensis	15		6.66														93.33			
Bergenia ciliata	65	63.07			6.15		1.53				21.53	3.07	4.61							
*Grewia optiva**	7																100			
Ophiocordyceps sinensis	15									60		40								
Number of species		**49**	**16**	**20**	**27**	**20**	**24**	**6**	**5**	**9**	**3**	**27**	**33**	**3**	**15**	**24**	**42**	**6**	**28**	**16**
Redundancy (%)		**40.16**	**13.11**	**16.39**	**22.13**	**16.39**	**19.67**	**4.91**	**4.09**	**7.37**	**2.45**	**22.13**	**27.04**	**2.45**	**12.29**	**19.67**	**34.42**	**4.91**	**22.95**	**13.11**
* Species with 100% fidelity, ** species with 100% fidelity and reported useful by >25% participants																				

Appendix G. IASC value, use reports and useful plant parts

Botanical name	Baitadi use types	Baitadi Use reports	Baitadi participants #	Baitadi IASc	Darchula use types	Darchula Use reports	Darchula participants #	Darchula IASc	Average IASc	Parts used	Use reports in present study
Abies pindrow (Royle ex D.Don) Royle	1	31	31	0.54	2	4	4	0.06	0.30	Wood	Plant is a common wood and cultural.
Abrus precatorius L.	4	4	3	0.00	0	0	0	0.00	0.00	Fruits	Fruits are used in eye complaints, cancer and ratuwa, pilo (skin pain).
Achyranthes aspera L.	2	3	3	0.03	0	0	0	0.00	0.01	Root	Root extract is antidysenteric and useful in indigestion.
Aconogonum rumicifolium Hara	1	2	2	0.04	4	7	4	0.05	0.04	Stem	Roots are useful in fever, stomachache and dysentery.
Acorus calamus L.	3	3	3	0.00	2	5	5	0.09	0.04	Rhizome	Rhizome is used in cough, fever, hoarse sounds and as an antileech.
Aegle marmelos (L.) Correa	2	5	5	0.07	1	2	2	0.05	0.06	Leaf, fruits	Fruits are digestive. Plant is cultural.
Aesculus indica (Wall. ex Cambess.) Hook	7	13	6	0.05	1	1	1	0.00	0.03	Fruits	Fruits and seeds are used in inflammation, foot unjury, headache, cough, cold and antihelmintic. Fruit also eases urination of livestock.
Agave cantala (Haw.) Roxb. ex Salm-Dyck	3	3	3	0.00	0	0	0	0.00	0.00	Leaf	Plant is good for fiber and making ropes. Plant is piscicidal in properties.
Ageratina adenophora (Sprengel) R. M. King & H. Rob.	1	2	2	0.04	1	2	2	0.05	0.04	Stem, leaf	Plant extract is used in cuts and wounds.
Allium prattii C.H. Wright	0	0	0	0.00	3	4	3	0.02	0.01	Shoot	Plant is depressant of cold and cough.
Allium wallichii Kunth	0	0	0	0.00	4	20	20	0.39	0.20	Rhizome	Rhizome is used in arthritis, backache, dysentery and gastric complants.
Alnus nepalensis D.Don	1	14	14	0.25	1	1	1	0.00	0.12	Bark	Bark is used in paralysis.
Aloe vera (L.) Burm. f.	1	3	3	0.05	1	1	1	0.00	0.03	Leaf	Plant juice is applied on burns and scalds and useful in diabetes.
Angelica archangelica L.	4	9	7	0.08	2	30	30	0.67	0.38	Root	Root is a good spices and used for cold, cough, constipation, gastric, stomachache and joint pain.
Aralia cachemirica Decne.	1	4	4	0.07	4	6	6	0.06	0.06	Whole plant	Plant is used in skin diseases, swells, stomachache, wounds and respiratory problems.
Artemisia indica Willd.	3	11	10	0.14	6	12	12	0.15	0.15	Leaf	Plant leaves are insecticidal, and useful in cuts, fever, headache, piles and skin diseases. Plant is also cultural.

Asparagus racemosus Willd.	5	7	7	0.04	2	3	3	0.03	0.04	Rhizome	Roots are useful in fever, typhoid, gastric, jaundice and useful as an agent for lactation and escaping away the evil spirits.
Azadirachta indica A. Juss.	0	0	0	0.00	2	3	3	0.03	0.02	Leaf	Leaves are used in diarrhea and fever.
Bauhinia purpurea L.	3	5	5	0.04	3	3	3	0.00	0.02	Bark	Plant inflorescence is used in diarrhea, stomachache, dusentery and indigestion.
*Bauhinia vahlii Wigh*t & Arn.	2	3	3	0.03	0	0	0	0.00	0.01	Leaf	Plant is a good forage and cultural.
Berberis aristata DC.	2	2	2	0.00	2	2	1	0.00	0.00	Bark , Root	Fruits are edible. Bark is useful in paralysis, cough, cuts and wounds.
Berberis asiatica Roxb. ex DC.	1	4	4	0.07	3	3	3	0.00	0.04	Fruits	Edible fruits are useful in jaundice, fever and diabetes.
Bergenia ciliata (Haw.) Sternb.	7	42	36	0.54	3	20	19	0.40	0.47	Rhizome	Root is used in stomachache, gastric, indigestion, fracture, cough, diarrhea, gall stone, constipation and nausea.
Betula utilis D.Don	0	0	0	0.00	2	3	3	0.03	0.02	Wood	Plant bark and wood are used in storing grains. People considered that the stored grains in bhojpatra are medicinal.
Butea monosperma (Lam.) Taub	1	4	3	0.05	0	0	0	0.00	0.03	Wood	Wood is considered cultural and used to protect evil spirits. Giving this plant wood to anyone is a symbol of divorce.
Calanthe plantaginea Lindl.	2	7	6	0.09	0	0	0	0.00	0.04	Stem	Plant is used as antidoting and useful in stomachache and snake bites.
Calotropis gigantea (L.) Dryand	1	1	1		3	3	3	0.00	0.00	Milk, leaf	Plant milk is used for sprain, joint pain. Leaf powder is used in snake bite. Plant is taken as cultural.
Cannabis sativa L.	1	1	1		2	3	2	0.02	0.01	Seeds	Plant is used in tila of cattle. Plant seeds are used for constipation and analgesic.
Carum carvi L.	4	5	5	0.02	3	3	2	0.00	0.01	Seeds	Plant seeds are helpful in easing respiration,
Castanopsis hystrix Hook. f. & Thomson ex A. DC.	2	4	4	0.05	0	0	0	0.00	0.02	Bark, Wood	Plant is a good wood, fodder and useful in snake bites.
Centella asiatica (L.) Urb.	9	24	22	0.25	3	3	3	0.00	0.13	Leaf	Plant juice is used in conjuntivitis, cuts, wounds, skin diseases, acnes, cold, fever, cattle urine dehydration, jaundice, pilo and makada.
Chrysopogon aciculatus (Retz.) Trin.	1	31	31	0.54	1	1	1	0.00	0.27	Shoot	Plant is a very good grass.

Cinnamomum tamala (Buch.-Ham.) T.Nees & Eberm.	2	1	1		4	16	10	0.19	0.09	Bark	Bark and leaves are used as spices and useful in cold, cough, arthritis and toothache.
Cirsium verutum (D.Don) Spreng.	5	14	14	0.17	0	0	0	0.00	0.09	Root	Root is useful in dehydration, cough, fever and urine complaints.
Clematis montana Buch.-Ham ex DC.	3	4	2	0.01	1	1	1	0.00	0.01	Stem	Flowers are useful in control diarrhea and vomiting. Stem is also used a rope.
Coriaria nepalensis Wall.	2	3	3	0.03	0	0	0	0.00	0.01	Fruits	Fruits are edible and applied on burns and scalds.
Curcuma angustifolia Roxb.	3	4	4	0.02	3	3	3	0.00	0.01	Rhizome	Rhizome is used in cough, inflammation, stomachache, fracture and skin diseases.
Cuscuta reflexa Roxb.	6	11	9	0.08	3	6	6	0.08	0.08	Stem	Plant is used in skin diseases, jaundice and conjunctivitis. Shoot is also used for pneumonia and cough of cattle. Shoot is sometimes used as an antifertility ingredient.
Cynodon dactylon (L.) Pers.	4	5	5	0.02	1	1	1	0.00	0.01	Whole plant	Plant is cultural. It is used with honey for fracture, jaundice and snakebite.
Cynoglossum zeylanicum (Vahl) Brand	4	4	3	0.00	1	1	1	0.00	0.00	Flowers, Root	Plant root is useful in pneumonia, fever, cough and joint pain. Flowers are used to reduce blood pressure.
Dactylorhiza hatagirea (D. Don) Soo	0	0	0	0.00	4	23	22	0.44	0.22	Salep	Plant salep is commonly used in cuts and wounds. Plant is tonic.
Debregeasia longifolia (Burm.f.) Wedd.	2	4	4	0.05	0	0	0	0.00	0.02	Wood	Plant wood is used for storing milk products. Plant wood is also used for fracture and sprain.
Delphinium himalayae Munz	0	0	0	0.00	1	4	4	0.09	0.05	Root	Root is antidiarrhoec and antidoting.
Dendrocalamus hamiltonii Nees& Arn. ex Munro	0	0	0	0.00	2	5	4	0.07	0.03	Shoot	Plant is cultural and a good fodder.
Desmodium oojeinense (Roxb.) H.Ohashi	2	5	4	0.05	0	0	0	0.00	0.03	Leaf, Wood	Plant is good for wood and fodder.
Desmostachys bipinnata (L.) Stapf.	2	6	5	0.07	1	9	9	0.21	0.14	Shoot	Plant is cultural, and used medicinally for heart attack, and reduce blood pressure.
Didymocarpus albicalyx C.B. Clarke	6	8	8	0.04	3	3	3	0.00	0.02	Leaf	Plant leaf and roots are used in fracture, sprains, skin diseases, respiratory diseases, dudhe rog, sool and to increase fertility.
Diploknema butyracea (Roxb.) H.J.Lam	5	8	4	0.03	2	2	1	0.00	0.02	Seeds	Fruits are edible. Plant is also a good source of fodder, fuelwood and oil.

Drepanostachyum falcatum (Nees) Keng f.	4	12	10	0.13	0	0	0	0.00	0.06	Shoot	Tender shoots are used as vegetable. Plant is cultural and used as a fodder.
Elaeagnus parvifolia Wall. ex Royle	1	3	3	0.05	2	2	2	0.00	0.03	Fruits	Fruits are edible and useful in dysentery.
Eleusine indica (L.) Geartn.	0	0	0	0.00	3	4	3	0.02	0.01	Seed	Seed is digestive and helpful in gastric, diarrhea and constipation.
Eryngium foetidum L.	1	1	1		2	2	2	0.00	0.00	Seeds	Plant and seeds are used in diarrhea, lactation and human fertility.
Eulaliopsis binata (Retz.) C.E.Hubb.	2	5	4	0.05	2	2	2	0.00	0.03	Stem	Plant is cultural, and used as grass and local material for making ropes.
Euphorbia royleana Bioss.	1	2	2	0.04	1	1	1	0.00	0.02	Milk	Milk is used for joint pain.
Ficus auriculata Lour.	2	4	4	0.05	1	1	1	0.00	0.02	Leaf	Plant is a good fodder tree.
Ficus benghalensis L.	2	2	2	0.00	1	1	1	0.00	0.00	Bark, wood	Plant is cultural. Bark is useful in skin diseases.
Ficus hederacea Roxb.	1	6	6	0.11	0	0	0	0.00	0.05	Milk	Plant juice and milk are used in skin rashes (makada).
Ficus neriifolia Sm.	2	2	2	0.00	1	1	1	0.00	0.00	Leaf	Plant is a good fodder tree.
Ficus palmata Forssk.	3	5	4	0.04	0	0	0	0.00	0.02	Shoot	Plant is used as vegetable and it helps to remove thorns. Tender shoots are used as vegetable.
Ficus religiosa L.	1	23	23	0.40	1	10	10	0.23	0.32	Leaf, Wood	Plant is cultural useful.
Ficus semicordata Buch.-Ham ex Sm.	2	1	1		1	2	2	0.05	0.02	Leaf	Plant is a good fodder tree.
Girardinia diversifolia (Link) Friis	2	4	4	0.05	0	0	0	0.00	0.02	Stem	Plant is useful in fracture.
Grewia optiva J.R. Drumm. ex Burret	3	8	5	0.06	0	0	0	0.00	0.03	Bark, leaf	Plant is a good fodder and fiber tree. Plant fiber is used in making ropes.
Hydrocotyle javanica Thunb.	2	3	3	0.03	0	0	0	0.00	0.01	Whole plant	Plant is used in cuts and wounds and snake bite.
Imperata cylindrica (L.) Raeusch.	2	10	10	0.16	0	0	0	0.00	0.08	Shoot	Plant rhizome juice is used in urine problem.
Jatropha curcas L.	1	1	1		2	2	2	0.00	0.00	Shoot	Young shoots are used in toothache, snake bites and polio.
Juglans regia L.	5	16	10	0.13	3	7	7	0.11	0.12	Bark, fruits	Fruits are edible. Root is used as toothache and bodyache. Leaf is used in antihairfall.
Juniperus indica Bertol.	0	0	0	0.00	4	9	8	0.12	0.06	Seed	Plant is cultural. Oil is used for backache, skin allergy and dusentery.
Lyonia ovalifolia (Wall.) Drude	3	4	4	0.02	0	0	0	0.00	0.01	Bark, wood	Bark is applied in skin diseases. Plant is also used as wood and fuel.
Magnolia kisopa (Buch.-Ham. ex DC.) Figlar	2	2	2	0.00	1	3	3	0.07	0.03	Wood	Plant is a cultural wood tree.

Mangifera indica L.	1	9	9	0.16	3	19	18	0.37	0.26	Leaf	Plant is cultural and bark juice is used in gastric and hydrocele.
Melia azedarach L.	2	2	1	0.00	3	5	4	0.05	0.02	Bark	Barks are antipyretic and anthelmintic. Fruits are useful in tila pareko of cattle.
Myrica esculenta Buch.-Ham. ex D. Don	10	21	18	0.17	2	3	2	0.02	0.10	Bark, fruits	Plant bark is used in jaundice, paralysis, and to improve fertility. It also removes skin scars and eases burns and scalds.
Nardostachys grandiflora DC.	0	0	0	0.00	5	8	8	0.08	0.04	Rhizome	Plant is used in stomachache, heart disease and dysentery.
Neopicrorhiza scrophulariiflora (Pennell) D.Y.Hong	1	1	1		4	31	28	0.59	0.29	Root	Roots are useful in indigestion, fever, TB and respiratory problems.
Ocimum gratissimum L.	2	5	4	0.05	3	3	2	0.00	0.03	Seed	Plant is considered as holy/cultural and controlled used for fever, rheumatism and jaundice with *Syzygium aromaticum*.
Ophiocordyceps sinensis (Berk.) G.H.Sung	0	0	0	0.00	2	15	12	0.26	0.13	Whole plant	Plant is highly tonic and used in fever and cough.
Oroxylum indicum (L.) Kurz	3	4	3	0.02	0	0	0	0.00	0.01	Seed	Plant is a fodder tree and useful in *tila* (livestock).
Paris polyphylla Sm.	5	27	23	0.34	4	28	27	0.56	0.45	Rhizome	Plant root is used for headache, fever, dizziness, diarrhea, indigestion, wounds, gastric, epilepsy and snake bites.
Perilla frutescens (L.) Britton	4	11	7	0.09	1	1	1	0.00	0.04	Seeds	Plant is used in fever, cough and cold. Plant leaf is applied to make an amulet for children for easing respiration.
Persea odoratissima (Nees) Kosterm.	3	3	3	0.00	1	1	1	0.00	0.00	Bark	Plant is a good fodder and useful in paralysis.
Phyllanthus emblica L.	5	24	23	0.33	3	7	5	0.08	0.21	Fruits, Leaf	Plant is cultural, and fruits are used as medicinal for cough, gastric, indigestion, skin diseases, hair growth and removing skin scars.
Phytolacca acinosa Roxb.	3	3	3	0.00	0	0	0	0.00	0.00	Stem	Plant is used as vegetable for jaundice and cold.
Picris hieracioides Sibth. & Sm.	5	6	6	0.02	1	1	1	0.00	0.01	Whole plant	Plant is useful in tetanus, burns and pneumonia, and urine problem of livestock.
Pinus roxburghii Sarg.	6	17	15	0.18	2	3	3	0.03	0.11	Resin	This is also a common wood. Plant resin is used in fracture and inflammation.
Pinus wallichiana A.B. Jacks.	0	0	0	0.00	3	4	4	0.03	0.02	Wood	Plant is a good fuelwood and wood species. It is also used in gastric.

Polygala abyssinica R.Br. ex Fresen.	2	28	27	0.46	0	0	0	0.00	0.23	Leaf	Plant is a common grass.
Polygonatum cirrhifolium (Wall.) Royle	1	1	1		2	2	2	0.00	0.00	Shoot, Root	Tender shoots are used as vegetable and appetizer.
Polygonatum verticillatum (L.) All	0	0	0	0.00	2	4	3	0.05	0.02	Root	Plant root is useful for indigestion and diarrhea.
Pouzolzia hirta (Blume) Hassk.	1	3	3	0.05	0	0	0	0.00	0.03	Root	Root extract is useful in skin diseases.
Prinsepia utilis Royle	0	0	0	0.00	4	5	5	0.03	0.01	Seed oil	Oil is applied for backache, sprain, bath rog and cuts and wounds.
Prunus cerasoides Buch.-Ham. ex D.Don	4	47	36	0.59	1	10	10	0.23	0.41	Bark	Plant is a good in fodder and cultural values. Bark is used in paralysis.
Prunus cornuta (Wall. ex Royle) Steud.	0	0	0	0.00	3	3	3	0.00	0.00	Root	Root juice is used for paralysis, dysentery and livestock wounds.
Quercus incana Bartram	3	4	4	0.02	0	0	0	0.00	0.01	Wood	Plant is good as fodder, fuelwood and agriculture implements.
Quercus lanata Sm.	7	58	34	0.53	2	4	3	0.05	0.29	Wood	Plant bark and resin is used for indigestion, cough, cold and pain relief.
Quercus semecarpifolia Sm.	3	18	17	0.26	0	0	0	0.00	0.13	Leaf, wood	Plant is good as fodder, fuelwood and agriculture implements.
Rheum australe D.Don	0	0	0	0.00	4	8	8	0.11	0.05	Stem	Plant root is used for backache, sprain and appendicitis.
Rhododendron anthopogon D. Don	0	0	0	0.00	1	4	3	0.07	0.03	Leaf	Plant is cultural and used for incense.
Rhododendron arboreum Sm.	5	17	14	0.18	2	3	3	0.03	0.11	Flower, Wood	Wood is used in making pots for storing milk and products. Flowers are useful in dysentery, blood purification and easing swallowing.
Ribes glaciale Wall.	1	2	2	0.04	2	2	2	0.00	0.02	Fruit	Fruits are used in inducing speaking to the children.
Rubia wallichiana Decne.	4	9	8	0.09	0	0	0	0.00	0.04	Stem	Stem juice is used in diarrhea, paralysis, cough and inflammation. It is also useful in inflammation of cattle.
Rubus ellipticus Sm.	7	8	11	0.03	2	2	2	0.00	0.01	Tender bud, root, fruits	Fruits are edible. Plant root extract is alcoholic and useful in diarrhea, indigestion, stomachache, typhoid, burns and epilepsy. Tender leaf buds are used in paralysis and swells.
Rumex nepalensis Spreng.	3	3	3	0.00	1	1	1	0.00	0.00	Shoot	Plant is vegetable and useful in scabies.
Selinum wallichianum (DC.) Raizada & H.O. Saxena	0	0	0	0.00	1	4	4	0.09	0.05	Root	Plant is used to escape away the evil spirits.

Shorea robusta Geartn.	4	12	7	0.09	1	1	1	0.00	0.04	Leaf, Wood	Plant is a good wood and fodder tree.
Solanum surattense Burm.f.	1	3	3	0.05	0	0	0	0.00	0.03	Seeds	Plant seeds are infused for toothache.
Swertia chirayita (Roxb.) Buch.-Ham. ex C.B.Clarke	5	37	30	0.47	6	26	24	0.45	0.46	Root, stem	Root is antidiarrhoic, and useful in cough, cold, indigestion, fever, TB, reducing blood pressure. This is also useful in livestock throat pain.
Syzygium cumini (L.) Skeels	2	8	8	0.12	2	5	5	0.09	0.10	Fruits	Fruits are useful in diabetes and diarrhea. Plant is cultural.
Taraxacum officinale var. parvulum Hook. f.	0	0	0	0.00	1	3	3	0.07	0.03	Root	Plant is anticancerous.
Taxus contorta Griff.	4	8	6	0.06	2	2	2	0.00	0.03	Leaf, wood	Plant wood is cultural, and used as an anticancer wood.
Terminalia alata Heyne ex Roth	1	4	4	0.07	1	1	1	0.00	0.04	Leaf, wood	Plant is a good wood and fodder tree.
Terminalia chebula Retz.	3	8	5	0.06	2	2	2	0.00	0.03	Fruit	Fruits are used in cough, cold, gastric and fever.
Thalictrum cultratum Wall.	0	0	0	0.00	3	4	3	0.02	0.01	Root	Plant root is valued for fever, gastric and jaundice.
Toona serrata (Royle) M Roem.	1	17	17	0.30	0	0	0	0.00	0.15	Wood	Plant is used for wood.
Trichosanthes tricuspidata Lour.	2	2	2	0.00	1	2	2	0.05	0.02	Fruits	Fruit is considered as digestive and applied in paralysis, gastric/tila of cattle.
Urtica dioica L.	5	8	7	0.05	5	5	4	0.00	0.03	Root	Root is used in rheumatism, paralysis, inflammation, fracture, sprain, and pida.
Valeriana jatamansii Jones	5	19	17	0.23	2	4	4	0.06	0.15	Rhizome	Root is used in throat pain, fever, cough, indigestion and skin and respiratory diseases.
Viscum album L.	2	2	2	0.00	1	1	1	0.00	0.00	Fruits	Plant is useful in fracture and sprains.
Vitex negundo L.	2	2	2	0.00	1	1	1	0.00	0.00	Leaf	Leaf juice is used in headache.
Woodfordia fruticosa (L.) Kurtz	3	4	3	0.02	0	0	0	0.00	0.01	Flowers	Flowers are useful in burns, scalds, indigestion and control diarrhea. They are also useful in making the sound better.
Zanthoxylum armatum DC.	5	11	8	0.08	4	12	10	0.17	0.13	Fruits	Seeds are good in cough, fever, cold, toothache, asthma and indigestion.
Ziziphus jujuba Mill.	3	3	3	0.00	1	1	1	0.00	0.00	Seed, bark	Edible fruits are used in diarrhea, dysentery, jaundice and fermentation.

Appendix H. Total 255 plant species including 191 plant species recorded in quadrats with their IVI and distribution

SN	Location	Botanical name	Abbrev	Family	Found in quadrat	Habit	Baitadi	Darchula	IVI	Elevation range (m asl)	Distribution	Distrb. In Nepal	Bioclimate
1.	Dipang gaun, Byash, Darchula	*Abies pindrow* (Royle ex D.Don) Royle	Abi pin	Pinaceae	+	Tree	+	+	56.816	2400-4400	Himalayan Endemic	WC	Temperate -Alpine
2.		*Aesculus indica* (Wall. ex Cambess.) Hook	Aes ind	Sapindaceae	+	Tree	+	+	6.317	1900-2400	Himalayan Endemic	WC	Temperate
3.		*Alnus nepalensis* D.Don	Aln nep	Betulaceae	+	Tree	+	+	8.112	500-2600	Himalayan Endemic	WCE	Tropical-Temperate
4.		*Artemisia indica* Willd.	Art ind	Asteraceae	+	Herb	+	+	4.778	300-3400	Pan Himalaya	WCE	Tropical-Temperate
5.	Khodpe	*Asparagus racemosus* Willd.	Asp rec	Asparagaceae	+	Climber Vine	+	+	1.376	600-2100	Broadly distributed	CE	Tropical-Temperate
6.	Gaga, Byash, Darchula	*Berberis aristata* DC.	Ber ari	Berberidaceae	+	Shrub	+	+	15.021	1800-3000	Himalayan Endemic	WC	Temperate -Alpine
7.	Jaljhalla, Chaukham	*Berberis asiatica* Roxb. ex DC.	Ber asi	Berberidaceae	+	Shrub	+	+	3.500	1200-2500	Himalayan Endemic	WCE	Tropical-Temperate
8.		*Chrysopogon aciculatus* (Retz.) Trin.	Chr aci	Poaceae	+	Herb	+	+	11.184	1700-4300	Himalayan Endemic	WC	Temperate -Alpine
9.		*Clematis montana* Buch.-Ham ex DC.	Cle mon	Ranunculaceae	+	Climber	+	+	3.432	1600-4000	Himalayan Endemic	WCE	Tropical-Temperate
10.		*Drepanostachyum falcatum* (Nees) Keng f.	Dre fal	Poaceae	+	Shrub	+	+	18.157	2100-3000	Himalayan Endemic	W	Tropical-Temperate
11.		*Elaeagnus parvifolia* Wall. ex Royla	Ela par	Elaegnaceae	+	Shrub	+	+	4.473	1300-3000	Himalayan Endemic	WCE	Tropical-Temperate
12.		*Juglans regia* L.	Jug erg	Juglandaceae	+	Tree	+	+	14.057	1200-2100	Himalayan Endemic	WCE	Tropical-Temperate
13.		*Lyonia ovalifolia* (Wall.) Drude	Lyo ova	Ericaceae	+	Tree	+	+	10.079	1300-3300	Himalayan Endemic	WCE	Tropical-Temperate
14.	Dipang gaun, Byash, Darchula	*Polygonatum cirrhifolium* (Wall.) Royle	Pol cir	Asparagaceae	+	Herb	+	+	1.453	1700-4600	Himalayan Endemic	WCE	Temperate -Alpine
15.		*Rhododendron arboreum* Sm.	Rho arb	Ericaceae	+	Tree	+	+	18.146	1500-3300	Himalayan Endemic	WCE	Tropical-Temperate
16.	Way to Gaga, Gaga, Byash	*Ribes glaciale* Wall.	Rib gla	Grossulariaceae	+	Shrub	+	+	5.342	2600-4400	Himalayan Endemic	WCE	Temperate -Alpine
17.	Paharal CF, Chaukham	*Rubia wallichiana* Decne.	Rub wal	Rubiaceae	+	Climber	+	+	1.534	1200-2100	Himalayan Endemic	CE	Tropical-Temperate
18.		*Swertia chirayita* (Roxb.) Buch.-Ham. ex C.B.Clarke	Swe chi	Gentianaceae	+	Herb	+	+	1.948	2800-4000	Himalayan Endemic	WCE	Temperate -Alpine
19.	Gaga, Byash, Darchula	*Taraxacum officinale* var. parvulum Hook. f.	Tar off	Asteraceae	+	Herb	+	+	7.187	3000-5600	Himalayan Endemic	WCE	Temperate -Alpine
20.	Kurjeneta, Gajari	*Taxus contorta* Griff.	Tax con	Taxaceae	+	Tree	+	+	15.082	2500-3000	Himalayan Endemic	WC	Temperate -Alpine
21.		*Thalictrum cultratum* Wall.	Tha cul	Ranunculaceae	+	Herb	+	+	5.223	2400-4200	Himalayan Endemic	WCE	Temperate -Alpine
22.	Gaga, Byash, Darchula	*Valeriana jatamansii* Jones	Val jat	Caprifoliaceae	+	Herb	+	+	5.927	1500-3300	Himalayan Endemic	WCE	Tropical-Temperate
23.	Thotne	*Aconogonum rumicifolium* Hara	Aco rum	Polygonaceae	+	Herb		+	1.662	3300-4400	Himalayan Endemic	WC	

24.	Vedaito, silphode, pakhanved, Paduwa	*Bergenia ciliata* (Haw.) Sternb.	Ber cil	Saxifragaceae	+	Herb		+	0.890	900-1700	Himalayan Endemic	WC	Tropical-Temperate
25.	Bhooj	*Betula utilis* D.Don	Bet uti	Betulaceae	+	Tree		+	13.522	2700-4300	Himalayan Endemic	WCE	Temperate -Alpine
26.		*Calanthe plantaginea* Lindl.	Cal pla	Orchidaceae	+	Herb		+	0.613	1500-1800	Himalayan Endemic	C	Tropical-Temperate
27.		*Cirsium verutum* (D.Don) Spreng.	Cir ver	Asteraceae	+	Herb		+	2.342	750-2200	Himalayan Endemic	WCE	Tropical-Temperate
28.		*Ficus palmata* Forssk.	Fic pal	Moraceae	+	Tree		+	0.678	600-2300	Himalayan Endemic	W	Tropical-Temperate
29.		*Girardinia diversifolia* (Link) Friis	Gir div	Urticaceae	+	Herb		+	0.929	1700-3000	Pan Himalaya	WCE	Tropical-Temperate
30.	Way to Gaga, Gaga, Byash	*Juniperus indica* Bertol.	Jun ind	Cupressaceae	+	Tree		+	3.556	3700-4100	Himalayan Endemic	WCE	Alpine
31.	Gaga, Byash, Darchula	*Juniperus squamata* Buch.-Ham. ex D.Don	Jun squ	Cupressaceae	+	Tree		+	4.208	3300-4400	Himalayan Endemic	WCE	Alpine
32.		*Phytolacca acinosa* Roxb.	Phy aci	Phytolaccaceae	+	Herb		+	0.507	2200-3200	Pan Himalaya	WC	Temperate -Alpine
33.		*Pinus wallichiana* A.B. Jacks.	Pin wal	Pinaceae	+	Tree		+	52.080	1800-3300	Himalayan Endemic	WCE	Temperate -Alpine
34.		*Prinsepia utilis* Royle	Pri uti	Rosaceae	+	Shrub		+	2.090	1500-2900	Himalayan Endemic	WCE	Tropical-Temperate
35.	Budi, Byash, Darchula	*Prunus cornuta* (Wall. ex Royle) Steud.	Pru cor	Rosaceae	+	Tree		+	7.111	2100-3500	Himalayan Endemic	WCE	Temperate -Alpine
36.	Dipang gaun, Byash, Darchula	*Rhododendron anthopogon* D. Don	Rho ant	Ericaceae	+	Shrub		+	0.947	3300-5100	Himalayan Endemic	WCE	Alpine
37.		*Rumex nepalensis* Spreng.	Rum nep	Polygonaceae	+	Herb		+	2.479	1200-4200	Himalayan Endemic	WCE	Temperate -Alpine
38.		*Urtica dioica* L.	Urt dio	Urticaceae	+	Herb		+	2.684	3000-4500	Broadly distributed	WC	Temperate -Alpine
39.		*Ageratina adenophora* (Sprengel) R. M. King & H. Rob.	Age ade	Asteraceae	+	Herb	+		1.509	850-2200	Broadly distributed	CE	Tropical-Temperate
40.	Sigas dhura, Gajari, Baitadi	*Angelica archangelica* L.	Ang arc	Apiaceae	+	Herb	+		0.6131	500-2500	Broadly distributed	WCE	Tropical-Temperate
41.		*Cinnamomum tamala* (Buch.-Ham.) T.Nees & Eberm.	Cin tam	Lauraceae	+	Tree	+		1.243	450-2000	Himalayan Endemic	WCE	Tropical-Temperate
42.	Raje 1, Dhungad, Baitadi	*Coriaria nepalensiis* Wall.	Cor nep	Coriariaceae	+	Shrub	+		1.440	1200-2400	Himalayan Endemic	WCE	Tropical-Temperate
43.		*Cynoglossum zeylanicum* (Vahl) Brand	Cyn zey	Boraginaceae	+	Herb	+		0.507	1200-4100	Pan Himalaya	WCE	Temperate -Alpine
44.	Banjpani, Chaukham	*Ficus hederacea* Roxb.	Fic hed	Moraceae	+	Climber	+		1.090	1400-2800	Himalayan Endemic	WC	Tropical-Temperate
45.		*Ficus neriifolia* Sm.	Fic ner	Moraceae	+	Tree	+		1.243	1400-2200	Himalayan Endemic	C	Tropical-Temperate
46.		*Magnolia kisopa* (Buch.-Ham. ex DC.) Figlar	Mag kis	Magnoliaceae	+	Tree	+		1.137	1400-2000	Himalayan Endemic	WCE	Tropical-Temperate
47.		*Myrica esculenta* Buch.-Ham. ex D. Don	Myr esc	Myricaceae	+	Tree	+		0.991	1200-2300	Himalayan Endemic	WCE	Tropical-Temperate
48.		*Ocimum gratissimum* L.	Oci gra	Lamiaceae	+	Herb	+		0.947	400-1200	Pan Himalaya	WCE	Tropical
49.	Sribhabar, Chaukham	*Paris polyphylla* Sm.	Par pol	Melanthiaceae	+	Herb	+		2.211	1800-3000	Himalayan Endemic	WCE	Temperate -Alpine

50.		*Persea odoratissima* (Nees) Kosterm.	Per odo	Lauraceae	+	Tree	+		12.1400	1000-2000	Himalayan Endemic	WCE	Tropical-Temperate
51.		*Phyllanthus emblica* L.	Phy emb	Phyllanthaceae	+	Tree	+		0.678	150-1400	Broadly distributed	WCE	Tropical-Temperate
52.	Yektare, Chaukham	*Picris heiracioides* Sibth. & Sm.	Pic hei	Asteraceae	+	Herb	+		1.0904	1800-3800	Pan Himalaya	WCE	Temperate -Alpine
53.		*Pinus roxburghii* Sarg.	Pin rox	Pinaceae	+	Tree	+		3.896	1100-2100	Himalayan Endemic	WCE	Tropical-Temperate
54.		*Quercus incana* Bartram	Que inc	Fagaceae	+	Tree	+		5.020	1500-2400	Himalayan Endemic	WCE	Tropical-Temperate
55.		*Quercus lanata* Sm.	Que lan	Fagaceae	+	Tree	+		11.753	450-2600	Pan Himalaya	WC	Tropical-Temperate
56.	Kurjeneta, Gajari, Baitadi	*Quercus semecarpifolia* Sm.	Qur sem	Fagaceae	+	Tree	+		19.017	1700-3800	Himalayan Endemic	WCE	Temperate -Alpine
57.		*Rubus ellipticus* Sm.	Rub ell	Rosaceae	+	Shrub	+		1.807	1700-2300	Pan Himalaya	WCE	Tropical-Temperate
58.		*Toona serrata* (Royle) M Roem.	Too ser	Meliaceae	+	Tree	+		3.529	2100-2300	Himalayan Endemic	WE	Temperate -Alpine
59.		*Woodfordia fruticosa* (L.) Kurtz	Wod fru	Lythraceae	+	Shrub	+		1.243	200-1800	Pan Himalaya	WCE	Tropical-Temperate
60.		*Zanthoxylum oxyphyllum* Edgew.	Zan oxy	Rutaceae	+	Shrub	+		3.762	1100-2500	Pan Himalaya	WCE	Tropical-Temperate
61.		*Acer campbelli* Hook.f. & Thomson ex Hiern	Ace cam	Sapindaceae		Tree	+	+	7.1643	2600-3600		WCE	Temperate -Alpine
62.		*Acer oblongum* Wall. ex DC.	Ace obl	Sapindaceae		Tree	+	+	12.827	1200-2400		WCE	Tropical-Temperate
63.	Banjpani, Chaukham	*Adiantum venustum* D. Don	Adi ven	Pteridaceae		Herb	+	+	1.762	2000-2900			Temperate
64.	Kurjeneta, Gajari, Baitadi	*Ainsliea latifolia* Kuntze	Ain lat	Asteraceae		Herb	+	+	5.329	1700-3500		WCE	Temperate -Alpine
65.		*Anaphalis triplinervis* (Sims) Sims ex C.B.Clarke	Ana tri	Asteraceae		Herb	+	+	9.899	2900-4100		WCE	Temperate -Alpine
66.	Paharal CF, Chaukham	*Astilbe rivularis* Buch.-Ham. ex D.Don	Ast riv	Saxifragaceae		Herb	+	+	1.244	2000-3600		WCE	Temperate -Alpine
67.		*Athyrium wallichianum* Ching	Ath wal	Athyriaceae		Herb	+	+	2.719	3500-4800			Alpine
68.		*Betula alnoides* Buch.-Ham. ex D.Don	Bet aln	Betulaceae		Tree	+	+	10.845	1200-2600		WCE	Tropical-Temperate
69.	Khalte, Gajari	*Boenninghausenia albiflora* (Hook.) Rchb. ex Meisn.	Boe alb	Rutaceae		Herb	+	+	0.962	600-3300		WCE	Tropical-Temperate
70.		*Caltha palustris* L.	Cal pal	Asteraceae		Herb	+	+	1.932	2900-3600		WE	Temperate -Alpine
71.		*Cissampelos pareira* L.	Cis par	Menispermaceae		Climber	+	+	0.613	150-2200		WCE	Tropical-Temperate
72.		*Cotoneaster frigidus* Wall. ex Lindl.	Cot fri	Rosaceae		Shrub	+	+	11.269	2200-3400		WC	Temperate -Alpine
73.		*Cotoneaster microphyllus* Wall. ex Lindl.	Cot mic	Rosaceae		Shrub	+	+	2.498	2000-5400		WE	Temperate -Alpine
74.		*Daphne bholua* Buch.-Ham. ex D.Don	Dap bho	Thymeleaceae		Shrub	+	+	20.061	2000-2900		CE	Temperate
75.		*Desmodium elegans* DC.	Des ele	Fabaceae		Shrub	+	+	0.890	1200-3000		WC	Tropical-Temperate
76.		*Dipsacus inermis* Wall.	Dip ine	Dipsacaceae		Herb	+	+	1.401	1400-4100		WC	Tropical-Alpine

77.		*Euonymus fimbriatus* Wall.	Euo fim	Celastraceae		Tree	+	+	3.399	2300-3600		WC	Temperate -Alpine
78.	Paharal CF, Chaukham	*Gentiana capitata* Buch.-Ham. ex D.Don	Gen cap	Gentianaceae		Herb	+	+	3.950	2000-2700		WCE	Temperate
79.	Gaga, Byash,	*Geranium nepalense* Sweet	Ger nep	Gernaniaceae		Herb	+	+	5.707	3200-4800		WCE	Alpine
80.	Dipang gaun, Byash, Darchula	*Goodyera repens* (L.) R.Br.	Goo rep	Orchidaceae		Herb	+	+	1.844	1000-4200		WCE	Tropical-Alpine
81.	Banjpani, Chaukham	Hedera nepalensis K.Koch	Hed nep	Araliaceae		Shrub	+	+	4.890	2000-3200		WCE	Temperate -Alpine
82.		*Hedychium ellipticum* Buch.-Ham. ex Sm.	Hed ell	Zingiberaceae		Herb	+	+	0.613	300-3100		WCE	Tropical-Temperate
83.	Sribhabar, Chaukham	*Impatiens balsamina* L.	Imp bal	Balsaminaceae		Herb	+	+	2.449	1200-1900		WCE	Tropical
84.	Kotila, Gajari	*Jasminum dispermum* Wall.	Jas dis	Oleaceae		Shrub	+	+	5.496	1500-2300		WCE	Tropical-Temperate
85.	Paharal CF, Chaukham	*Lonicera lanceolata* Wall.	Lon lan	Caprifoliaceae		Shrub	+	+	7.104	2700-3800		WCE	Temperate -Alpine
86.		*Neolitsea pallens* (D. Don) Momiy. & H. Hara	Neo pal	Lauraceae		Tree	+	+	14.1838	2000-3000		WCE	Temperate
87.		*Potentilla lineata* Trevir.	Pot lin	Rosaceae		Herb	+	+	5.616	1600-4800		WCE	Tropical-Temperate
88.		*Pyrus pashia* Buch.-Ham. ex D. Don	Pyr pas	Rosaceae		Tree	+	+	5.909	750-2600		WCE	Tropical-Temperate
89.		*Rhus javanica* L.	Rhu jav	Anacardiaceae		Tree	+	+	5.458	1300-2400		WCE	Tropical-Temperate
90.	Gaga, Byash, Darchula	*Rosa sericea* Lindl.	Ros ser	Rosaceae		Shrub	+	+	7.915	2200-4600		WCE	Temperate -Alpine
91.		*Rubus nepalensis* (Hook. f.) Kuntze.	Rub nep	Rosaceae		Shrub	+	+	6.003	210-3200		WCE	Temperate -Alpine
92.	Sribhabar, Chaukham	*Salix daltoniana* Anderss.	Sal dal	Salicaceae		Shrub	+	+	5.780	3400-4400		C	Alpine
93.	Kurjeneta, Gajari, Baitadi	*Sarcococca hookeriana* Baill.	Sar hoo	Buxaceae		Shrub	+	+	12.648	1800-3500		WCE	Temperate -Alpine
94.		*Setaria verticillata* (L.) Beauv.	Set ver	Poaceae		Herb	+	+	2.619	300-800		WE	Tropical
95.		*Smilax aspera* L.	Smi asp	Smilacaceae		Climber	+	+	2.739	1100-2700		CE	Tropical-Temperate
96.		*Strobilanthes urticifolia* Wall. ex Kuntze	Sto urt	Urticaceae		Herb	+	+	3.894	1700-2300		C	Tropical-Temperate
97.		*Tetrastigma obtectum* (Wall. ex Lawson) Planch.	Tet obt	Vitaceae		Climber	+	+	3.344	300-2500		WC	Tropical-Temperate
98.		*Theropogon pallidus* (Kunth.) Maxim	The pal	Asparagaceae		Herb	+	+	1.844	1800-2700		WCE	Temperate -Alpine
99.	Kurjeneta, Gajari, Baitadi	*Viburnum cylindricum* Buch.-Ham. ex D.Don	Vib cyl	Adoxaceae		Shrub	+	+	3.935	1200-2500	Himalayan Endemic	WCE	Tropical-Temperate
100.		*Viburnum erubescens* Wall.	Vib eru	Adoxaceae		Shrub	+	+	12.288	1500-3000	Himalayan Endemic	WCE	Tropical-Temperate
101.		*Viburnum nervosum* D.Don	Vib ner	Adoxaceae		Shrub	+	+	5.814	2600-3500	Himalayan Endemic	WCE	Temperate -Alpine
102.	Kurjeneta, Gajari, Baitadi	*Viola canescens* Wall.	Vio can	Violaceae		Herb	+	+	7.666	1500-2400	Himalayan Endemic	WC	Tropical-Temperate
103.		*Androsace sarmentosa* Wall.	And sar	Primulaceae		Herb		+	1.710	2500-4000		WCE	Temperate -Alpine

104.		*Anemone rupicola* Cambess. ex Jacquem.	Ane rup	Ranunculaceae		Herb		+	1.784	2900-4700		WCE	Temperate -Alpine
105.		*Aster diplostephioides* (DC.) C.B.Clarke	Ast dip	Asteraceae		Herb		+	6.050	3200-4900		WCE	Alpine
106.		*Astragalus candolleanus* subsp. candolleanus (Benth.) Podlech	Ast can	Fabaceae		Herb		+	3.029	3500-4500	Himalayan Endemic	WC	Alpine
107.		*Bupleurum candoleii* Wall. ex DC.	Bup can	Apiaceae		Herb		+	2.958	2400-4000		WCE	Temperate -Alpine
108.	Near tinker , Byash, Darchula	*Buxus rugulosa* Hatus.	Bux rug	Buxaceae		Shrub		+	5.60	3300-3500		W	Alpine
109.		*Celtis australis* L.	Cel aus	Cannabaceae		Tree		+	3.922	1300-2200		C	Tropical-Temperate
110.		*Coccinia grandis* (L.) Voigt.	Coc gra	Cucurbitaceae		Climber		+	0.507	200-900		WCE	Tropical
111.		*Cortia depressa* (D.Don) C.Norman	Cot dep	Apiaceae		Herb		+	3.227	3600-4900		WCE	Alpine
112.		*Corydalis casimiriana* Duthie & Prain ex Prain	Cor cas	Papaveraceae		Herb		+	1.680	2700-4500		WCE	Temperate -Alpine
113.		*Deutzia staminea* R.Br. ex Wall.	Det sta	Hydrangeaceae		Shrub		+	1.713	1700-3200		WCE	Temperate -Alpine
114.		*Dracocephalum heterophyllum* Benth.	Dra het	Lamiaceae		Herb		+	1.615	3400-5500		WC	Alpine
115.		*Duchesnea indica* (Andrews) Focke	Duc ind	Rosaceae		Herb		+	2.474	1000-2500	Pan Himalaya	WCE	Tropical-Temperate
116.		*Ephedra gerardiana* Wall. ex Stapf	Eph ger	Ephedraceae		Herb		+	1.243	3700-5200		W	Alpine
117.		*Epilobium sikkimense* Hausskn.	Epi ski	Onagraceae		Herb		+	0.947	3000-4600		WCE	Alpine
118.		*Equisetum diffusum* D.Don.	Equ dif	Equisetaceae		Herb		+	1.090	500-3400			Tropical-Temperate
119.		*Fragaria nubicola* (Hook. f.) Lindl. ex Lacaita	Fra nub	Rosaceae		Herb		+	4.826	1600-4000		WCE	Tropical-Temperate
120.		*Galium elegens* Wall. ex Roxb.	Gal ele	Rubiaceae		Herb		+	3.726	2000-2700		C	Temperate
121.	Budi, Byash, Darchula	*Hippophae salicifolia* D.Don	Hip sal	Elaegnaceae		Shrub		+	8.098	2200-3500		WC	Temperate -Alpine
122.		*Iris decora* Wall.	Iri dec	Iridaceae		Herb		+	1.387	1800-4000		WCE	Temperate -Alpine
123.		*Juncus thomsonii* Bucheneu	Jun tho	Juncaceae		Herb		+	0.947	2700-5200		WCE	Temperate -Alpine
124.		*Morina longifolia* Wall.	Mor lon	Moringaceae		Herb		+	3.706	3000-4200		WCE	Temperate -Alpine
125.		*Origanum vulgare* L.	Ori vul	Lamiaceae		Herb		+	3.670	3500-4000		WC	Alpine
126.		*Oxalis corniculata* L.	Oxa cor	Oxalidaceae		Herb		+	1.165	300-2900		WCE	Tropical-Temperate
127.		*Oxygraphis endlicheri* (Walp.) Bennet & Sumer Chandra	Oxy end	Ranunculaceae		Herb		+	0.851	2200-5000		WCE	Temperate -Alpine
128.		*Pedicularis hoffmeisterii* Klotz.	Ped hof	Orobanchaceae		Herb		+	2.173	2500-4500		WCE	Temperate -Alpine

129.		*Persicaria amplexicaulis* (D.Don) Ronse Decr.	Per amp	Polygonaceae		Herb		+	2.229	2400-4500		WC	Temperate -Alpine
130.		*Piptanthes nepalensis* (Hook.) D.Don	Ppi nep	Fabaceae		Shrub		+	0.678	200-3800		WCE	Tropical-Alpine
131.		*Plantago erosa* Wall.	Pla ero	Plantaginaceae		Herb		+	3.497	900-1400		WCE	Tropical-Temperate
132.	Gaga, Byash, Darchula	*Poa pratensis* L.	Poa pra	Poaceae		Herb		+	9.581	4100-4400		C	Tropical-Alpine
133.		*Polygonum delicatulum* Meisn.	Pol del	Polygonaceae		Herb		+	1.233	2700-4400		WCE	Temperate -Alpine
134.	Sribhabar, Chaukham	*Primula glomerata* Pax	Pri glo	Primulaceae		Herb		+	4.147	3100-5200		WCE	Alpine
135.		*Rhododendron campanulatum* D.Don	Rho cam	Ericaceae		Shrub		+	3.782	2800-4400		WCE	Temperate -Alpine
136.	Dipang gaun, Byash, Darchula	*Rhododendron lepodiotum* Wall. ex G. Don	Rho lep	Ericaceae		Shrub		+	1.243	2400-4600		CE	Temperate -Alpine
137.		*Rosa laevigata* Michx.	Ros lae	Rosaceae		Shrub		+	2.928	1200-3200		C	Tropical-Temperate
138.	Way to Gaga, Gaga, Byash	*Salix denticulata* Andress.	Sal den	Salicaceae		Shrub		+	11.811	2400-3000		WCE	Temperate -Alpine
139.		*Saussurea nepalensis* Spreng.	Sau nep	Asteraceae		Herb		+	2.389	3200-4900		CE	Alpine
140.		*Sorbus cuspidata* (Spach.) Hedlund	Sor cus	Rosaceae		Tree		+	1.775	2700-3700		WCE	Temperate -Alpine
141.	Gaga, Byash, Darchula	*Sorbus microphylla* Wenzig	Sor mic	Rosaceae		Tree		+	1.973	300-4500		WCE	Tropical-Alpine
142.		*Spirea canescens* D.Don	Spi can	Rosaceae		Shrub		+	1.846	1500-3200		WCE	Tropical-Temperate
143.		*Stelleria media* (L.) Vill.	Ste med	Caryophyllaceae		Herb		+	1.047	1800-2700		WC	Temperate -Alpine
144.		*Thymus linearis* Benth.	Thy lin	Lamiaceae		Herb		+	1.405	2400-4500		WC	Temperate -Alpine
145.	Budi, Byash, Darchula	*Trillidium govanianum* (D.Don) Kunth.	Tri gov	Melanthiaceae		Herb		+	0.947	2700-4000		WCE	Temperate -Alpine
146.		*Tsuga dumosa* (D.Don) Eichler	Tsu dum	Pinaceae		Tree		+	11.906	2100-3600		WCE	Temperate -Alpine
147.		*Verbascum thapsus* L.	Ver tha	Scrophulariaceae		Herb		+	0.851	1800-4000	Himalayan Endemic	WCE	Temperate -Alpine
148.		*Viburnum cotonifolium* D.Don	Vib cot	Adoxaceae		Shrub		+	1.663	2100-3600	Himalayan Endemic	WC	Temperate -Alpine
149.		*Asplenium yoshinagae* Makino	Asp yos	Aspleniaceae		Herb	+		0.613	600-2700			Tropical-Temperate
150.	Sribhabar, Chaukham	*Aristolochia griffithii* Hook.f. & Thomson ex Duch.	Ars grf	Aristolochiaceae		Climber	+		0.613	2000-2900		CE	Temperate
151.	Sribhabar, Chaukham	*Botrychium lanuginosum* Wall. ex Hook. & Grev.	Bot lan	Ophioglossaceae		Herb	+		0.947	1000-3000			Tropical-Temperate
152.		*Cardiocrinum giganteum* (Wall.) Makina	Car gi	Liliaceae		Herb	+		0.851	1800-3000		WCE	Temperate -Alpine
153.	Rodigad, Gajari, Baitadi	*Cornus capitata* Wall.	Cor cap	Cornaceae		Tree	+		3.994	2100-3400		WC	Temperate -Alpine

154.	Sribhabar, Chaukham	*Cyrtomium anomophyllum* Fraser-Jenk.	Cyr ano	Dryopteridaceae		Herb	+		1.233	1700-2800			Tropical-Temperate
155.		*Daphniphyllum himalense* (Benth.) Müll. Arg.	Dap him	Daphniphyllaceae		Tree	+		2.180	1400-2300		E	Tropical-Temperate
156.		*Dichroa febrifuga* Lour.	Dic feb	Hydrangeaceae		Shrub	+		0.507	900-2400		CE	Tropical-Temperate
157.		*Dryopteris cochleata* (D. Don) C. Chr.	Dry coc	Dryopteridaceae		Herb	+		2.283	1200-1600			Tropical
158.	Kurjeneta, Gajari, Baitadi	*Elatostema sessile* J.R.Forst. & G.Forst.	Ela ses	Urticaceae		Herb	+		3.818	2500-3000		E	Temperate
159.		*Elsholtzia flava* (Benth.) Benth.	Els fla	Lamiaceae		Herb	+		1.0904	1900-2700		CE	Temperate
160.		*Erigeron karvinskianus* DC.	Eri kar	Asta		Herb	+		2.185	2100-3800		WCE	Temperate -Alpine
161.	Paharal CF, Chaukham	*Eriobotrya elliptica* Lindl.	Eri ell	Rosaceae		Tree	+		3.530	2100-2500		WCE	Temperate
162.	Kurjeneta, Gajari	*Eurya accuminata* DC.	Eur acc	Pentaphylacaceae		Tree	+		7.469	1300-2500		WCE	Tropical-Temperate
163.		*Garuga pinnata* Roxb.	Gar pin	Burseraceae		Tree	+		10.057	300-1200		WCE	Tropical
164.		*Holboellia latifolia* Wall.	Hol lat	Lardizabalaceae		Climber	+		1.047	1600-3000		CE	Temperate
165.		*Hypericum oblongofolium* Choisy	Hyp obl	Hypericaceae		Shrub	+		2.33	800-2100		WC	Tropical-Temperate
166.		*Ilex depyrena* Wall.	Ile dep	Aquifoliaceae		Tree	+		13.348	2500-3000		WCE	Temperate
167.		*Ilex excelsa* (Wall.) Voigt	Ile exe	Aquifoliaceae		Tree	+		8.678	600-2100		C	Tropical-Temperate
168.		*Indigofera heterantha* Brandis	Ind het	Fabaceae		Shrub	+		1.090	600-1300		WC	Tropical
169.		*Inula cappa* (Buch.-Ham. ex D.Don) DC.	Inu cap	Asteraceae		Herb	+		0.947	150-2500		WCE	Tropical-Temperate
170.		*Justicia adhatoda* L.	Jus adh	Acanthaceae		Shrub	+		4.829	500-1600		WCE	Tropical
171.		*Lindera neesiana* (Wall. ex Nees) Kurz	Lin nee	Lauraceae		Tree	+		14.865	1800-2700		CE	Temperate -Alpine
172.	Kurjeneta	*Litsea doshia* (D.Don) Kosterm.	Lit dos	Lauraceae		Tree	+		5.809	1300-2700		CE	Tropical-Temperate
173.		*Machilus duthiei* King	Mac dut	Lauraceae		Tree	+		5.916	1000-2900	Himalayan Endemic	WCE	Tropical-Temperate
174.		*Mahonia napaulensis* DC.	Mah nap	Berberidaceae		Shrub	+		2.703	2000-2900		WCE	Temperate
175.	Paharal CF, Chaukham	*Myrsine africana* L.	Myr afr	Primulaceae		Tree	+		2.999	1200-2300		WC	Tropical-Temperate
176.		*Olea paniculata* R.Br.	Ole pan	Oleaceae		Tree	+		2.9265	500-1400		WC	Tropical
177.		*Osyris lanceolata* Hochst. & Steud.	Osy lan	Santalaceae		Tree	+		2.429	1100-2600		CE	Tropical-Temperate
178.		*Persicaria capitata* (Buch.-Ham. ex D.Don) H.Gross	Per cap	Polygonaceae		Herb	+		0.851	600-2400		WCE	Tropical-Temperate
179.		*Phoenix sylvestris* (L.) Roxb.	Pho syl	Arecaceae		Shrub	+		0.507	150-1500		W	Tropical
180.		*Pistacia chinensis* Bunge	Pis chi	Anacardiaceae		Tree	+		0.507	1500-2500		W	Tropical-Temperate

181.		*Prunus undulata* Buch.-Ham. ex D. Don	Pru und	Rosaceae		Tree	+		3.028	1500-2100		WCE	Tropical-Temperate
182.	Banjpani, Chaukham	*Pteris cretica* L.	Pte cre	Pteridaceae		Herb	+		1.244	400-3200			Tropical-Temperate
183.		*Pyracantha crenulata* (D. Don) M. Roem.	Pyr cre	Rosaceae		Shrub	+		4.337	1200-2500		WCE	Tropical-Temperate
184.	Bhagawati, Darchula	*Quercus glauca* Thunb.	Qre gla	Fagaceae		Tree	+		3.121	450-3100		WCE	Tropical-Temperate
185.		*Reinwardtia indica* Dumort.	Rei ind	Linaceae		Shrub	+		1.283	300-2300		WCE	Tropical-Temperate
186.		*Rubus paniculatus* Sm.	Rub pan	Rosaceae		Shrub	+		1.100	2100-2900		WCE	Temperate
187.		*Senescio chrysanthemoides* DC.	Sen chr	Asteraceae		Herb	+		0.947	1400-4000		WCE	Tropical-Alpine
188.	Paharal CF, Chaukham	*Skimmia arborescens* T. Anderson ex Gamble	Ski arb	Rutaceae		Shrub	+		0.851	1600-2500		CE	Temperate
189.		*Stephania glabra* (Roxb.) Miers	Ste gla	Menispermaceae		Climber	+		0.947	1000-2500	Pan Himalaya	CE	Tropical-Temperate
190.		*Toricellia tilifolia* DC.	Tor til	Cornaceae		Tree	+		2.188	1600-2500		WC	Temperate
191.		*Wikstroemia cannescens* Meisn.	Wik can	Thymeleaceae		Shrub	+		2.372	1800-3200	Himalayan Endemic	WC	Temperate -Alpine
192.		*Prunus cerasoides* Buch.-Ham. ex D.Don	Pru cer	Rosaceae	+++	Tree				1300-2400	Himalayan Endemic	WCE	Tropical-Temperate
193.		*Ficus religiosa* L.	Fic rel	Moraceae	+++	Tree				150-1500	Pan Himalaya	WCE	Tropical-Temperate
194.		*Neopicrorhiza scrophulariiflora* (Pennell) D.Y.Hong	Neo scr	Plantaginaceae	+++	Herb				3500-4800	Himalayan Endemic	WCE	Temperate -Alpine
195.		*Mangifera indica* L.	Man ind	Anacardiaceae	+++	Tree				100-700	Broadly distributed	WCE	Tropical
196.		*Polygala abyssinica* R.Br. ex Fresen.	Pol aby	Polygalaceae	+++	Shrub				1500-2700	Himalayan Endemic	WC	Tropical-Temperate
197.		*Centella asiatica* (L.) Urb.	Cen asi	Apiaceae	+++	Herb				500-2100	Broadly distributed	WCE	Tropical-Temperate
198.		*Dactylorhiza hatagirea* (D. Don) Soo	Dac hat	Orchidaceae	+++	Herb				2800-4000	Himalayan Endemic	WCE	Temperate -Alpine
199.		*Allium wallichii* Kunth	All wal	Amaryllidaceae	+++	Herb				2400-4650	Himalayan Endemic	WCE	Temperate -Alpine
200.		*Cuscuta reflexa* Roxb.	Cus ref	Convolvulaceae	+++	Shrub				1100-3100	Pan Himalaya	WCE	Tropical-Temperate
201.		*Desmostachys bipinnata* (L.) Stapf.	Des bip	Poaceae	+++	Herb				200-500	Pan Himalaya	CE	Tropical-Temperate
202.		*Ophiocordyceps sinensis* (Berk.) G.H.Sung	Oph sin	Ophiocordycipitaceae	+++	Herb				3000-4200	Himalayan Endemic	WCE	Temperate -Alpine
203.		*Shorea robusta* Geartn.	Sho rob	Dipterocarpaceae	+++	Tree				150-1500	Himalayan Endemic	WCE	Tropical-Temperate
204.		*Syzygium cumini* (L.) Skeels	Syz cum	Myrtaceae	+++	Tree				300-1200	Pan Himalaya	WCE	Tropical-Temperate
205.		*Aralia cachemirica* Decne.	Ara cac	Araliaceae	+++	Herb				2400-4200	Himalayan Endemic	WCE	Temperate -Alpine
206.		*Didymocarpus albicalyx* C.B. Clarke	Did alb	Gesneriaceae	+++	Herb				1200-1800	Himalayan Endemic	E	Tropical-Temperate
207.		*Perilla frutescens* (L.) Britton	Per fru	Lamiaceae	+++	Herb				600-2400	Himalayan Endemic	WCE	Tropical-Temperate

208.		*Diploknema butyracea* (Roxb.) H.J.Lam	Dip but	Sapotaceae	+++	Tree				200-1500	Pan Himalaya	CE	Tropical-Temperate
209.		*Imperata cylindrica* (L.) Raeusch.	Imp cyl	Poaceae	+++	Herb				700-2400	Himalayan Endemic	WCE	Tropical-Temperate
210.		*Terminalia chebula* Retz.	Ter che	Combretaceae	+++	Tree				150-1100	Pan Himalaya	CE	Tropical-Temperate
211.		*Acorus calamus* L.	Aco cal	Acoraceae	+++	Herb				100-2300	Broadly distributed	WCE	Tropical-Temperate
212.		*Bauhinia purpurea* L.	Bau pur	Fabaceae	+++	Tree				300-1600	Himalayan Endemic	WCE	Tropical-Temperate
213.		*Carum carvi* L.	Car	Apiaceae	+++	Herb				2500-5100	Himalayan Endemic	WC	Temperate -Alpine
214.		*Grewia optiva* J.R. Drumm. ex Burret	Gre opt	Malvaceae	+++	Tree				150-1800	Himalayan Endemic	W	Tropical-Temperate
215.		*Nardostachys grandiflora* DC.	Nar gra	Caprifoliaceae	+++	Herb				3200-5000	Himalayan Endemic	WCE	Temperate -Alpine
216.		*Rheum australe* D.Don	Rhe aus	Polygonaceae	+++	Herb				3200-4200	Himalayan Endemic	CE	Temperate -Alpine
217.		*Aegle marmelos* (L.) Correa	Aeg mar	Rutaceae	+++	Tree				600-1100	Pan Himalaya	WCE	Tropical-Temperate
218.		*Curcuma angustifolia* Roxb.	Cur ang	Zingiberaceae	+++	Herb				700-1500	Himalayan Endemic	C	Tropical-Temperate
219.		*Eulaliopsis binata* (Retz.) C.E.Hubb.	Eul bin	Poaceae	+++	Herb				150-2600	Himalayan Endemic	WCE	Tropical-Temperate
220.		*Melia azedarach* L.	Mel aze	Meliaceae	+++	Tree				700-1100	Pan Himalaya	WE	Tropical-Temperate
221.		*Cynodon dactylon* (L.) Pers.	Cyn dac	Poaceae	+++	Herb				100-1300	Broadly distributed	WCE	Tropical-Temperate
222.		*Allium prattii* C.H. Wright	All pra	Amaryllidaceae	+++	Herb				2400-4500	Himalayan Endemic	WCE	Temperate -Alpine
223.		*Butea monosperma* (Lam.) Taub	But mon	Fabaceae	+++	Tree				150-1200	Pan Himalaya	WCE	Tropical-Temperate
224.		*Dendrocalamus hamiltonii* Nees& Arn. ex Munro	Den ham	Poaceae	+++	Tree				1000-2000	Himalayan Endemic	WCE	Tropical-Temperate
225.		*Desmodium oojeinense* (Roxb.) H.Ohashi	Des ooj	Fabaceae	+++	Shrub				200-1250	Himalayan Endemic	C	Tropical-Temperate
226.		*Ficus auriculata* Lour.	Fic aur	Moraceae	+++	Tree				250-1700	Himalayan Endemic	C	Tropical-Temperate
227.		*Terminalia alata* Heyne ex Roth	Ter ala	Combretaceae	+++	Tree				200-1400	Pan Himalaya	WCE	Tropical-Temperate
228.		*Ziziphus jujuba* Mill.	Ziz juj	Rhamnaceae	+++	Shrub				200-1200	Broadly distributed	WCE	Tropical-Temperate
229.		*Abrus precatorius* L.	Abr pre	Fabaceae	+++	Shrub				300-1100	Broadly distributed	WE	Tropical-Temperate
230.		*Aloe vera* (L.) Burm. f.	Alo ver	Xanthorhoeaceae	+++	Herb				1200-1400	Broadly distributed	W	Tropical-Temperate
231.		*Calotropis gigantea* (L.) Dryand	Cal gig	Apocynaceae	+++	Shrub				100-1000	Pan Himalaya	WCE	Tropical-Temperate
232.		*Cannabis sativa* L.	Can sat	Cannabaceae	+++	Herb				200-2700	Broadly distributed	WCE	Tropical-Temperate
233.		*Castanopsis hystrix* Hook. f. & Thomson ex A. DC.	Cas hys	Fagaceae	+++	Tree				450-2300	Pan Himalaya	WCE	Tropical-Temperate
234.		*Debregeasia longifolia* (Burm.f.) Wedd.	Deb lon	Urticaceae	+++	Tree				1000-2000	Pan Himalaya	WCE	Tropical-Temperate

235.		*Delphinium himalayae* Munz	Del him	Ranunculaceae	+++	Herb				3000-4500	Nepal Endemic	WC	Temperate -Alpine
236.		*Eleusine indica* (L.) Geartn.	Ele ind	Poaceae	+++	Herb				600-2600	Pan Himalaya	WCE	Tropical-Temperate
237.		*Ficus semicordata* Buch.-Ham ex Sm.	Fic sem	Moraceae	+++	Tree				200-1700	Himalayan Endemic	WCE	Tropical-Temperate
238.		*Oroxylum indicum* (L.) Kurz	Oro ind	Bignoniaceae	+++	Tree				400-1400	Pan Himalaya	WCE	Tropical-Temperate
239.		*Selinum wallichianum* (DC.) Raizada & H.O. Saxena	Sel wal	Apiaceae	+++	Herb				2700-3800	Himalayan Endemic	WCE	Temperate -Alpine
240.		*Trichosanthes tricuspidata* Lour.	Tri	Cucurbitaceae	+++	Shrub				1200-2300	Broadly distributed	WCE	Tropical-Temperate
241.		*Achyranthes aspera* L.	Ach asp	Amaranthaceae	+++	Herb				100-2900	Himalayan Endemic	WCE	Tropical-Temperate
242.		*Agave cantala* (Haw.) Roxb. ex Salm-Dyck	Aga can	Asparagaceae	+++	Shrub				1000-2000	Pan Himalaya	W	Tropical-Temperate
243.		*Azadirachta indica* A. Juss.	Aza ind	Meliaceae	+++	Tree				300-1700	Pan Himalaya	CE	Tropical-Temperate
244.		*Bauhinia vahlii* Wight & Arn.	Bau vah	Fabaceae	+++	Shrub				200-1300	Himalayan Endemic	WCE	Tropical-Temperate
245.		*Eryngium foetidum* L.	Ery foe	Apiaceae	+++	Herb				700-1200	Broadly distributed	CE	Tropical-Temperate
246.		*Euphorbia royleana* Bioss.	Eup roy	Euphorbiaceae	+++	Shrub				1100-2100	Himalayan Endemic	WE	Tropical-Temperate
247.		*Ficus benghalensis* L.	Fic ben	Moraceae	+++	Tree				500-1200	Himalayan Endemic	WCE	Tropical-Temperate
248.		*Hydrocotyle javanica* Thunb.	Hyd jav	Apiaceae	+++	Herb				600-2000	Pan Himalaya	WCE	Tropical-Temperate
249.		*Jatropha curcas* L.	Jat cur	Euphorbiaceae	+++	Shrub				500-1200	Broadly distributed	WCE	Tropical-Temperate
250.		*Polygonatum verticillatum* (L.) All	Pol ver	Moringaceae	+++	Tree				3000-4200	Himalayan Endemic	WCE	Temperate -Alpine
251.		*Pouzolzia hirta* (Blume) Hassk.	Pou hir	Urticaceae	+++	Herb				500-2400	Himalayan Endemic	WCE	Tropical-Temperate
252.		*Solanum surattense* Burm.f.	Sol sur	Solanaceae	+++	Shrub				300-900	Pan Himalaya	WCE	Tropical-Temperate
253.		*Viscum album* L.	Vis alb	Santalaceae	+++	Shrub				600-2300	Himalayan Endemic	WC	Tropical-Temperate
254.		*Vitex negundo* L.	Vit neg	Lamiaceae	+++	Shrub				100-1200	Himalayan Endemic	WCE	Tropical-Temperate
255.		*Smilax ferox* Burm.f.	Smi fer	Smilacaceae	+++	Herb				1100-2700	Himalayan Endemic	CE	Tropical-Temperate

+ = Presence, +++ = Species recorded only in ethnobotanical survey, Distrb..= Distribution, W = West Nepal, C = Central Nepal, E = East Nepal

Appendix I. Data of ten environmental and socioeconomic factors for CCA analysis

SN	Quadrat Number	District	Slope (º)	Aspect	Temp. (ºC)	Precip. (cm)	Evapo-transpiration	Aridity	Radiation	Elevation (m asl)	Use pressure	Disturbance	Richness (S)	Diversity (H)	Evenness (E)
1.	Q34	Baitadi	13.86	23.36	15.32	144.1	768.46	1.88	-0.91	2,007	2	1	34	1.47	0.41
2.	Q31	Baitadi	12.05	132.43	15.61	146.6	800.96	1.83	-0.71	1,974	3	2	29	1.40	0.41
3.	Q37	Baitadi	16.17	11.32	13.08	128.5	649.34	1.98	0.55	2,400	2	0	29	1.45	0.43
4.	Q32	Baitadi	11.85	25.24	15.55	145.7	799.33	1.82	-0.68	1,802	2	0	28	1.29	0.38
5.	Q97	Darchula	9.46	180.93	6.11	107.9	459.39	2.35	-0.19	2,100	2	1	26	1.34	0.41
6.	Q86	Darchula	7.39	149.77	4.1	101.2	413	2.45	-0.21	2,450	3	1	26	1.35	0.41
7.	Q84	Darchula	7.39	149.77	4.1	101.2	413	2.45	-0.21	2,490	2	0	26	1.38	0.42
8.	Q33	Baitadi	11.85	25.24	15.55	145.7	799.33	1.82	-0.68	1,825	4	0	25	1.27	0.39
9.	Q22	Baitadi	4.95	17.53	12.81	128	725.08	1.77	0.51	2,505	4	0	25	1.35	0.42
10.	Q1	Darchula	7.01	133.57	3.44	99.1	397.65	2.49	0.01	2,620	4	1	24	1.19	0.37
11.	Q94	Darchula	9.25	170.78	6.09	107.6	460.16	2.34	-0.04	2,215	2	1	24	1.25	0.39
12.	Q27	Darchula	6.54	257.26	5.22	101.3	447.4	2.26	0.35	3,248	4	1	24	1.30	0.41
13.	Q85	Darchula	7.39	149.77	4.1	101.2	413	2.45	-0.21	2,450	2	1	23	1.23	0.39
14.	Q90	Darchula	8.55	163.55	4.56	102.9	420.23	2.45	0.4	2,330	3	1	23	1.25	0.39
15.	Q49	Darchula	4.84	245.48	4.69	99.8	438.96	2.27	-0.81	3,180	3	0	23	1.26	0.40
16.	Q35	Baitadi	8.82	342.13	12.94	128.2	704.63	1.82	0.11	2,401	2	0	23	1.27	0.40
17.	Q29	Baitadi	4.97	48.53	13	128.7	733.41	1.75	0.74	2,232	3	0	23	1.30	0.41
18.	Q48	Darchula	4.84	245.48	4.69	99.8	438.96	2.27	-0.81	3,160	4	0	23	1.34	0.42
19.	Q93	Darchula	10.54	175.83	5.56	106.1	438.54	2.42	-0.55	2,235	2	1	22	1.23	0.40
20.	Q88	Darchula	7.39	149.77	4.1	101.2	413	2.45	-0.21	2,435	3	1	22	1.25	0.40
21.	Q27	Baitadi	15.05	148.74	13.53	131.8	678.2	1.94	-0.32	2,306	3	2	22	1.26	0.40
22.	Q50	Darchula	4.84	245.48	4.69	99.8	438.96	2.27	-0.81	3,170	2	1	22	1.27	0.41
23.	Q83	Darchula	7.01	133.57	3.44	99.1	397.65	2.49	0.68	2,535	2	1	22	1.29	0.41
24.	Q18	Baitadi	9.49	198.05	12.43	126.1	678.41	1.86	0.39	2,680	3	1	22	1.30	0.42
25.	Q47	Darchula	4.88	223.2	4.42	99	431.15	2.3	0.72	3,150	3	0	22	1.31	0.42
26.	Q46	Darchula	4.69	233.45	5.32	101.7	457.9	2.22	-0.97	3,120	3	0	22	1.33	0.43
27.	Q44	Darchula	4.69	233.45	5.32	101.7	457.9	2.22	-0.97	3,105	2	0	22	1.40	0.45
28.	Q63	Darchula	2.03	235.58	5.52	102.4	472.87	2.17	-0.61	3,055	2	0	22	1.41	0.45
29.	Q38	Baitadi	1.49	337.04	12.3	125	721.47	1.73	-0.96	2,546	2	0	21	1.12	0.36
30.	Q24	Baitadi	8.45	145.6	12.52	126.5	689.35	1.84	0.95	2,567	3	0	21	1.24	0.40
31.	Q96	Darchula	9.46	180.93	6.11	107.9	459.39	2.35	-0.19	2,180	2	0	21	1.27	0.41
32.	Q23	Darchula	4	245.17	5.49	102.2	465.28	2.2	-0.69	3,050	3	0	21	1.28	0.42
33.	Q45	Darchula	4.69	233.45	5.32	101.7	457.9	2.22	-0.97	3,100	3	0	21	1.34	0.44
34.	Q40	Darchula	4.69	233.45	5.32	101.7	457.9	2.22	-0.97	3,110	2	1	21	1.38	0.45
35.	Q21	Baitadi	14.15	192.67	13.44	131.6	682.87	1.93	-0.93	2,506	4	0	20	1.10	0.36
36.	Q19	Baitadi	9.49	198.05	12.43	126.1	678.41	1.86	0.39	2,718	3	1	20	1.12	0.37
37.	Q15	Baitadi	4.95	89.37	13.37	131	750.18	1.75	-0.89	2,495	2	1	20	1.15	0.38
38.	Q95	Darchula	9.25	170.78	6.09	107.6	460.16	2.34	-0.04	2,200	2	0	20	1.18	0.39
39.	Q30	Darchula	9.93	324.94	6.55	104.5	470.56	2.22	0.16	3,074	3	0	20	1.19	0.39
40.	Q91	Darchula	10.54	175.83	5.56	106.1	438.54	2.42	-0.55	2,315	3	0	20	1.21	0.40
41.	Q92	Darchula	10.54	175.83	5.56	106.1	438.54	2.42	-0.55	2,240	2	1	20	1.21	0.40
42.	Q39	Baitadi	8.09	39.44	11.79	122.7	661.86	1.85	0.71	2,594	3	0	20	1.24	0.41
43.	Q22	Darchula	4	245.17	5.49	102.2	465.28	2.2	-0.69	3,050	3	1	20	1.25	0.41
44.	Q4	Darchula	7.01	133.57	3.44	99.1	397.65	2.49	0.68	2,742	2	1	20	1.30	0.43
45.	Q72	Darchula	2.56	103.62	5.32	102.5	465.46	2.2	-0.52	3,045	2	0	20	1.30	0.43
46.	Q76	Darchula	4.92	104.1	5.11	102.1	450.71	2.27	0.88	3,020	1	1	20	1.34	0.44
47.	Q42	Darchula	4.69	233.45	5.32	101.7	457.9	2.22	-0.97	3,128	2	1	20	1.37	0.46
48.	Q80	Darchula	7.13	127.45	4.52	101.4	425.22	2.38	0.64	2,985	3	1	20	1.39	0.46

49.	Q70	Darchula	1.03	113.88	5.51	102.7	475.67	2.16	0.96	3,005	2	0	19	1.10	0.37
50.	Q42	Baitadi	8.09	39.44	11.79	122.7	661.86	1.85	0.71	2,849	4	1	19	1.18	0.40
51.	Q55	Darchula	8.19	102.81	4.67	99	425.21	2.33	0.11	3,320	3	0	19	1.20	0.40
52.	Q30	Baitadi	4.95	17.53	12.81	128	725.08	1.77	0.51	2,347	3	0	19	1.20	0.40
53.	Q89	Darchula	8.55	163.55	4.56	102.9	420.23	2.45	0.4	2,420	3	1	19	1.22	0.41
54.	Q71	Darchula	1.03	113.88	5.51	102.7	475.67	2.16	0.96	3,025	2	1	19	1.22	0.41
55.	Q25	Darchula	6.54	257.26	5.22	101.3	447.4	2.26	0.35	3,250	3	0	19	1.25	0.42
56.	Q81	Darchula	7.01	133.57	3.44	99.1	397.65	2.49	0.68	2,570	2	1	19	1.27	0.43
57.	Q53	Darchula	5.56	150.73	3.85	97.3	413.63	2.35	-0.13	3,200	2	0	19	1.35	0.45
58.	Q8	Darchula	7.13	127.45	4.52	101.4	425.22	2.38	0.64	3,044	3	0	19	1.35	0.46
59.	Q59	Darchula	7.73	70.16	5.68	100.8	455.69	2.21	0.98	3,330	2	0	19	1.36	0.46
60.	Q26	Darchula	6.54	257.26	5.22	101.3	447.4	2.26	0.35	3,274	4	1	18	1.05	0.36
61.	Q68	Darchula	4.69	233.45	5.32	101.7	457.9	2.22	-0.97	3,070	3	0	18	1.07	0.37
62.	Q51	Darchula	4.88	223.2	4.42	99	431.15	2.3	0.72	3,150	4	0	18	1.13	0.39
63.	Q21	Darchula	4	245.17	5.49	102.2	465.28	2.2	-0.69	3,040	3	1	18	1.16	0.40
64.	Q24	Darchula	4	245.17	5.49	102.2	465.28	2.2	-0.69	3,066	4	0	18	1.17	0.40
65.	Q20	Baitadi	9.49	198.05	12.43	126.1	678.41	1.86	0.39	2,732	2	1	18	1.17	0.40
66.	Q82	Darchula	7.01	133.57	3.44	99.1	397.65	2.49	0.68	2,540	2	0	18	1.21	0.42
67.	Q61	Darchula	8.19	102.81	4.67	99	425.21	2.33	0.11	3,376	3	0	18	1.22	0.42
68.	Q74	Darchula	2.56	103.62	5.32	102.5	465.46	2.2	-0.52	2,970	2	1	18	1.24	0.42
69.	Q7	Darchula	7.13	127.45	4.52	101.4	425.22	2.38	0.64	2,788	2	2	18	1.28	0.44
70.	Q6	Darchula	7.35	141.04	4.92	103.1	435.26	2.37	-0.14	2,741	2	0	18	1.30	0.45
71.	Q9	Darchula	4.75	138.56	5.39	103.2	459.49	2.25	-0.79	3,093	2	1	18	1.32	0.45
72.	Q75	Darchula	4.92	104.1	5.11	102.1	450.71	2.27	0.88	2,975	1	0	18	1.35	0.46
73.	Q12	Darchula	4.48	117.54	5.14	102.5	453.23	2.26	0.82	3,234	2	0	18	1.35	0.46
74.	Q52	Darchula	4.88	223.2	4.42	99	431.15	2.3	0.72	3,155	4	0	18	1.36	0.47
75.	Q66	Darchula	2.03	235.58	5.52	102.4	472.87	2.17	-0.61	3,060	3	1	17	1.00	0.35
76.	Q34	Darchula	11.89	311.93	7.71	106.6	494.62	2.16	0.83	3,184	2	2	17	1.10	0.39
77.	Q23	Baitadi	8.45	145.6	12.52	126.5	689.35	1.84	0.95	2,584	4	0	17	1.11	0.39
78.	Q87	Darchula	7.39	149.77	4.1	101.2	413	2.45	-0.21	2,440	2	1	17	1.17	0.41
79.	Q41	Darchula	3.1	234.96	5.45	102.1	467.04	2.19	-0.26	3,325	2	1	17	1.18	0.41
80.	Q39	Darchula	7.12	235.14	4.85	100.2	434.68	2.31	0.07	3,300	4	1	17	1.19	0.42
81.	Q33	Darchula	11.89	311.93	7.71	106.6	494.62	2.16	0.83	3,200	3	0	17	1.24	0.44
82.	Q77	Darchula	4.92	104.1	5.11	102.1	450.71	2.27	0.88	3,075	2	1	17	1.29	0.45
83.	Q43	Darchula	4.69	233.45	5.32	101.7	457.9	2.22	-0.97	3,119	3	0	17	1.30	0.45
84.	Q11	Baitadi	15.95	215.1	12.72	126.6	637.89	1.98	0.16	2,206	2	2	16	0.98	0.35
85.	Q6	Baitadi	12.79	193.57	16.63	154.9	844	1.84	-0.48	2,137	2	1	16	0.99	0.35
86.	Q16	Baitadi	12.93	197.94	13.39	131	691.36	1.89	-0.53	2,499	3	0	16	1.00	0.36
87.	Q62	Darchula	2.03	235.58	5.52	102.4	472.87	2.17	-0.61	3,050	2	1	16	1.01	0.36
88.	Q25	Baitadi	15.05	148.74	13.53	131.8	678.2	1.94	-0.32	2,504	4	0	16	1.01	0.36
89.	Q1	Baitadi	4.95	89.37	13.37	131	750.18	1.75	-0.89	2,269	3	1	16	1.08	0.39
90.	Q17	Baitadi	12.93	197.94	13.39	131	691.36	1.89	-0.53	2,553	2	1	16	1.08	0.39
91.	Q13	Baitadi	16.51	209.24	14.24	136.1	694	1.96	-0.12	2,214	3	0	16	1.10	0.39
92.	Q69	Darchula	1.03	113.88	5.51	102.7	475.67	2.16	0.96	3,120	3	0	16	1.11	0.40
93.	Q36	Darchula	8.55	286.35	8.4	108.1	536.13	2.02	-0.85	3,237	3	1	16	1.17	0.42
94.	Q5	Darchula	7.16	129.15	3.99	100.4	411.1	2.44	-0.46	2,750	4	1	16	1.21	0.43
95.	Q38	Darchula	7.12	235.14	4.85	100.2	434.68	2.31	0.07	3,400	4	1	16	1.23	0.44
96.	Q64	Darchula	2.03	235.58	5.52	102.4	472.87	2.17	-0.61	3,058	2	1	16	1.24	0.45
97.	Q32	Darchula	9.93	324.94	6.55	104.5	470.56	2.22	0.16	3,210	3	2	16	1.25	0.45
98.	Q54	Darchula	8.19	102.81	4.67	99	425.21	2.33	0.11	3,110	2	1	16	1.27	0.46
99.	Q10	Baitadi	15.95	215.1	12.72	126.6	637.89	1.98	0.16	2,216	3	0	15	0.93	0.34
100.	Q43	Baitadi	8.09	39.44	11.79	122.7	661.86	1.85	0.71	2,847	4	0	15	0.94	0.34
101.	Q26	Baitadi	15.05	148.74	13.53	131.8	678.2	1.94	-0.32	2,363	3	1	15	0.96	0.35

102.	Q14	Baitadi	16.51	209.24	14.24	136.1	694	1.96	-0.12	2,268	4	1	15	0.96	0.35
103.	Q36	Baitadi	16.17	11.32	13.08	128.5	649.34	1.98	0.55	2,377	3	1	15	0.96	0.35
104.	Q67	Darchula	2.03	235.58	5.52	102.4	472.87	2.17	-0.61	3,065	3	0	15	0.98	0.36
105.	Q41	Baitadi	8.09	39.44	11.79	122.7	661.86	1.85	0.71	2,830	4	1	15	0.98	0.36
106.	Q20	Darchula	2.03	235.58	5.52	102.4	472.87	2.17	-0.61	3,050	4	1	15	1.01	0.37
107.	Q58	Darchula	8.52	27.17	6.74	102.8	483.1	2.13	0.17	3,400	3	0	15	1.02	0.37
108.	Q8	Baitadi	15.95	215.1	12.72	126.6	637.89	1.98	0.16	2,235	2	0	15	1.04	0.38
109.	Q28	Baitadi	15.05	148.74	13.53	131.8	678.2	1.94	-0.32	2,273	3	1	15	1.06	0.39
110.	Q31	Darchula	15.37	280.86	5.79	102.6	419.22	2.45	-0.58	3,127	3	1	15	1.09	0.40
111.	Q44	Baitadi	13.66	228.07	12.73	127.2	657.86	1.93	0.32	2,760	4	0	15	1.14	0.42
112.	Q60	Darchula	8.19	102.81	4.67	99	425.21	2.33	0.11	3,320	2	1	15	1.19	0.43
113.	Q78	Darchula	4.48	117.54	5.14	102.5	453.23	2.26	0.82	3,140	2	1	15	1.19	0.44
114.	Q73	Darchula	2.56	103.62	5.32	102.5	465.46	2.2	-0.52	2,980	3	0	15	1.20	0.44
115.	Q14	Darchula	4.69	233.45	5.32	101.7	457.9	2.22	-0.97	3,094	3	1	15	1.21	0.44
116.	Q11	Darchula	4.48	117.54	5.14	102.5	453.23	2.26	0.82	3,241	3	0	15	1.23	0.45
117.	Q56	Darchula	7.73	70.16	5.68	100.8	455.69	2.21	0.98	3,379	3	1	15	1.25	0.46
118.	Q18	Darchula	2.03	235.58	5.52	102.4	472.87	2.17	-0.61	3,304	2	1	15	1.27	0.46
119.	Q40	Baitadi	8.09	39.44	11.79	122.7	661.86	1.85	0.71	2,718	3	1	14	0.92	0.35
120.	Q29	Darchula	6.54	257.26	5.22	101.3	447.4	2.26	0.35	3,150	3	1	14	0.97	0.36
121.	Q65	Darchula	2.03	235.58	5.52	102.4	472.87	2.17	-0.61	3,030	3	1	14	1.09	0.41
122.	Q57	Darchula	8.52	27.17	6.74	102.8	483.1	2.13	0.17	3,664	2	1	14	1.09	0.41
123.	Q4	Baitadi	4.95	89.37	13.37	131	750.18	1.75	-0.89	2,406	2	1	14	1.11	0.42
124.	Q13	Darchula	4.48	117.54	5.14	102.5	453.23	2.26	0.82	3,186	2	1	14	1.13	0.43
125.	Q37	Darchula	7.12	235.14	4.85	100.2	434.68	2.31	0.07	3,450	3	1	14	1.14	0.43
126.	Q16	Darchula	4.69	233.45	5.32	101.7	457.9	2.22	-0.97	3,180	3	1	14	1.20	0.45
127.	Q5	Baitadi	16.51	209.24	14.24	136.1	694	1.96	-0.12	2,134	3	0	13	0.95	0.37
128.	Q17	Darchula	4.69	233.45	5.32	101.7	457.9	2.22	-0.97	3,240	2	1	13	1.16	0.45
129.	Q9	Baitadi	15.95	215.1	12.72	126.6	637.89	1.98	0.16	2,228	3	0	12	0.77	0.31
130.	Q12	Baitadi	16.51	209.24	14.24	136.1	694	1.96	-0.12	2,193	3	0	12	0.92	0.37
131.	Q7	Baitadi	15.95	215.1	12.72	126.6	637.89	1.98	0.16	2,281	4	0	12	0.92	0.37
132.	Q15	Darchula	4.69	233.45	5.32	101.7	457.9	2.22	-0.97	3,130	3	1	12	1.00	0.40
133.	Q10	Darchula	4.48	117.54	5.14	102.5	453.23	2.26	0.82	3,131	2	1	12	1.05	0.42
134.	Q79	Darchula	4.48	117.54	5.14	102.5	453.23	2.26	0.82	3,210	1	0	12	1.16	0.46
135.	Q2	Baitadi	4.95	89.37	13.37	131	750.18	1.75	-0.89	2,276	3	0	11	0.86	0.36
136.	Q19	Darchula	4	245.17	5.49	102.2	465.28	2.2	-0.69	3,370	2	1	11	0.89	0.37
137.	Q35	Darchula	8.55	286.35	8.4	108.1	536.13	2.02	-0.85	3,210	3	1	11	0.92	0.38
138.	Q2	Darchula	7.01	133.57	3.44	99.1	397.65	2.49	0.68	2,700	3	1	11	0.99	0.41
139.	Q3	Darchula	7.01	133.57	3.44	99.1	397.65	2.49	0.68	2,770	3	1	10	0.97	0.42
140.	Q28	Darchula	6.54	257.26	5.22	101.3	447.4	2.26	0.35	3,160	3	1	9	0.72	0.32
141.	Q3	Baitadi	4.95	89.37	13.37	131	750.18	1.75	-0.89	2,360	3	0	8	0.85	0.41
	Q = quadrat number														

Appendix J. Total 122 useful plant species with their use values

SN	Botanical name	Local name	Voucher code	Family	TUV	MuV	OUV	BUVL	BTUV	DUVL	DTUV	TUVL
1.	*Swertia chirayita* (Roxb.) Buch.-Ham. ex C.B.Clarke	Chiraito, tite	KU 07277, DBU 067	Gentianaceae	0.63	0.60	0.03	1.18	0.65	1.28	0.60	1.22
2.	*Quercus lanata* Sm.	Banj	175-15 KATH	Fagaceae	0.62	0.11	0.51	1.89	1.02	0.16	0.09	1.15
3.	*Bergenia ciliata* (Haw.) Sternb.	Vedaito, silphode, pakhanved, Paduwa	KU 07252 DKU 124	Saxifragaceae	0.61	0.57	0.04	1.23	0.74	0.88	0.44	1.08
4.	*Prunus cerasoides* Buch.-Ham. ex D.Don	Paiyu	RK1201	Rosaceae	0.57	0.04	0.53	1.88	0.82	0.47	0.23	1.27
5.	*Paris polyphylla* Sm.	Satuwa	RK121806	Melanthiaceae	0.54	0.52	0.02	1.00	0.47	1.35	0.63	1.15
6.	*Angelica archangelica* L.	Gannano Chipi, Siwi, Hiwi	KU 07210, RK122101	Apiaceae	0.39	0.37	0.02	0.26	0.16	1.42	0.70	0.76
7.	*Abies pindrow* (Royle ex D.Don) Royle	Salla, Himisin	RK127	Pinaceae	0.35	0.00	0.35	1.26	0.54	0.16	0.09	0.79
8.	*Ficus religiosa* L.	Peepal	RK1217	Moraceae	0.33	0.00	0.33	0.82	0.39	0.49	0.26	0.68
9.	*Chrysopogon aciculatus* (Retz.) Trin.	Salmo	RK105	Poaceae	0.32	0.00	0.32	1.18	0.54	0.05	0.02	0.69
10.	*Neopicrorhiza scrophulariiflora* (Pennell) D.Y.Hong	Katuko, Kutki	DKU 090.	Plantaginaceae	0.32	0.32	0.00	0.04	0.02	1.28	0.72	0.57
11.	*Phyllanthus emblica* L.	Amala	KU 07262 BKU 135	Phyllanthaceae	0.30	0.07	0.23	0.72	0.40	0.23	0.16	0.51
12.	*Mangifera indica* L.	Aanp	RK1211	Anacardiaceae	0.28	0.02	0.26	0.30	0.16	0.81	0.44	0.52
13.	*Polygala abyssinica* R.Br. ex Fresen.	Luinche	RK1204	Polygalaceae	0.28	0.00	0.28	1.04	0.49	0.00	0.00	0.59
14.	*Centella asiatica* (L.) Urb.	Khochade, Brahmi, Pitmar	KU 07276 DBU 006	Apiaceae	0.27	0.26	0.01	0.60	0.42	0.16	0.07	0.41
15.	*Myrica esculenta* Buch.-Ham. ex D. Don	Kafal	KU 567/00	Myricaceae	0.24	0.08	0.16	0.70	0.37	0.07	0.07	0.43
16.	*Dactylorhiza hatagirea* (D. Don) Soo	Panchaunle, Hathajadi	R 126, RK 122	Orchidaceae	0.23	0.23	0.00	0.00	0.00	1.00	0.53	0.43
17.	*Juglans regia* L.	Okhar	KU 07272, DBU 099	Juglandaceae	0.23	0.10	0.13	0.58	0.28	0.30	0.16	0.46
18.	*Valeriana jatamansii* Jones	Simme, Sugandhwal, Samayo	KU 07279, DKU 084, RK112413	Caprifoliaceae	0.23	0.21	0.02	0.53	0.33	0.19	0.09	0.38
19.	*Zanthoxylum armatum* DC.	Timur	KU 07291 DKU 069	Rutaceae	0.23	0.16	0.07	0.26	0.19	0.49	0.28	0.36
20.	*Artemisia indica* Willd.	Kurjo	KU 07214	Asteraceae	0.22	0.10	0.12	0.33	0.19	0.53	0.26	0.42
21.	*Allium wallichii* Kunth	Ban lasun Dum, Sir, Sekwa, Ganrani	RK117	Amaryllidaceae	0.20	0.19	0.00	0.00	0.00	0.95	0.47	0.41
22.	*Pinus roxburghii* Sarg.	Sallo resin	RK1206	Pinaceae	0.20	0.05	0.15	0.47	0.30	0.16	0.07	0.34
23.	*Rhododendron arboreum* Sm.	Gurans	DBU 063	Ericaceae	0.20	0.07	0.13	0.47	0.30	0.14	0.07	0.33
24.	*Cinnamomum tamala* (Buch.-Ham.) T.Nees & Eberm.	Dalchini, Tejpat	KU 07215 BBU 095	Lauraceae	0.18	0.09	0.09	0.04	0.04	0.47	0.37	0.22
25.	*Cuscuta reflexa* Roxb.	Akasbeli	KU 07265, BKU 053	Convolvulaceae	0.17	0.16	0.01	0.23	0.19	0.26	0.14	0.24
26.	*Quercus semecarpifolia* Sm.	Khasru, Tikso	RK 112408	Fagaceae	0.17	0.00	0.17	0.61	0.30	0.00	0.00	0.35
27.	*Toona serrata* (Royle) M Roem.	Dallo	RK 112207	Meliaceae	0.17	0.00	0.17	0.61	0.30	0.00	0.00	0.35
28.	*Alnus nepalensis* D.Don	Uttis	RK 114	Betulaceae	0.15	0.01	0.14	0.42	0.25	0.02	0.02	0.25
29.	*Desmostachys bipinnata* (L.) Stapf.	Kush	KU 07268	Poaceae	0.15	0.01	0.14	0.21	0.11	0.42	0.21	0.30
30.	*Ophiocordyceps sinensis* (Berk.) G.H.Sung	Yartsagumba	KU 07241	Ophiocordycipitaceae	0.15	0.15	0.00	0.00	0.00	0.72	0.35	0.31
31.	*Cirsium verutum* (D.Don) Spreng.	Thakailo	KU 07222	Asteraceae	0.14	0.12	0.02	0.33	0.25	0.00	0.00	0.19

32.	*Rubus ellipticus* Sm.	Aisedu	183-15 KATH	Rosaceae	0.13	0.12	0.01	0.26	0.19	0.05	0.05	0.17
33.	*Shorea robusta* Geartn.	Sal	RK 112205	Dipterocarpaceae	0.13	0.00	0.13	0.49	0.21	0.07	0.02	0.31
34.	*Syzygium cumini* (L.) Skeels	Jamuno	KU 07283, BBU 085	Myrtaceae	0.13	0.04	0.09	0.21	0.14	0.19	0.12	0.20
35.	*Urtica dioica* L.	Sisnu med	KU 07290	Urticaceae	0.13	0.11	0.02	0.23	0.14	0.19	0.12	0.21
36.	*Drepanostachyum falcatum* (Nees) Keng f.	Nigalo	RK 109	Poaceae	0.12	0.00	0.12	0.40	0.21	0.00	0.00	0.23
37.	*Aralia cachemirica* Decne.	Panchpate	RK 110	Araliaceae	0.11	0.11	0.00	0.14	0.09	0.23	0.14	0.18
38.	*Didymocarpus albicalyx* C.B. Clarke	Kumkum, Pathhar dhud	KU 07216	Gerneriaceae	0.11	0.10	0.01	0.26	0.14	0.12	0.07	0.20
39.	*Perilla frutescens* (L.) Britton	Bhangkhaper	RK1208	Lamiaceae	0.11	0.11	0.00	0.19	0.19	0.00	0.00	0.11
40.	*Asparagus racemosus* Willd.	Kurilo, Jhirjhikado	KU 07221, BBU 065	Asparagaceae	0.10	0.08	0.02	0.18	0.12	0.12	0.07	0.15
41.	*Diploknema butyracea* (Roxb.) H.J.Lam	Chiuri	KU 07225	Sapotaceae	0.10	0.00	0.10	0.30	0.14	0.05	0.05	0.19
42.	*Imperata cylindrica* (L.) Raeusch.	Siru	RK1213	Poaceae	0.10	0.01	0.09	0.23	0.18	0.00	0.00	0.13
43.	*Taxus contorta* Griff.	Lothsalla	KU 99/00, RK 111, RK121808	Taxaceae	0.10	0.04	0.06	0.33	0.14	0.05	0.05	0.21
44.	*Terminalia chebula* Retz.	Harro	KU 07278, BKU 068	Combretaceae	0.10	0.08	0.02	0.19	0.14	0.05	0.05	0.13
45.	*Aconogonum rumicifolium* Hara	Khyakjadi, Chadule, Chaunle	RK 118	Polygonaceae	0.09	0.08	0.01	0.05	0.04	0.19	0.16	0.11
46.	*Aesculus indica* (Wall. ex Cambess.) Hook	Pangar	KU 563/00	Sapindaceae	0.09	0.05	0.04	0.23	0.14	0.02	0.02	0.14
47.	*Juniperus indica* Bertol.	Dhupi Chamar, Pama	RK113	Cupressaceae	0.09	0.04	0.05	0.00	0.00	0.53	0.21	0.23
48.	*Rubia wallichiana* Decne.	Mijitthi	RK121902	Rubiaceae	0.09	0.07	0.02	0.16	0.16	0.00	0.00	0.09
49.	*Acorus calamus* L.	Bojho	KU 07234, BKU 176	Acoraceae	0.08	0.08	0.00	0.07	0.05	0.23	0.12	0.14
50.	*Bauhinia purpurea* L.	Koiralo	KU 07249	Fabaceae	0.08	0.05	0.03	0.18	0.09	0.09	0.07	0.14
51.	*Carum carvi* L.	Kalijira	RK 107	Apiaceae	0.08	0.07	0.01	0.09	0.09	0.07	0.07	0.08
52.	*Grewia optiva* J.R. Drumm. ex Burret	Veyol	RK 1215	Malvaceae	0.08	0.00	0.08	0.19	0.14	0.00	0.00	0.11
53.	*Nardostachys grandoflora* DC.	Balaichan, Jatamasi	KU 07218, DBU 060	Caprifoliaceae	0.08	0.08	0.00	0.00	0.00	0.35	0.19	0.15
54.	*Ocimum gratissimum* L.	Ban tulasi	KU 07200	Lamiaceae	0.08	0.06	0.02	0.19	0.09	0.09	0.07	0.15
55.	*Rheum australe* D.Don	Chulethi, Dolu	RK1200	Polygonaceae	0.08	0.06	0.02	0.00	0.00	0.30	0.19	0.13
56.	*Aegle marmelos* (L.) Correa	Bael	KU 07213 BBU 097	Rutaceae	0.07	0.03	0.04	0.14	0.09	0.09	0.05	0.12
57.	*Berberis asiatica* Roxb. ex DC.	Chutro, Kirmada	DKU 034, RK 112201	Berberidaceae	0.07	0.03	0.04	0.09	0.07	0.09	0.07	0.09
58.	*Calanthe plantaginea* Lindl.	Bishmaro	RK 112204	Orchidaceae	0.07	0.07	0.00	0.19	0.12	0.00	0.00	0.11
59.	*Curcuma angustifolia* Roxb.	Haldo Kalo	KU 07259.	Zingiberaceae	0.07	0.07	0.00	0.11	0.07	0.12	0.07	0.11
60.	*Eulaliopsis binata* (Retz.) C.E.Hubb.	Babiyo	RK 1221	Poaceae	0.07	0.00	0.07	0.14	0.07	0.09	0.07	0.12
61.	*Melia azedarach* L.	Bakaino	RK 1210	Meliaceae	0.07	0.03	0.04	0.04	0.04	0.16	0.12	0.09
62.	*Picris hieracioides* Sibth. & Sm.	Ratpate Picris	RK 122403	Asteraceae	0.07	0.05	0.02	0.21	0.11	0.02	0.02	0.13
63.	*Cynodon dactylon* (L.) Pers.	Dubo	RK 104	Poaceae	0.06	0.04	0.02	0.09	0.09	0.05	0.02	0.07
64.	*Ficus hederacea* Roxb.	Makadbelo	RK 112206	Moraceae	0.06	0.06	0.00	0.25	0.11	0.00	0.00	0.14
65.	*Allium prattii* C.H. Wright	Jimbu	RK 116	Amaryllidaceae	0.05	0.04	0.01	0.00	0.00	0.12	0.12	0.05
66.	*Berberis aristata* DC.	Chutro	RK 121	Berberidaceae	0.05	0.04	0.01	0.05	0.05	0.05	0.05	0.05
67.	*Butea monosperma* (Lam.) Taub	Palans	KU 07205	Fabaceae	0.05	0.00	0.05	0.14	0.09	0.00	0.00	0.08
68.	*Clematis montana* Buch.-Ham ex DC.	Juge belo	132-15 NHM	Ranunculaceae	0.05	0.04	0.01	0.07	0.07	0.05	0.02	0.06
69.	*Cynoglossum zeylanicum* (Vahl) Brand	Bippe kuro, Datiune	RK 103	Boraginaceae	0.05	0.04	0.01	0.07	0.07	0.07	0.02	0.07

70.	*Dendrocalamus hamiltonii* Nees& Arn. ex Munro	Bans	RK 1225	Poaceae	0.05	0.00	0.05	0.00	0.00	0.19	0.12	0.08
71.	*Desmodium oojeinense* (Roxb.) H.Ohashi	Sadan		Fabaceae	0.05	0.00	0.05	0.14	0.09	0.00	0.00	0.08
72.	*Elaeagnus parvifolia* Wall. ex Royla	Mallido	E246	Elaegnaceae	0.05	0.01	0.04	0.09	0.05	0.09	0.05	0.09
73.	*Ficus auriculata* Lour.	Timilo	RK 1219	Moraceae	0.05	0.02	0.03	0.07	0.07	0.07	0.02	0.07
74.	*Ficus palmata* Forssk.	Bedu	BBU 095, 153-15 KATH	Moraceae	0.05	0.04	0.01	0.09	0.09	0.00	0.00	0.05
75.	*Magnolia kisopa* (Buch.-Ham. ex DC.) Figlar	Sirma	RK 1209	Magnoliaceae	0.05	0.00	0.05	0.11	0.04	0.14	0.07	0.12
76.	*Prinsepia utilis* Royle	Hirpa, Dhatelo	KU 07229 BKU 136	Rosaceae	0.05	0.05	0.00	0.00	0.00	0.33	0.12	0.14
77.	*Terminalia alata* Heyne ex Roth	Saj	RK 112206	Combretaceae	0.05	0.00	0.05	0.09	0.07	0.07	0.02	0.08
78.	*Ziziphus jujuba* Mill.	Bayer, Bewari	BKU 082	Rhamnaceae	0.05	0.05	0.00	0.11	0.07	0.02	0.02	0.07
79.	*Abrus precatorius* L.	Ratigedi	KU 07209	Fabaceae	0.04	0.03	0.01	0.07	0.07	0.00	0.00	0.04
80.	*Ageratina adenophora* (Sprengel) R. M. King & H. Rob.	Banmara, Kaloban	RK 120	Asteraceae	0.04	0.04	0.00	0.07	0.04	0.09	0.05	0.08
81.	*Aloe vera* (L.) Burm. f.	Ghiukumari	RK 125	Xanthorhoeaceae	0.04	0.04	0.00	0.07	0.05	0.02	0.02	0.05
82.	*Calotropis gigantea* (L.) Dryand	Aank	KU 07264, BBU 054	Apocynaceae	0.04	0.03	0.01	0.02	0.02	0.07	0.07	0.04
83.	*Cannabis sativa* L.	Bhango	Heng 9806	Cannabaceae	0.04	0.03	0.01	0.02	0.02	0.12	0.07	0.06
84.	*Castanopsis hystrix* Hook. f. & Thomson ex A. DC.	Kataunj	RK 106	Fagaceae	0.04	0.00	0.04	0.09	0.07	0.00	0.00	0.05
85.	*Debregeasia longifolia* (Burm.f.) Wedd.	Githi, Tusare	RK 101	Urticaceae	0.04	0.03	0.01	0.09	0.07	0.00	0.00	0.05
86.	*Delphinium himalayae* Munz	Atis	RK 100	Ranunculaceae	0.04	0.04	0.00	0.00	0.00	0.14	0.09	0.06
87.	*Eleusine indica* (L.) Geartn.	Ban kodo	RK 1223	Poaceae	0.04	0.04	0.00	0.00	0.00	0.21	0.09	0.09
88.	*Ficus semicordata* Buch.-Ham ex Sm.	Khaneu	KU 07286	Moraceae	0.04	0.00	0.04	0.04	0.04	0.12	0.05	0.07
89.	*Girardinia diversifolia* (Link) Friis	Allo	RK 1216	Urticaceae	0.04	0.04	0.00	0.12	0.07	0.00	0.00	0.07
90.	*Lyonia ovalifolia* (Wall.) Drude	Aayer	RK 1212	Ericaceae	0.04	0.02	0.02	0.09	0.07	0.00	0.00	0.05
91.	*Oroxylum indicum* (L.) Kurz	Tata, Faltate, Tatelo	KU 07238 BKU 061	Bignoniaceae	0.04	0.03	0.01	0.14	0.07	0.00	0.00	0.08
92.	*Persea odoratissima* (Nees) Kosterm.	Kaulo, Dhuyun	198-15 KATH	Lauraceae	0.04	0.02	0.02	0.05	0.05	0.02	0.02	0.04
93.	*Pinus wallichiana* A.B. Jacks.	Sallo, Lamesinm	RK 1205	Pinaceae	0.04	0.01	0.03	0.00	0.00	0.19	0.09	0.08
94.	*Rhododendron anthopogon* D. Don	Sunpati Chima	RK 115	Ericaceae	0.04	0.00	0.04	0.00	0.00	0.23	0.09	0.10
95.	*Ribes glaciale* Wall.	Sankhdhar	RK 124	Grossulariaceae	0.04	0.04	0.00	0.04	0.04	0.09	0.05	0.06
96.	*Rumex nepalensis* Spreng.	Halhale	RK 112202	Polygonaceae	0.04	0.03	0.01	0.07	0.05	0.05	0.02	0.06
97.	*Selinum wallichianum* (DC.) Raizada & H.O. Saxena	Bhutksh	RK 112203	Apiaceae	0.04	0.00	0.04	0.00	0.00	0.16	0.09	0.07
98.	*Thalictrum cultratum* Wall.	Peljadi Thalictrum	KU 07284, 107-15-NHM	Ranunculaceae	0.04	0.04	0.00	0.00	0.00	0.12	0.09	0.05
99.	*Trichosanthes tricuspidata* Lour.	Indrayani	RK 112208	Cucurbitaceae	0.04	0.03	0.01	0.04	0.04	0.07	0.05	0.05
100.	*Woodfordia fruticosa* (L.) Kurtz	Dhainro	RK 112209	Lythraceae	0.04	0.04	0.00	0.11	0.07	0.00	0.00	0.06
101.	*Achyranthes aspera* L.	Apamarh	KU 07223, BKU 098	Amaranthaceae	0.03	0.03	0.00	0.09	0.05	0.00	0.00	0.05
102.	*Agave cantala* (Haw.) Roxb. ex Salm-Dyck	Rambans	RK 119	Asparagaceae	0.03	0.01	0.02	0.05	0.05	0.00	0.00	0.03
103.	*Azadirachta indica* A. Juss.	Neem	RK 108	Meliaceae	0.03	0.03	0.00	0.00	0.00	0.09	0.07	0.04
104.	*Bauhinia vahlii* Wight & Arn.	Malu	KU 07240	Fabaceae	0.03	0.00	0.03	0.11	0.05	0.00	0.00	0.06
105.	*Betula utilis* D.Don	Bhojpatra	KU 556/00	Betulaceae	0.03	0.00	0.03	0.00	0.00	0.09	0.07	0.04
106.	*Coriaria nepalensiis* Wall.	Machhaino	KU 07247, RK 112407	Coriariaceae	0.03	0.02	0.01	0.09	0.05	0.00	0.00	0.05
107.	*Eryngium foetidum* L.	Ban Dhaniya	RK1 222	Apiaceae	0.03	0.03	0.00	0.02	0.02	0.07	0.05	0.04

108.	*Euphorbia royleana* Bioss.	Siudi	RK 1220	Euphorbiaceae	0.03	0.03	0.00	0.04	0.04	0.02	0.02	0.03
109.	*Ficus benghalensis* L.	Bar	KU 07287	Moraceae	0.03	0.01	0.02	0.07	0.04	0.05	0.02	0.06
110.	*Ficus neriifolia* Sm.	Dudhilo	RK 1218	Moraceae	0.03	0.00	0.03	0.07	0.04	0.07	0.02	0.07
111.	*Hydrocotyle javanica* Thunb.	Dhapadyo	RK 1214	Apiaceae	0.03	0.03	0.00	0.11	0.05	0.00	0.00	0.06
112.	*Jatropha curcas* L.	Inno	KU 07260, BBU 056	Euphorbiaceae	0.03	0.03	0.00	0.02	0.02	0.05	0.05	0.03
113.	*Phytolacca acinosa* Roxb.	Jarakho, Poke weed	RK 1207	Phytolaccaceae	0.03	0.02	0.01	0.07	0.05	0.00	0.00	0.04
114.	*Polygonatum cirrhifolium* (Wall.) Royle	Khiraunla	RK 1226	Asparagaceae	0.03	0.01	0.02	0.04	0.02	0.09	0.05	0.06
115.	*Polygonatum verticillatum* (L.) All	Setakchini, Khakan	RK 1203	Moringaceae	0.03	0.03	0.00	0.00	0.00	0.14	0.07	0.06
116.	*Pouzolzia hirta* (Blume) Hassk.	Aterno	RK 1202	Urticaceae	0.03	0.03	0.00	0.12	0.05	0.00	0.00	0.07
117.	*Prunus cornuta* (Wall. ex Royle) Steud.	Aaruato	RK 112	Rosaceae	0.03	0.03	0.00	0.00	0.00	0.16	0.07	0.07
118.	*Quercus incana* Bartram	Falant	197-15 KATH, RK 112215	Fagaceae	0.03	0.00	0.03	0.12	0.05	0.00	0.00	0.07
119.	*Solanum surattense* Burm.f.	Kantakari, Jhyaure baigan	DKU 086.	Solanaceae	0.03	0.03	0.00	0.11	0.05	0.00	0.00	0.06
120.	*Taraxacum officinale* var. parvulum Hook. f.	Taraxacum	RK 123	Asteraceae	0.03	0.03	0.00	0.00	0.00	0.14	0.07	0.06
121.	*Viscum album* L.	Ainjedu, Hainjedu	204-15 KATH, NHM -150	Santalaceae	0.03	0.03	0.00	0.07	0.04	0.02	0.02	0.05
122.	*Vitex negundo* L.	Syali	RK 102	Lamiaceae	0.03	0.03	0.00	0.07	0.04	0.07	0.02	0.07

TUV= Total use Value, MuV=medicinal use value, OUV=Others use value, UVL= Use Value (Lawrence), B= Baitadi, D = Darchula

Appendix K. Family IVI, TUV and number of useful species and other species of 255 species

SN	Family	Importance Value Index (IVI)	Total Use Value (TUV)	Number of Species	Number of useful species
1.	Acanthaceae	2.20	0.00	1	0
2.	Acoraceae	0.00	0.28	1	1
3.	Adoxaceae	4.87	0.00	4	0
4.	Amaranthaceae	0.00	0.17	1	1
5.	Amaryllidaceae	0.00	0.50	2	2
6.	Anacardiaceae	2.44	0.53	3	1
7.	Apiaceae	2.61	0.92	8	7
8.	Apocynaceae	0.00	0.20	1	1
9.	Aquifoliaceae	4.69	0.00	2	0
10.	Araliaceae	2.21	0.33	2	1
11.	Arecaceae	0.71	0.00	1	0
12.	Aristolochiaceae	0.78	0.00	1	0
13.	Asparagaceae	2.16	0.40	4	3
14.	Aspleniaceae	0.78	0.00	1	0
15.	Asteraceae	6.83	0.69	13	5
16.	Athyriaceae	1.65	0.00	1	0
17.	Balsaminaceae	1.56	0.00	1	0
18.	Berberidaceae	4.61	0.35	3	2
19.	Betulaceae	5.70	0.42	3	2
20.	Bignoniaceae	0.00	0.20	1	1
21.	Boraginaceae	0.71	0.22	1	1
22.	Burseraceae	3.17	0.22	1	0
23.	Buxaceae	4.27	0.00	2	0
24.	Cannabaceae	1.98	0.20	2	1
25.	Caprifoliaceae	4.09	0.56	4	2
26.	Caryophyllaceae	1.02	0.00	1	0
27.	Celastraceae	1.84	0.00	1	0
28.	Combretaceae	0.00	0.39	2	2
29.	Convolvulaceae	0.00	0.41	1	1
30.	Coriariaceae	1.20	0.17	1	1
31.	Cornaceae	2.49	0.00	2	0
32.	Cucurbitaceae	0.71	0.20	2	1
33.	Cupressaceae	2.78	0.30	2	1
34.	Daphniphyllaceae	1.48	0.00	1	0
35.	Dipsacaceae	1.18	0.00	1	0
36.	Dipterocarpaceae	0.00	0.36	1	1
37.	Dryopteridaceae	1.87	0.00	2	0
38.	Elaegnaceae	3.55	0.22	2	1
39.	Ephedraceae	1.11	0.00	1	0
40.	Equisetaceae	1.04	0.00	1	0
41.	Ericaceae	5.85	0.53	5	3
42.	Euphorbiaceae	0.00	0.24	2	2
43.	Fabaceae	2.38	0.50	9	5

44.	Fagaceae	6.24	0.93	5	4
45.	Gentianaceae	2.43	0.79	2	1
46.	Gesneriaceae	2.39	0.33	2	1
47.	Grossulariaceae	2.31	0.20	1	1
48.	Hydrangeaceae	1.49	0.00	2	0
49.	Hypericaceae	1.53	0.00	1	0
50.	Iridaceae	1.18	0.00	1	0
51.	Juglandaceae	3.75	0.48	1	1
52.	Juncaceae	0.97	0.00	1	0
53.	Lamiaceae	2.95	0.47	7	3
54.	Lardizabalaceae	1.02	0.00	1	0
55.	Lauraceae	7.36	0.47	6	2
56.	Liliaceae	0.92	0.00	1	0
57.	Linaceae	1.13	0.00	1	0
58.	Lythraceae	1.11	0.20	1	1
59.	Magnoliaceae	1.07	0.22	1	1
60.	Malvaceae	0.00	0.28	1	1
61.	Melanthiaceae	1.77	0.73	2	1
62.	Meliaceae	1.88	0.52	3	3
63.	Menispermaceae	1.25	0.00	2	0
64.	Moraceae	1.73	0.77	7	7
65.	Moringaceae	0.00	0.17	1	1
66.	Myricaceae	0.58	0.49	1	1
67.	Myrtaceae	0.00	0.36	1	1
68.	Oleaceae	2.90	0.00	2	0
69.	Onagraceae	0.97	0.00	1	0
70.	Ophiocordycipitaceae	0.00	0.39	1	1
71.	Ophioglossaceae	0.97	0.00	1	0
72.	Orchidaceae	1.57	0.55	3	2
73.	Orobanchaceae	1.47	0.00	1	0
74.	Oxalidaceae	1.08	0.00	1	0
75.	Papaveraceae	1.30	0.00	1	0
76.	Pentaphylacaceae	2.73	0.00	1	0
77.	Phyllanthaceae	0.82	0.55	1	1
78.	Phytolaccaceae	0.71	0.17	1	1
79.	Pinaceae	11.17	0.77	4	3
80.	Plantaginaceae	1.87	0.57	2	1
81.	Poaceae	6.45	0.95	10	8
82.	Polygalaceae	0.00	0.53	1	1
83.	Polygonaceae	2.91	0.46	6	3
84.	Primulaceae	2.97	0.00	3	0
85.	Pteridaceae	1.73	0.00	2	0
86.	Ranunculaceae	3.36	0.36	5	3
87.	Rhamnaceae	0.00	0.22	1	1
88.	Rosaceae	8.83	0.88	20	4
89.	Rubiaceae	2.29	0.30	2	1

90.	Rutaceae	2.36	0.55	4	2
91.	Salicaceae	4.19	0.00	2	0
92.	Santalaceae	1.56	0.17	2	1
93.	Sapindaceae	5.13	0.30	3	1
94.	Sapotaceae	0.00	0.10	1	0
95.	Saxifragaceae	1.46	0.78	2	1
96.	Scrophulariaceae	0.92	0.00	1	0
97.	Smilacaceae	2.23	0.00	2	0
98.	Solanaceae	0.00	0.17	1	1
99.	Taxaceae	3.88	0.32	1	1
100.	Thymeleaceae	4.74	0.00	2	0
101.	Urticaceae	3.37	0.49	6	4
102.	Violaceae	2.77	0.00	1	0
103.	Vitaceae	1.83	0.00	1	0
104.	Xanthorhoeaceae	0.00	0.20	1	1
105.	Zingiberaceae	0.78	0.26	2	1

Appendix L. Socio-economic factors for meta analysis

Code	District	Ethnic Groups	Lang. spoken	Food	Income from Maps (%)	Edu.	Gender	Occup.	Healing practice since (yrs	Age	How long been settled (yrs)	Land	Liv.	Distance Home-Forest (hr)	Distance Home-District center (hr)	Distance home-Health post (hr)	Fam. size	TUR	UU R	OU R	MU R
B16012504	Baitadi	Chettri	1	> 6 months	5	Illiterate	Female	Healer	20	70	150	5	0	1	2	1	9	14	4	3	11
B16112101	Baitadi	Chettri	1	< 6 months	5	Illiterate	Male	Healer	80	90	100	10	5	2	7	3	8	19	2	14	5
DSL10	Darchula	Chettri	1	< 6 months	10	Illiterate	Male	Healer	17	60	50	7	2	0.5	10	1	7	15	2	4	11
DSL25	Darchula	Byashi	1	< 6 months	5	Illiterate	Female	Healer	15	55	50	6	5	1	48	1	7	11	1	5	6
Baitadi163	Baitadi	Chettri	2	< 6 months	10	Illiterate	Female	Healer	30	55	18	5	8	0.5	7	3	4	12	2	9	3
B100674S	Baitadi	Chettri	2	< 6 months	5	Illiterate	Female	Healer	30	62	100	20	8	1	8	1.5	6	18	0	9	9
Baitadi164	Baitadi	Chettri	2	> 6 months	5	Illiterate	Male	Healer	15	63	32	30	10	0.5	7	2	13	18	3	15	3
B150674S	Baitadi	Chettri	2	< 6 months	10	Illiterate	Female	Healer	40	69	100	15	5	0.5	8	1.5	8	13	0	7	6
B050674S	Baitadi	Chettri	2	> 6 months	25	Illiterate	Female	Healer	50	73	150	20	10	1.5	8	1.5	13	15	1	9	6
B16112302	Baitadi	Chettri	2	< 6 months	5	Illiterate	Female	Healer	60	73	200	10	6	1	7	1	7	18	2	12	6
B070674S	Baitadi	Chettri	2	> 6 months	5	Illiterate	Male	Healer	40	74	200	20	9	1.5	8	1.5	13	20	3	11	9
B030674S	Baitadi	Chettri	2	> 6 months	5	Illiterate	Female	Healer	50	75	200	20	13	2	8	1	11	8	0	5	3
B170674S	Baitadi	Chettri	2	> 6 months	20	Illiterate	Female	Healer	45	75	150	8	10	1	8	2	10	16	2	9	7
Baitadi166	Baitadi	Chettri	2	> 6 months	5	Illiterate	Male	Healer	40	82	33	20	9	1	8	3	11	9	3	4	5
B16112404	Baitadi	Dalits	2	< 6 months	10	Illiterate	Male	Healer	50	61	150	15	0	3	7	0.5	9	24	4	13	11
B060674S	Baitadi	Dalits	2	< 6 months	10	Illiterate	Male	Healer	40	68	150	3	5	1.5	8	1.5	7	19	1	11	8
B200674S	Baitadi	Dalits	2	< 6 months	10	Illiterate	Male	Healer	50	78	100	5	5	1	8	2	8	17	2	10	7
DSL15	Darchula	Chettri	2	< 6 months	20	Illiterate	Male	Healer	10	50	50	2	4	1	48	1	6	15	1	6	9
DSL27	Darchula	Brahmin	2	< 6 months	10	Illiterate	Female	Healer	10	56	50	7	2	0.5	1	0.5	7	17	2	6	11
DRI2	Darchula	Chettri	2	< 6 months	10	Illiterate	Male	Healer	50	63	80	2	8	0.5	2	0.5	7	8	3	1	7
DSL12	Darchula	Brahmin	2	< 6 months	10	Illiterate	Female	Healer	30	67	50	1	1	0.5	1	0.5	1	18	1	5	13
DSL20	Darchula	Brahmin	2	> 6 months	10	Illiterate	Female	Healer	65	74	60	12	4	0.5	0.5	0.5	21	17	1	6	11
DRI3	Darchula	Chettri	2	> 6 months	5	Illiterate	Male	Healer	60	84	100	10	10	1	2	0.5	8	14	4	0	14
DST2	Darchula	Brahmin	2	< 6 months	5	Illiterate	Female	Healer	20	90	70	2	1	4	2	2	1	13	6	0	13

DRI6	Darchula	Brahmin	2	< 6 months	5	Illiterate	Female	Healer	0	99	90	2	9	1	1	1	19	12	5	9	3
DSL22	Darchula	Byashi	2	< 6 months	10	Illiterate	Female	Healer	15	55	40	6	2	0.5	48	1	6	11	0	1	10
DSL24	Darchula	Byashi	2	< 6 months	10	Illiterate	Female	Healer	15	56	50	5	7	1	48	1	7	12	0	2	10
DSL21	Darchula	Byashi	2	> 6 months	10	Illiterate	Female	Healer	25	60	50	25	8	1	48	1	14	13	0	3	10
DSL7	Darchula	Byashi	2	< 6 months	5	Illiterate	Female	Healer	50	62	20	4	2	3	48	3	4	9	0	0	9
DSL23	Darchula	Byashi	2	< 6 months	10	Illiterate	Male	Healer	10	62	50	10	4	1	48	1	10	11	0	2	9
DSL11	Darchula	Byashi	2	< 6 months	5	Illiterate	Male	Healer	75	99	100	7	1	1	48	1	7	9	0	2	7
DSL14	Darchula	Byashi	2	< 6 months	10	Illiterate	Female	Healer	50	99	100	5	2	1	48	1	7	12	1	4	8
DSL13	Darchula	Byashi	2	< 6 months	10	Illiterate	Female	Healer	25	100	100	12	4	1	48	1	12	10	1	2	8
DSL6	Darchula	Byashi	2	< 6 months	10	Illiterate	Male	Healer	75	102	100	10	2	1	48	1	23	12	2	4	8
B110674S	Baitadi	Chettri	2	> 6 months	10	Literate	Male	Healer	15	44	100	20	8	1.5	8	1.5	8	19	1	12	7
B160674S	Baitadi	Chettri	2	> 6 months	10	Literate	Male	Healer	15	45	20	15	5	1	8	2	7	17	0	10	7
B16112001	Baitadi	Brahmin	2	< 6 months	5	Literate	Male	Healer	15	46	150	28	4	0.5	7	1.5	6	16	4	14	2
Baitadi167	Baitadi	Brahmin	2	> 6 months	10	Literate	Male	Healer	10	51	200	15	4	0.5	7	0.5	5	15	8	4	11
B180674S	Baitadi	Chettri	2	> 6 months	10	Literate	Male	Healer	15	56	100	15	5	1	8	2	5	17	0	11	6
B010674S	Baitadi	Chettri	2	> 6 months	5	Literate	Male	Healer	30	57	100	15	5	0.5	8	1	8	13	1	7	6
B020674S	Baitadi	Chettri	2	< 6 months	5	Literate	Female	Healer	50	60	100	20	8	1.5	8	1	9	8	1	4	4
B130674S	Baitadi	Chettri	2	< 6 months	5	Literate	Female	Healer	30	61	150	20	6	1.5	8	2	7	18	1	10	8
B16112401	Baitadi	Chettri	2	< 6 months	20	Literate	Male	Healer	10	63	200	10	9	1	7	1	11	21	2	16	5
B080674S	Baitadi	Chettri	2	> 6 months	5	Literate	Male	Healer	30	65	100	20	10	0.5	8	1	7	17	0	9	8
B140674S	Baitadi	Chettri	2	< 6 months	5	Literate	Female	Healer	35	67	150	20	5	1.5	8	1.5	8	16	1	11	5
B040674S	Baitadi	Chettri	2	< 6 months	5	Literate	Male	Healer	50	71	200	15	18	1	8	1	11	14	5	8	6
B16111902	Baitadi	Chettri	2	< 6 months	5	Literate	Male	Healer	10	71	100	40	21	0.5	6	2	21	20	3	18	2
B190674S	Baitadi	Chettri	2	< 6 months	5	Literate	Male	Healer	35	71	50	15	5	1	8	2	8	17	2	11	6
B16012801	Baitadi	Chettri	2	< 6 months	10	Literate	Male	Healer	50	71	100	5	0	0.5	3	1	6	10	2	2	8
B16012502	Baitadi	Brahmin	2	> 6 months	10	Literate	Male	Healer	25	71	100	10	0	1	2	1	7	12	4	0	12
B120674S	Baitadi	Chettri	2	> 6 months	5	Literate	Male	Healer	50	75	150	20	7	0.5	8	2	7	19	1	11	8
B090674S	Baitadi	Chettri	2	> 6 months	10	Literate	Male	Healer	30	77	150	10	9	1.5	8	1.5	8	11	1	8	3
B16111801	Baitadi	Chettri	2	< 6 months	20	Literate	Female	Healer	20	79	70	3	8	2	6	3	12	24	3	18	6

B16102501	Baitadi	Dalits	2	< 6 months	5	Literate	Male	Healer	30	40	100	20	8	1	6	1.5	15	10	2	1	9
DRI5	Darchula	Brahmin	2	< 6 months	5	Literate	Female	Healer	20	42	11	2	0	1	1	1	7	14	7	0	14
DSL18	Darchula	Chettri	2	< 6 months	10	Literate	Male	Healer	25	50	50	12	4	0.5	10	1	5	11	1	3	8
DSL17	Darchula	Chettri	2	< 6 months	10	Literate	Male	Healer	20	51	20	10	2	1	12	1	12	9	0	1	8
DSL26	Darchula	Brahmin	2	< 6 months	5	Literate	Female	Healer	12	63	60	4	1	0.5	1	0.5	11	10	4	3	7
DST1	Darchula	Chettri	2	< 6 months	5	Literate	Male	Healer	60	78	60	16	10	2	4	1	15	16	7	0	16
DSL5	Darchula	Byashi	2	< 6 months	5	Literate	Male	Healer	10	57	20	5	2	0.5	60	1	6	10	2	3	7
DSL16	Darchula	Byashi	2	< 6 months	5	Literate	Male	Healer	20	61	50	5	4	2	48	1	8	13	0	3	10
DHI1	Darchula	Byashi	2	> 6 months	10	Literate	Male	Healer	40	77	200	5	10	1	60	0.5	14	14	5	1	13
DRI9	Darchula	Chettri	3	< 6 months	0	Illiterate	Male	Healer	0	49	100	5	0	1	5	1	6	7	2	2	5
DHI3	Darchula	Byashi	3	< 6 months	5	Illiterate	Female	Healer	25	65	100	10	3	0.5	60	0.5	8	9	4	1	8
DHI2	Darchula	Byashi	3	< 6 months	10	Illiterate	Male	Healer	20	68	38	20	7	0.5	60	0.5	7	8	2	0	8
DHI4	Darchula	Byashi	3	> 6 months	0	Illiterate	Male	Healer	63	85	100	40	24	0.5	60	0.5	9	9	2	1	8
B16111901	Baitadi	Chettri	3	< 6 months	5	Literate	Male	Healer	30	40	150	5	9	0.5	6	2	4	25	3	13	12
B16102502	Baitadi	Chettri	3	< 6 months	5	Literate	Male	Healer	30	46	120	40	6	0.5	6	1.5	10	10	4	0	10
DRI4	Darchula	Brahmin	3	< 6 months	5	Literate	Male	Healer	40	55	20	1	9	1	1	1	6	11	3	2	9
DSL28	Darchula	Chettri	3	< 6 months	10	Literate	Male	Healer	20	57	50	10	2	1	60	1	5	11	1	1	10
DSL2	Darchula	Byashi	3	< 6 months	5	Literate	Male	Healer	50	49	50	5	4	0.5	60	0.5	5	10	2	4	6
DSL4	Darchula	Byashi	3	< 6 months	10	Literate	Male	Healer	0	65	30	7	0	0.5	4	0.5	6	8	2	3	5
DSL1	Darchula	Byashi	3	< 6 months	20	Literate	Male	Healer	0	67	100	20	0	0.5	60	0.5	10	13	2	4	9
DRI7	Darchula	Byashi	3	< 6 months	5	Literate	Male	Healer	0	67	250	5	7	0.5	60	0.5	7	8	3	4	4
DSL19	Darchula	Byashi	3	< 6 months	5	Literate	Female	Healer	16	70	100	5	2	1	60	1	5	9	0	3	6
DRI8	Darchula	Byashi	3	< 6 months	5	Literate	Male	Healer	0	77	200	20	7	0.5	60	0.5	12	8	2	6	2
DSL3	Darchula	Chettri	4	< 6 months	25	Literate	Male	Healer	20	41	20	5	4	0.5	5	1	5	13	2	3	10
B16012507	Baitadi	Chettri	1	< 6 months	5	Illiterate	Female	NonHealer	0	67	100	1	0	0.5	2	1	5	9	1	0	9
B16112301	Baitadi	Chettri	1	< 6 months	0	Illiterate	Female	NonHealer	0	73	150	5	6	1	7	1	6	13	0	8	5
B16112102	Baitadi	Chettri	1	> 6 months	0	Illiterate	Male	NonHealer	0	80	300	40	22	1	8	1	9	20	3	16	4
B16112201	Baitadi	Chettri	1	< 6 months	0	Illiterate	Female	NonHealer	0	85	40	6	7	1	7	2	9	10	1	6	4
B16112502	Baitadi	Chettri	2	< 6 months	0	Illiterate	Male	NonHealer	0	53	120	10	23	0.5	5	1.5	15	19	2	12	7

B16112402	Baitadi	Chettri	2	< 6 months	0	Illiterate	Male	NonHealer	0	65	100	20	9	2	7	0.5	11	23	3	14	9
B16112002	Baitadi	Chettri	2	> 6 months	5	Illiterate	Male	NonHealer	0	74	50	50	14	1	7	1.5	20	13	2	8	5
B16112403	Baitadi	Chettri	2	< 6 months	0	Illiterate	Male	NonHealer	0	88	300	4	3	1	7	1	3	20	1	14	6
B16012501	Baitadi	Chettri	2	> 6 months	5	Illiterate	Male	NonHealer	0	96	100	5	0	1	3	1	6	8	2	1	7
DRI1	Darchula	Chettri	2	< 6 months	5	Illiterate	Female	NonHealer	0	73	50	5	4	1	2	1	5	10	1	6	4
B16111903	Baitadi	Chettri	2	< 6 months	0	Literate	Male	NonHealer	0	65	78	6	5	5	5	2	10	19	3	14	5
B16112202	Baitadi	Chettri	2	< 6 months	0	Literate	Male	NonHealer	0	72	10	8	14	0.5	7	3	11	16	1	10	6
B16012802	Baitadi	Chettri	2	< 6 months	5	Literate	Male	NonHealer	0	73	100	10	0	0.5	3	1	9	22	5	10	12
B16112501	Baitadi	Chettri	2	< 6 months	0	Literate	Male	NonHealer	0	74	70	8	6	1	7	2	7	23	3	17	6
B16112504	Baitadi	Chettri	2	< 6 months	0	Literate	Male	NonHealer	0	74	150	40	4	1	5	1.5	11	9	0	6	3
Baitadi162	Baitadi	Chettri	2	< 6 months	0	Literate	Male	NonHealer	0	75	35	12	9	0.5	7	3	8	14	2	10	4
Baitadi161	Baitadi	Brahmin	2	< 6 months	0	Literate	Male	NonHealer	0	75	50	12	9	0.5	7	2	7	15	1	9	6
B16012503	Baitadi	Brahmin	2	> 6 months	5	Literate	Male	NonHealer	0	78	150	10	0	1	2	1	7	9	2	2	7
B16012506	Baitadi	Brahmin	2	> 6 months	5	Literate	Male	NonHealer	0	84	150	2	0	0.5	2	1	9	10	4	2	8
B16112503	Baitadi	Chettri	3	< 6 months	0	Illiterate	Male	NonHealer	0	77	70	10	0	2	5	2	10	22	3	9	13
Baitadi165	Baitadi	Chettri	3	> 6 months	0	Illiterate	Male	NonHealer	0	79	80	20	7	0.5	8	1	11	11	1	2	9
DSL8	Darchula	Byashi	3	> 6 months	5	Illiterate	Male	NonHealer	0	44	8	40	2	0.5	36	1	5	15	2	5	10
DSL9	Darchula	Byashi	3	< 6 months	10	Literate	Male	NonHealer	0	68	50	7	0	0.5	60	1	5	13	3	3	10

Edu. = education, Fam = Fsmily, Lang. = Language, Liv. = Livestock, Occup. = Occupation,

REFERENCES

Abington, J.B. (1992). *Sustainable livestock production in the mountain agro-ecosystem of Nepal.* Food and Agriculture Organization of the United Nations, Rome.

Acharya, K. (2002). Twenty-four years of community forestry in Nepal. *International Forestry Review* 4(2): 149-156. DOI: 10.1505/IFOR.4.2.149.17447.

Acharya, K., & Dangi, R. (2009). *Case studies on measuring and assessing forest degradation: forest degradation in Nepal: review of data and methods*. FAO Rome, Italy. pp 163.

Acharya, R., Bhattarai, B. Dahal, N., Kunwar, R., Karki, G., & Bhattarai, H. (2015). Governance in community forestry in Nepal through forest certification. *International Forestry Review* 17: 1-9.

Acharya, R.P., Dahal, S., Kunwar, R.M., Sharma, R., & Baral, S. (2015). Medicinal and aromatic plants in far western Nepal: a sustainable livelihood framework. In: Hartmann, M. & Weipert Z. (Eds.), *Biodiversitat und Naturausstattung im Himalaya 5*: 77-82, Germany.

Adnan, M., & Holscher, D. (2011). Diversity and abundance of medicinal plants among different forest-use types of the Pakistani Himalaya. *Economic Botany* 66: 344–356.

Aigbokhan, E.I., & Agianaku, O.F. (2015). Composition, structure and conservation potential of vegetation adjoining a wire-mesh perimeter fence at university of Benin farmsite, Benin city, Nigeria. *Nigerian Journal of Weed Science* 28: 1-39.

Albuquerque, U. P. (2006). Re-examining hypotheses concerning the use and knowledge of medicinal plants a study in the Caatinga vegetation of NE Brazil. *Journal of Ethnobiology and Ethnomedicine* 2(30): 1-10

Albuquerque, U.P. (2005). Introdução à etnobotânica. Rio de Janeiro: *Interciência*.

Albuquerque, U.P., & Lucena, F.P. (2005). Can apparency affect the use of plants by local people in tropical forests? *Intercencia* 30: 506-511.

Albuquerque, U.P., & Lucena, P. (2004) Methods etechicas para coleta de dados. In: Albuquerque, U.P. & Lucena, P. (Eds). *Methods e technicas na Pesquisa ethnobotanica.* NUPEAEA/Livro Rapido, recife pp 37-62.

Albuquerque, U.P., & Oliveira, R.F. (2007). Is the use-impact on native caatinga species in Brazil reduced by the high species richness of medicinal plants? *Journal of Ethnopharmacology* 113: 156-170.

Albuquerque, U.P., Lucena, R.F.P., Cunha, L.V.F.C., & Alves, R.R.N. (2014). *Methods and Techniques in Ethnobiology and Ethnoecology.* Springer Protocols Handbooks. Berlin.

Albuquerque, U.P., Soldati, G.T., Ramos, M.A., Melo, J.G., Medeiros, P.M., Nascimento, A.L.B., & Ferreira, W.S. (2015). The influence of the environment on natural resource use:

evidence of the environment of apparency. In: Albuquerque, U.P., Medeiros, P.M., & Casas, A. (Eds), *Evolutionary Ethnobiology*. Springer International, NY, USA.

Aldunate, C., Armesto, J., Castro, V., & Villagran, C. (1981). Estidio ethnobotanio en una communidad precordillerana de Antofagasta: *Tocoe. Boletin Museo Historia Natural de Chile* 38: 183-223.

Alencar, N.L., Araujo, T.A.S., de Amorim, E.L.C., & Albuquerque, U.P. (2009). Can the apparency hypothesis explain the selection of medicinal plants in an area of caatinga vegetation? A chemical perspective. *Acta Botanica Brasilica* 23(3): 908–909.

Alencar, N.L., Santoro, F.R., & Albuquerque, U.P. (2014). What is the role of exotic medicinal plants in local medical systems? A study from the perspective of utilitarian redundancy. *Brazilian Journal of Pharmacognosy* 24: 506–515.

Alexander, R., & Millington, A. (2000) *Vegetation Mapping: From Patch to Planet.* Chichester, United Kingdom: Wiley.

Alexiades, M.N. (1996). Collecting ethnobotanical data, an introduction to basic concepts and techniques. In: Alexiades, M. N. & Sheldon, J. W. (Eds.), *Selected guidelines for ethnobotanical research: a field manual,* pp 53-94. The New York Botanical Garden, NY.

Alexiades, M.N. (2003). Ethnobotany in the third Millennium: expectations and unresolved issues. *Delpinoa* 45: 15-28.

Alves, R.R.N., & Rosa, I.M.L. (2007). Biodiversity, traditional medicine and public health: where do they meet? *Journal of Ethnobiology and Ethnomedicine* 3:14.

Amatya, G. (2008). Trade and socio-economic attribution of *Cordyceps sinensis* (Berk) Saccardo in Darchula District, Nepal. In: Jha, P.K., Karmacharya, S.B., Chettri, M.K., Thapa, C.B., & Shrestha, B.B. (Eds.), *Medicinal Plants in Nepal: An Anthology of Contemporary Research*, pp 194-202. Ecological Society, Nepal.

Anderson, A.B. & Posey, D.A. (1989). Management of a tropical scrub savanna by the Gorotire Kayapó of Brazil. *Advances in Economic Botany* 7: 159-173.

Anderson, D., Salick, J., Moseley, R.K., & Xiaokun, O. (2005) Conserving the sacred medicine mountains: a vegetation analysis of Tibetan sacred sites in Northwest Yunnan. *Biodiversity and Conservation* 14: 3065-3091.

Anderson, J.R.H., Roach, J.T., & Witmer, R.E.A. (1976). *Land-use and land cover classification system for use with remote sensor data.* United States Government Printing Office: Washington, DC, USA.

ANSAB. (2003). *Market Assessments of Non-Timber Forest Products in Darchula and Baitadi Districts.* Asia Network for Sustainable Agriculture and Bioresouces, Kathmandu, Nepal.

Anyinam, C. (1995). Ecology and ethnomedicine: Exploring links between current environmental crisis and indigenous medical practices. *Social Science and Medicine* 40(3): 321–329.

Araujo, E.L., Araújo, T.A.S., Alencar, N.L., Amorim, E.L.C., & Albuquerque, U.P. (2008) New Approach to Study Medicinal Plants with Tannins and Flavonoids Contents from the Local Knowledge. *Journal of Ethnopharmacology* 120: 72–80.

Aryal, K.P., Poudel, S., Chaudhary, R.P., Chettri, N., Chaudhary, P., Ning, W., & Kotru, R. (2018). Diversity and use of wild and non-cultivated edible plants in the Western Himalaya. *Journal of Ethnobiology and Ethnomedicine* 14: 10. DOI: 10.1186/s13002-018-0211-1.

Aryal, S., Maraseni, T.N., & Cockfield, G. (2014). Sustainability of transhumance grazing systems under socio-economic threats in Langtang, Nepal. *Journal of Mountain Science* 11(4): 1023–1034.

Atkinson, E.T. (1980). *The Himalayan Gazzeter*. Vol III, part I, 400 p, Cosmo publication, Delhi, India.

Atreya, K., Pyakurel, D., Thagunna, K.S., Bhatta, L., Uprety, Y., Chaudhary, R., Oli, B.N., & Rimal, S. (2018). Factors contributing to the decline of traditional practices in communities from the Gwallek-Kedar area, Baitadi, Kailash Sacred Landscape, Nepal. *Environmental Management* DOI: 10.1007/s00267-018-1009-6.

Austin, D.F. (2004). *Florida Ethnobotany*. CRC Press, Boca Raton, US.

Aziz, M.A., Adnan, M., Khan, A.H., Sufyan, M., & Khan, S.N. (2018). Cross-Cultural Analysis of Medicinal Plants commonly used in Ethnoveterinary Practices at South Waziristan Agency and Bajaur Agency, Federally Administrated Tribal Areas (FATA), Pakistan. *Journal of Ethnopharmacology* 210: 443-468.

Bajracharya, D. (1983). Fuel, food of forest: Dilemma in Nepali village. *World Development* 2: 1057-1074.

Balée, W. (1998). *Advances in historical ecology*. New York: Columbia University Press.

Balick, M. (2009). *Ethnobotany of Pohnpei: Plants, People, and Island Culture.* New York Botanical Garden, New York.

Balick, M.J. (1996). Transforming ethnobotany for the new millennium. *Annals of the Missouri Botanical Garden* 83: 58-66.

Balick, M.J., & Cox, P.A. (1996). *Plants, people and culture: the science of ethnobotany*. Scientific American Library, New York.

Begon, M., Towsend, C.R., & Harper, J.L. (2006) *Ecology: from individuals to ecosystems.* Malden: Blackwell publishing.

Begossi, A. (1996). Use of ecological methods in ethnobotany: Diversity indices. *Economic Botany* 50(3): 280–289.

Bennett, B. & Husby, C.E. (2008). Patterns of medicinal plant use: An examination of the Ecuadorian Shuar medicinal flora using contingency table and binomial analyses. *Journal of Ethnopharmacology* 116: 422–430.

Bennett, B. & Prance, G.T. (2000). Introduced plants in the indigenous pharmacopoeia of Northern South America. *Economic Botany* 54: 90–102.

Bennett, B. (2005). Ethnobotany Education, Opportunities, and Needs in the U.S. *Ethnobotany Research & Applications* 3: 113-121.

Bennett, B.C. (1992) Plants and people of the Amazonian rainforests. The role of ethnobotany in sustainable development. *Bioscience* 42: 599-607.

Benz, B., Santana, F., Rosales, J. & Graf, S. (2000). Losing knowledge about plant use in the Sierra de Manatlan Biosphere Reserve, Mexico. *Economic Botany* 54(2): 183–191.

Bernard, R. (1995). *Research methods in anthropology*. Altamira Press, Lanham, MD.

Bernstein, L., Pachauri, R.K., & Reisinger, A. (2008). *Climate change 2007: Synthesis report.* Geneva: Intergovernmental Panel on Climate Change (IPCC), Switzerland.

Bhandari, G. (2013). Effect of Rainfall on the yield of major cereals in Darchula district of Nepal. *International Journal of Environment* 3(1): 205-213.

Bhandari, J.S. (1981). Structure and change among the borderland communities of Kumaon Himalaya. In: Lall, J.S. & Moddie, A.D. (Eds.), *The Himalaya: Aspects of Change*, pp 204-216, Oxford University press, New Delhi.

Bhasin, V. (2007). Medical Anthropology: A Review. *Ethno-Med Journal* 1: 1-20, New Delhi: Kamla Raj.

Bhatt, V.P. (2010). Loss of cultural values: a threat to biodiversity in Uttaranchal Himalaya. *Zoos' Print Journal* 17: 802-806.

Bhatta, D.B. (2003). *Community approaches to natural resources management: Sacred and non-sacred landscapes in Nepal*. Master thesis, Miami University, Oxford, Ohio.

Bhattarai, K., Conway, D., & Yousef, M. (2009). Determinants of deforestation in Nepal's Central development region. *Journal of Environment Management* 91: 471–488.

Bhattarai, K.R. & Vetaas, O.R. (2003). Variation in plant species richness of different life forms along a subtropical elevation gradient in the Himalayas. *Global Ecology and Biogeography* 12: 327-340.

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

Bhattarai, K.R., Maren, I.E., & Chaudhary, R.P. (2011). Medicinal plant knowledge of the Panchase region in the middle hills of the Nepalese Himalaya. *Banko Janakari* 21(2): 31–39.

Bhattarai, K.R., Vetaas, O.R., & Grytness, J.A. (2004). Relationship between plant species richness and biomass in arid sub-alpine grassland of the central Himalayas. Nepal. *Folia Geobotanica* 39: 57–71.

Bhattarai, N.K. (1992). Medical ethnobotany in Karnali zone, Nepal. *Economic Botany* 46(3): 257-261.

Bhuju, U. R., Shakya, P. R., Basnet, T. B, & Shrestha, S. (2007). *Nepal Biodiversity Resource Book: Protected areas, Ramsar sites, and World Heritage sites*. ICIMOD, Kathmandu and Ministry of Environment, Science and Technology, Government of Nepal, Kathmandu.

Billings, W. (1974). Adaptation and Origins of Alpine Plants. *Arctic Alpine Research* 6: 129–142.

Bishop, B.C. (1990). *Karnali under stress: livelihood strategies and seasonal rhythms in a changing Nepal Himalaya.* University of Chicago. p 460.

Bista, S., & Webb, E.L. (2006). Collection and marketing of non-timber forest products in far western hills of Nepal. *Environmental Conservation* 33: 244–255.

Bradford, P. (2018). *Food Security indices for Nepal. International Center for Integrated Mountain Development. Kathmandu, Nepal*. Retrieved from http://geoapps.icimod.org/npfoodsecurity?utm_content=buffer7d3ee&utm_medium=social&utm_source=facebook.com&utm_campaign=buffer.

Bradley, B.A., Blumenthal, D.M., Wilcove, D.S., & Ziska, L.H. (2010). Predicting plant invasions in an era of global change. *Trends in Ecology and Evolution* 25: 310–318.

Brusle, T. (2008). Choosing a destination and work: Migration Strategies of Nepalese Workers in Uttarakhand, Northern India. *Mountain Research and Development* 28: 240-247.

Burlakoti, C., & Kunwar, R.M. (2008). Folk herbal medicines of Mahakali watershed, Nepal. In: Jha, P.K., Karmacharya, S.B., Chettri, M.K., Thapa, C.B., & Shrestha, B.B. (Eds.), *Medicinal Plants in Nepal: An Anthology of Contemporary Research*, pp 187–193. Ecological Society, Nepal.

Bussmann, R.W. (2002). Ethnobotany and biodiversity conservation. In: Ambasht, R.S. & Ambasht, N. K. (Eds.), *Modern Trends in Applied Terrestrial Ecology*, pp 345-362. Kluwer publishers, Dordrecht, The Netherlands.

Bussmann, R.W. (2017). *Twenty-five years of Ethnobotany around the globe – from magic to molecules, conservation and the Nagoya Protocol*. 58th Annual meeting of Society of Economic Botany, June 4-9, 2017, p 20, Braganca, Portugal.

Bussmann, R.W., & Sharon, D. (2006). Traditional medicinal plant use in Northern Peru: tracking two thousand years of healing culture. *Journal of Ethnobiology and Ethnomedicine* 2: 47-10.1186/1746-4269-2-47.

Byg, A., & Balslev, H. (2001). Diversity and use of palms in Zahamena, eastern Madagascar. *Biodiversity and Conservation* 10: 951-970.

Byg, A., Salick, J., & Law, W. (2010). Medicinal plant knowledge among lay people in five eastern Tibet villages. *Human Ecology* 38(2): 177–191.

Byg, A., Vormisto, J., & Balslev, H. (2007). Influence of biodiversity and road access on palm extraction at landscape scale in SE Ecuador. *Biodiversity and Conservation* 16: 631-642. http://dx.doi.org/10.1007/s10531-005-1342-y.

Cameron, M.M. (1996). Biodiversity and medicinal plants in Nepal: involving untouchables in conservation and development. *Human Organization* 55 (1): 84-92.

Cameron, M.M. (1998). *On the Edge of the Auspicious: Gender and Caste in Nepal*. University of Illinois Press, IL.

Cameron, M.M. (2009). Considering Dalits and Political Identity in Imagining a New Nepal: Special issue on Dalits in Nepal. *Himalaya* 27(1-2): 5-18.

Cameron, M.M. (2011). *Trading Health: Biodiversity Conservation, Traditional Medicine, Natures, and the Poor in South Asia*. Anthropology CourseReader. Detroit: Gale.

Campbell, J.G., Shrestha, R.P., & Euphrat, F. (1987). Socio-economic factors in traditional forest use and management: preliminary results from a community forest management in Nepal. *Banko Janakari* 1(4): 45-54.

Case, R.J., Pauli, G.F., & Soejarto, D.D. (2005). Factors in maintaining indigenous knowledge among ethnic communities of Manus island. *Economic Botany* 59(4): 356-365.

CBS. (2013). *Environment Statistics of Nepal*. Central Beaureu of Statistics, Thapathali, Kathmandu. Nepal.

Cetinkaya, G. (2009). Challenges for the maintenance of traditional knowledge in the Satoyama and Satoumi ecosystems, Noto peninsula, Japan. *Human Ecology Review* 16: 27-40.

Chand, P.B., & Wilson, A. (1987). A case study of the development of local forest management in Darchula. *Banko Janakari* 1(4): 20-23.

Chandrashekara, U.M., & Sankar, S. (1998). Ecology and Management of Sacred Groves in Kerala, India. *Forest Ecology and Management* 112: 165-177.

Chaturvedi, O.P., & Singh, J.S. (1986). The structure and function of pine forest in central Himalaya. I: Dry matter dynamics. *Annals of Botany* 60: 237-52.

Chaudhary, R.P., Shrestha, K.K., Jha, P.K., & Bhatta, K. (2010). *Kailash Sacred Landscape Conservation Initiative Feasibility Assessment Report* - Nepal. ICIMOD.

Chawla, A., Rajkumar, S., Singh, K., Lal, B., Singh, R., & Thukral, A. (2008). Plant species diversity along an altitudinal gradient of Bhabha Valley in western Himalaya. *Journal of Mountain Science* 5: 157–77.

Chettri, N., Sharma, E., & Thapa, R. (2009). Long term monitoring using transect and landscape approaches within Hindu Kush Himalayas. In: *Proceedings of the International Mountain Biodiversity Conference,* Sharma E (ed.) Kathmandu, Nepal. pp. 201–208.

Chhetri, P. (2015). *Use of high resolution Digital Globe satellite imagery to map the alpine treeline ecotone of the Nepal Himalaya.* Digital Globe Foundation, USA.

Chhetri, R., & Lodhiyal, L.S. (2008). Collection of Ophiocordyceps sinensis and its implication to rural livelihood and biodiversity conservation: a case of Darchula, Nepal, in: Jha PK, Karmacharya SB, Chettri MK, Thapa CB, Shrestha BB (Eds.), *Medicinal Plants in Nepal: An Anthology of Contemporary Research*, Ecological Society, Nepal: 214-223.

Chhetri, R., & Pandey, T.R. (1992). *Use group forestry in Far Western Region of Nepal: Case studies from Baitadi and Accham.* International Center for Integrated Mountain Development (ICIMOD), Kathmandu, Nepal.

Chinsembu, K.C., Neumbo, J., Likando, M., & Mbangu, A. (2014). An ethnobotanical study of medicinal plants used to treat livestock diseases in Onayena and Katima Mulilo, Namibia. *South African Journal of Botany* 94: 101-107.

Christensen, M., Bhattarai, S., Devkota, S., & Larsen, H.O. (2008). Collection and Use of Wild Edible Fungi in Nepal. *Economic Botany* 62(1): 12-23.

Clarke, R.C. (2007). Traditional cannabis cultivation in Darchula district, Nepal–seed, resin and textiles. *Journal of Industrial Hemp* 12: 19–42.

Cochrane, M. (2003). Fire science for rainforests. *Science* 421: 913–919.

Collins, R., & Jenkins, A. (1996). The impact of agricultural land-use on stream chemistry in the Middle Hills of the Himalayas, Nepal. *Journal of Hydrology* 185(1): 71-86. DOI: 10.1016/0022-1694(95)03008-5.

Cook, F.E.M. (1995). *Economic botany data collection standard*. Royal Botanic Gardens, Kew.

Corvinus, G. (1996). The prehistory of Nepal. *Journal of the Nepal Research Centre* 10: 1-25.

Corvinus, G. (2004). Homo erectus in East and Southeast Asia, and the questions of the age of the species and its association with stone artifacts, with special attention to handaxe-like tooly. *Quaternary International* 117: 141-151.

Cotton, C.M. (1996). *Ethnobotany: Principles and Applications*. John Wiley and Sons, New York.

Dadal, A.S. (2010). *The role of non-timber forest products in income generating activities: A case study of Yartsagumba in Yerkot VDC of Darchula District*. MS thesis, Central Department of Economics, Tribhuvan University, Nepal.

Dalle, S.P., & Potvin, C. (2004). Conservation of useful plants: an evaluation of local priorities from two indigenous communities in eastern Panama. *Economic Botany* 58(1): 38–57.

Davis, A. & Wagner, J.R. (2003). Who Knows? On the Importance of Identifying “Experts” When Researching Local Ecological Knowledge. *Human Ecology* 31: 463-489.

DDO. (2010). *District Development Office profile*. Darchula and Baitadi, Nepal.

Devkota, R. & Karmacharya, S.B. (2003). Documentation in indigenous knowledge of medicinal plants in Gwallek VDC, Baitadi, Nepal. *Botanica Orientalis* 3: 135–143.

DFO. (2008). *District profiles.* District Forest Office, Baitadi and Darchula, Nepal.

DFO. (2015). *Annual progress report of district development committee*. District Development Committee, Khalanga, Darchula.

DFO. (2016). *Annual progress report of District forest office profile*, 51 p. Baitadi, Nepal.

DFO. (2017). *Sigas protected forest, Sigas, Baitadi*. District Forest office, Baitadi, Nepal.

DFRS. (2015). *State of Nepal's Forests*, Vol 5. Department of Forest Research and Survey, Kathmandu.

DNPWC. (2008). *Feasibility Study of Proposed Conservation Area of Api-Nampa Conservation Area in Darchula District.* Department of National Parks and Conservation Area, Kathmandu.

DoF. (2010). *Forest and vegetation types of Nepal.* Department of Forest, Kathmandu.

DoF. (2017). *Community forest database of Nepal.* Community forest division, Department of Forest, Kathmandu, Nepal.

Dullinger, S., Dirnböck, T., & Grabherr, G. (2004). Modeling climate change-driven tree line shifts: relative effects of temperature increase, dispersal and invasibility. *Journal of Ecology* 92: 241-252.

Edwards, D.M. (1996). *Non-timber forest products from Nepal: aspects of the trade in medicinal and aromatic plants.* FORESC Monograph no. 1/96, Department of Forest, Kathmandu.

Ekholm, E.P. (1975). The deterioration of mountain environment. *Science* 189: 764-770.

Ellen, R.F. (1999). Modes of subsistence and ethnobiological knowledge: between extraction and cultivation in Southeast Asia. In: Medin, D. L. & Atran, S. (Eds.), *Folk Biology*. MIT Press, Cambridge, Massachusetts, USA. (ISBN 0262133490).

Elliott, A. (2012). *Botanical exploration of Darchula district, Far West Nepal.* Scottish Rock Garden Club, Royal Botanic Garden Edinburgh, The University of Edinburgh, Edinburgh, UK.

Eriksson, M., Xu, J., Shrestha, A.B., Vaidya, R.A., Nepal, S. & Sandström, K. (2009)*. The changing Himalayas: Impact of climate change on water resources and livelihoods in the Greater Himalayas*. Kathmandu: ICIMOD.

Fadiman, M. (2005). Cultivated food plants: culture and gendered spaces of colonists and the Chachi in Ecuador. *Journal of Latin American Geography* 4(1): 43-57.

Fadiman, M. (2013). Marketing, culture and conservation values of NTFPs: Case study of Afro-Ecuadorian use of Piquigua, *Heteropsis ecuadonrensis* (Araceae). In: Voeks, R. & Rashford J. (Eds). pp 175-194, *African ethnobotany in the Americas*, Springer, New York.

FAO. (2005). *Adaptation of forest ecosystems and the forest sector to climate change*. Forests and Climate Change Working Paper No. 2, Food and Agriculture Organization, Rome.

FAO. (2010). *Land cover map of Himalaya region. Global Land Cover Network*. Food and Agriculture Organization, Rome, Italy.

Farnsworth, N.R., & Morris, R.W. (1976). Higher plants – the Sleeping Gian of Drug Development. *The American Journal of Pharmaceutical Education* 148: 46-52.

Farooquee, N.A., & Saxena, K.G. (1996). Conservation and utilization of medicinal plants in high hills of the central Himalayas. *Environmental Conservation* 23: 75-80.

Farooquee, N.A., Samal, P.K., & Saxena, K.G. (1994). Adaptation, culture and sustainability in a high Himalayan society: case of Bhotiyas. *Man and Life* 20: 201-208.

Feeny, P.P. (1976). Plant apparency and chemical defense. In: Wallace JW, ManselL RL (eds.), *Recent Advances in Phytochemistry* 1-40. Plenum Press, New York.

Ferraz, J.S.F., Albuquerque, U.P., & Meunier, I.M.J. (2006). Valor de uso e estrutura da vegetação lenhosa às margens do Riacho do Navio, Floresta, PE, Brasil. *Acta Botanica Brasilica* 20(1): 125-134.

Finerman, R., & Sackett, R. (2003). Using home gardens to decipher health and healing in the Andes. *Medical Anthropology Quarterly* 17(4): 459–482.

Fisher, R.J. (1991). *Studying indigenous forest management system in Nepal: toward a more systematic approach*. 30 p. EAI East West Center, Hawaii.

Folmar, S., Cameron, M., & Pariyar, M. (2015). *Digging for Dalit: Social Justice and an Inclusive Anthropology of Nepal: Hot Spots*, Cultural Anthropology website, October 14, 2015. Retrieved from https://culanth.org/fieldsights/739-digging-for-dalit-social-justice-and-an-inclusive-anthropology-of-nepal.

Fortier, J. (2009). *Kings of the Forest: The Cultural Resilience of Himalayan Hunter-Gatherers*. University of Hawaii Press, pp 232.

Friedman, J., Yaniv, Z., Dafni, A., & Palevitch, D. (1986). A preliminary classification of the healing potential of medicinal plants, based on a rational analysis of an ethnopharmacological field survey among bedouins in the Negev desert, Israel. *Journal of Ethnopharmacology* 16: 275–287. DOI: 10.1016/0378-8741(86)90094-2.

Gairola, S., Sharma, J., & Bedi, Y.S. (2014). A cross-cultural analysis of Jammu, Kashmir and Ladakh (India) medicinal plant use. *Journal of Ethnopharmacology* 155: 925-986.

Galeano, G. (2000). Forest use at the pacific coast of chocó, Colombia: a quantitative approach. *Economic Botany* 54: 358-376.

Gallardo-Cruz, A.J., Pérez-García, E.A., & Meave, J.A. (2009). B-Diversity and vegetation structure as influenced by slope aspect and altitude in a seasonally dry tropical landscape. *Landscape Ecology* 24: 473-482. DOI: 10.1007/s10980-009-9332-1.

Gandiwa, E. (2014). Vegetation factors influencing density and distribution of wild large herbivores in a southern African savannah. *African Journal of Ecology* 52(3): 274–283.

Gangwar, K.K., Deepali, & Gangwar, R.S. (2010). Ethnomedicinal plant diversity in Kumaun Himalaya of Uttarakhand, India. *Nature and Science* 8: 66-78.

Garbyal, S.S., Aggrawal, K.K., & Babu, C.R. (2005b). Return of biodiversity in Dharma valley, Dharchula Himalayas, Northern India following fortuitous changes in traditional lifestyle of the local inhabitants. *Current Science* 88: 722-725.

Garbyal, S.S., Aggrawal. K.K., & Babu, C.R. (2005a). Traditionally used medicinal plants in Dharchula Himalayas of Pithoragarh. *Indian Journal of Traditional Knowledge* 4: 199-207.

Garbyal, S.S., Grover, A., Aggrawal, K.K., & Babu, C.R. (2007). Traditional phytomedicinal knowledge of Bhotias of Dharchula in Pithoragarh. *Indian Journal of Traditional Knowledge* 6: 360-364.

Gautam, A., Shivakoti, G., & Webb, E. (2004). A review of forest policies, institutions, and changes in the resource condition in Nepal. *International Forestry Review* 6(2): 136-148. DOI: 10.1505/ifor.6.2.136.38397.

Gazzaneo, L.R.S., de Lucena, R.F.P., & Albuquerque, U.P. (2005). Knowledge and use of medicinal plants by local specialists in a region of Atlantic Forest in the state of Pernambuco (Northeastern Brazil). *Journal of Ethnobiology and Ethnomedicine* 1:9.

Gehrke, B., & Linder, H.P. (2014) Species richness, endemism and species composition in the tropical Afroalpine flora. *Alpine Botany* 24(2): 165–177.

Gertsch, J. (2012). Cross-cultural comparisons of medicinal floras- What are the implications for bioprospecting? *Journal of Ethnopharmacology* 139: 685–687.

Ghimire, S.K. (2008). Medicinal plants in Nepal Himalaya: current issues, sustainable harvesting, knowledge gaps and research priorities. In: Jha, P.K., Karmacharya, S.B., Chettri, M.K., Thapa, C.B., Shrestha, B.B. (Eds.), *Medicinal Plants in Nepal: An Anthology of Contemporary Research,* pp. 25–42. Ecological Society, Nepal.

Giday, M., Asfaw, Z, Elmqvist, T., & Woldu, Z. (2003). An ethnobotanical study of medicinal plants used by the Zay people in Ethiopia. *Journal of Ethnopharmacology* 85: 43-52.

Gillam, S. (1989). The traditional healer as village health worker. *Journal of Institute of Medicine* 11: 67-76.

Gomez-Beloz, A. (2002). Plant use knowledge of the Winikina Warao: The case for questionnaires in ethnobotany. *Economic Botany* 56(3): 231–241.

GoN. (1995). *Topographical Map.* Min Bhawan, Kathmandu, Nepal.

GoN. (2001). *HMGN-Department of Survey (DoS) (1998/2001) Land Use Estimation through Topo-maps.* Department of Survey, Kathmandu, Nepal.

GoN. (2006-2016). *Hamro Ban (Our Forests) series*. Department of Forests, Kathmandu, Nepal.

GoN. (2008). *Stocktaking Report: Land Degradation, National Capacity Self-Assessment for Global Environment Management*. Kathmandu.

GoN. (2010). *Feasibility Assessment Report for Api-Nampa Conservation Area, Darchula.* Department of National Parks and Wildlife Conservation. Kathmandu, Nepal.

GoN. (2011). *Nepal Population Report. Kathmandu*; Retrieved from www.mohp.gov.np/english/files/new_publications/Nepal Population Report 2011.pdf.

GoN. (2014). *Nepal Human Development Report 2014-Beyond Geography, Unlocking Human Potential.* UNDP, Government of Nepal, Kathmandu, Nepal, 2014: 128 p.

GoN. (2015). *Management Plan for Api-Nampa Conservation Area, Darchula (2015-2019)*. Ministry of Forests and Soil Conservation, Department of National Parks and Wildlife Conservation, Kathmandu.

GoN/DFRS. (2015). *State of Nepal's Forests.* Department of Forest Research and Survey, Government of Nepal. Kathmandu. 52 p.

GoN/DOED. (2016). *Detailed Environmental Management Plan (DEMP) of Pancheswar Multipurpose Project.* Department of Electricity Development, Government of Nepal. Kathmandu. Retrieved from http://www.doed.gov.np/DEMP-of-PMP.php.

GoN/MoFSC. (2014). *Understanding drivers and causes of deforestation and forest degradation in Nepal: potential policies and measures for REDD+*. FAO, UNEP, UNDP and Government of Nepal, Ministry of Forests and Soil Conservation, Kathmandu.

Graner, E. (1997). Kami (Blacksmiths) Today: Forests and Livelihood Security. *Contribution to Nepalese Studies* 24(2): 217-231.

Gray, C.L., Bilsborrow, R.E., Bremer, J.L., & Lu, F. (2008). Indigenous land use in the Ecuadorian Amazon: a cross-cultural and multilevel analysis. *Human Ecology* 36: 97–109.

Greg-Smith, E.A. (1983). Anthropological applications of Optimal Foraging Theory: A critical review. *Current Anthropology* 24(5): 625-651.

Gspurning, J., Kostka, R., & Sulzer, W. (2004). *Applicability of available Geodata in high mountain environmental research – examples from the Khumbu Himal Area, Nepal*. 19th European & Scandinavian Conference for ESRI Users, Copenhagen.

Guimbo, D., Muller, I.J., & Larwanou, M. (2011). Ethnobotanical knowledge of men, women and children in rural Niger: A mixed methods approach. *Ethnobotany Research & Applications* 9: 235–242.

Gunderson, L.H., & Holling, C.S. (2002). *Panarchy: understanding transformations in human and natural systems*. Island Press, Washington, D.C., USA.

Gurung, A.B., Von dach, S.W., Price, M.F., Aspinall, R., Balsigar, J., Baron, J.S., Sharma, E., & Kohler, T. (2012). Global Change and the World's Mountains— Research Needs and Emerging Themes for Sustainable Development. *Mountain Research and Development* 32 (S1): S47-S54.

Hagen, T. (1969). Report on the geological survey of Nepal. *Denckschrift desschweizerischen Naturforschenden Gesellschaft* 86: 1-160.

Haimendorf, C von. (1975). *Himalayan traders: life in Highland Nepal*. John Murray, London.

Han, H., Jang, K., Song, J., Seol, A., Chung, W., & Chung, J. (2011). The effects of site factors on herb species diversity in Kwangneung forest stands. *Forest Science and Technology* 7: 1-7.

Hanazaki, N., Souza, V.C., & Rodrigues, R.R. (2006). Ethnobotany of Rural People from the Boundaries of Carlos Botelho State Park, São Paulo State, Brazil. *Acta Botanica Brasilica* 20: 899–909.

Harlan, J. (1992). *Crops and man*. American Society of Agronomy and the Crop Science Society of America, Madison, WI.

Harshberger, J.W. (1896). Purpose of ethnobotany. *Botanical Gazette* 21: 146-154.

Hart, G., Gaoue, O., LaTorre, L., Navarrete, H., Muriel, P., Macia, M.J., Baslev, H., Leon-Yanez, S., Jogresen, P., & Duffy, D.C. (2017). Availability, diversification and versatility explain human selection of introduced plants in Ecuadorian traditional medicine. *PLOS One* 12(9): e 0184369.

Heck, K.L., Van-Belle, G., & Simberloff, D. (1975). Explicit Calculation of the Rarefaction Diversity Measurement and the Determination of Sufficient Sample Size. *Ecology* 56(6):1459-1461.

Heim, A., & Gansser A. (1939). *The Throne of the Gods*. The McMillan Co., New York. 233 p.

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

Heinrich, M., Edwards, S., Moerman, D.E., Leonti, M. (2009). Ethnopharmacological field studies: a critical assessment of their conceptual basis and methods. *Journal of Ethnopharmacology* 124: 1-17.

Hill, I. (1999). *Forest Management in Nepal: Economics and Ecology*. Washington DC: World Bank Publications.

Hitchcock, J. (1973). Ecologically Related Differences Between Communities in West Central Nepal. Paper presented at the *Annual Meeting of the American Anthropological Association,* New Orleans.

Holland, P.G., & Steyne, D.G. (1975). Vegetation responses to latitudinal variations in slope angle and aspect. *Journal of Biogeography* 2: 179-83. DOI: 10.2307/3037989.

Holtmeier, F.K. (2009). *Mountain timberlines: ecology, patchiness, and dynamics*. Springer, UK, 437 p.

Humagain, K. (2012). *Examining Land Use/Land Cover Change and Potential Causal Factors in the Context of Climate Change in Sagarmatha National Park, Nepal*. Masters Theses & Specialist Projects. Paper 1218. http://digitalcommons.wku.edu/theses/1218

Humphreys, G. (2014). Reframing climate change as a health issue. *Bulletin of the World Health Organization* 92: 551–552.

IUCN. (2000). *Nepal Iso-Potential Agro-Ecological Zone Map*. IUCN, Nepal, HMG/DANIDA, NARMSAP, TISC, Kathmandu, Nepal.

Jianlin, H., Richard, C., Hanotte, O., McVeigh, C., & Rege, J.E.O. (Eds). (2002). Yak production in central Asian highlands. In: *Proceedings of the third international congress on yak,* 572 pp, Lhasa, P.R. China, 4–9 September 2000. ILRI, Nairobi, Kenya.

Joshi, B. D. (1981). Exploration for amaranth in North-West India. *Plant Genetic Resources News Letter* 48: 41-52. International Board for Plant Genetic Resources, FAO, Rome.

Joshi, K. (2008). Ethnomedicinal uses of plants: a case study of Sharmoli VDC, Darchula, Nepal. In: Jha, P.K., Karmacharya, S.B., Chettri, M.K., Thapa, C.B., & Shrestha, B.B. (Eds.), *Medicinal Plants in Nepal: An Anthology of Contemporary Research*, pp 178–187. Ecological Society, Nepal.

Kala, C.P. (2005). Indigenous uses, population density, and conservation of threatened medicinal plants in protected areas of the Indian Himalayas. *Conservation Biology* 19: 368-378.

Kanel, K.R., Kunwar, R.M., Bhattarai, R., & Baral, S.R. (2017). *Status Study/Mapping of Important Medicinal and Aromatic Plants (MAPs) of Nepal and Preparation of Document for Jadibuti Program.* Department of Forest, Babarmahal, Kathmandu.

Khan, W., Khan, S.M., & Ahmad, H. (2015). Altitudinal variation in plant species richness and diversity at Thandiani sub forests division, Abbottabad, Pakistan. *Journal of Biodiversity and Environmental Sciences* 7: 46–53.

Khanal, N. (2002). *Land Use and Land Cover Dynamics in the Himalaya: A Case Study of the Madi Watershed, Western Development Region, Nepal*. Tribhuvan University, Kirtipur, Nepal. p 297.

Khumbongmayum, A.D., Khan, M.L., & Tripathi, R.S. (2005). Ethnomedicinal plants in the sacred grooves of Manipur. *Indian Journal of Traditional Knowledge* 4: 21-32.

Kindscher, K., Corbett, S., & McClure, K. (2013). A statistical analysis of medicinal plants: A case study of plant families in Kansas and the great plains. *Transaction of the Kansas Academy of Science* 116: 149-155.

Klamn, D. (1985). Culture and conservation: Some thought for the future. In: *Culture and Conservation: the human dimension of environmental planning*, McNeely, J.A., & Peet, D.(eds), pp 239-57, Croom Helm, London.

Kohn, E. (1992). Some observation on the use of medicinal plants from primary and secondary growth by the Runa of eastern lowland Ecuador. *Journal of Ethnopharmacology* 12: 141–152.

Körner, C. (2007). The use of altitude in ecological research. *Trends in Ecology & Evolution* 22: 569–574.

Kristensen, M. & Baslev, H. (2003). Perceptions, use and availability of woody plants among the Gourounsi in Burkina Faso. *Biodiversity and Conservation* 12: 1715–1739.

Kumar, S. (1967). *Rana polity in Nepal: Origin and growth*. Asia Publishing House, Bombay, India.

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

Kunwar, R.M., & Sharma, S. (2004). Quantitative analysis of tree species in two community forests of Dolpa district, mid-west Nepal. *Himalayan Journal of Sciences* 2(3): 23-28.

Kunwar, R.M., Acharya, R.P., Chowdhary C.L. & Bussmann, R.W. (2015). Medicinal plant dynamics in Indigenous medicines in far west Nepal. *Journal of Ethnopharmacology* 163: 210-219.

Kunwar, R.M., Baral, K., Paudel, P., Acharya, R.P., Thapa-Magar, K.B., Cameron, M., & Bussmann, R.W. (2016). Land-Use and Socioeconomic Change, Medicinal Plant Selection and Biodiversity Resilience in Far Western Nepal. *PLoS ONE* 11(12): e0167812. DOI: 10.1371/journal.pone.0167812.

Kunwar, R.M., Mahat, L, Sharma, L.N., Shrestha, K.P., Kominee, H., & Bussmann, R.W. (2012). Underutilized plant species in Far West Nepal. *Journal of Mountain Science* 9(5): 589–600.

Kunwar, R.M., Mahat, L., Acharya, R.P., & Bussmann, R.W. (2013). Medicinal plants, traditional medicine, markets and management in far west Nepal. *Journal of Ethnobiology and Ethnomedicine* 9: 24. http://www.ethnobiomed.com/content/9/1/24.

Kunwar, R.M., Sapkota, P., Dhami, H.S., Joshi, S., Fadiman, M., & Bussmann, R.W. (2017*). Cross-cultural Ethnobotany in Kailash Sacred Landscape, Nepal*. 58th Annual meeting of Society of Economic Botany, June 4-9, 2017, pp 37, Braganca, Portugal.

Kunwar, R.M., Shrestha, K, Dhungana, S.K., Shrestha, P.R., & Shrestha, K.K. (2010). Floral biodiversity of Nepal: an update. *Journal of Natural History Museum* 25: 295-311.

Kunwar, R.M., Uprety, Y., Burlakoti, C., Chowdhary, C.L., & Bussmann, R.W. (2009). Indigenous use and ethnopharmacology of medicinal plants in Far West Nepal. *Journal of Ethnobotany Research & Applications* 7: 5-28. www.ethnobotanyjournal.org.

La Torre-Cuadros, M., & Garald, I.A. (2003). Traditional ecological knowledge and use of vegetation in southeastern Mexico: a case study of Mapuche community from northwestern Patagonia. *Biodiversity and Conservation* 12: 2455-2476.

Labeyrie, V., Rono, B., & Leclerc, C. (2014). How social organization shapes crop diversity: an ecological anthropology approach among Tharaka farmers of Mount Kenya. *Agriculture and Human Values* 31: 97–107.

Ladio, A. H., & Lozada, M. (2000). Edible wild plant use in a Mapuche community of Northwestern Patagonia. *Human Ecology* 28: 53–71. DOI:10.1023/A:1007027705077.

Ladio, A.H., & Lozada, M. (2003). Comparison of wild edible plant diversity and foraging strategies in two aboriginal communities of northwestern Patagonia. *Biodiversity and Conservation* 12: 937-951.

Ladio, A.H., & Lozada, M. (2004). Patterns of use and knowledge of wild edible plants in distinct ecological environments: a case study of a Mapuche community from Northwestern Patagonia. *Biodiversity and Conservation* 13(6): 1153-1176.

Lange, D., & Schippmann, U. (1997). *Trade Survey of Medicinal Plants in Germany: A Contribution to International Plant Species Conservation*. Bundesamt für Naturschutz, Bonn.

Lardos, A., & Heinrich, M. (2013). Continuity and change in medicinal plant use: the example of monasteries on Cyprus and historical atrosophia texts. *Journal of Ethnopharmacology* 150: 202-214.

Lawrence, A., Phillips, O.L., Ismodes, A.R., Lopez, M., Rose, S., Wood, D., & Farfan, A.J. (2005). Local values for harvested forest plants in Madre de Dios, Peru: towards a more contextualized interpretation of quantitative ethnobotanical data. *Biodiversity and Conservation* 14: 45-79. DOI:10.1007/s10531-005-4050-8.

Lees, B., & Ritman, K. (1991). Decision-tree and rule-induction approach to integration of remotely sensed and GIS data in mapping vegetation in disturbed or hilly environments. *Environmental Management* 15: 823–831.

Leonti, M., & Casu, L. (2013). Traditional medicines and globalization: current and future perspectives in ethnopharmacology. *Frontiers in Pharmacology* 25: 4–92.

Lewis, G., Schrire, B., MacKinder, B., & Lock, M. (2005). (eds). *Legumes of the world*. Royal Botanical Gardens, Kew, UK.

Li, M., & Feng, J. (2015). Biogeographical interpretation of elevational pattern of genus diversity of seed plants in Nepal. *PLOS One* 10(10): e0140992.

Lilleso, J.B., Shrestha, T.B., Dhakal, L.P., Nayaju, R.P., & Shrestha, R. (2005). The map of potential vegetation of Nepal: a forestry/agro-ecological/biodiversity classification system. *Forest & Landscape Development and Environment Series 2 and CFC-TIS Series*, 110.

Loffler, J., & Pape, R. (2008). Diversity patterns in relation to the environment in Alpine Tundra ecosystems of the Northern Norway. *Arctic, Antarctic, and Alpine Research* 40: 373–381.

Lovett, J.C., Marshall, A.R., & Carr, J. (2006). Changes in tropical forest vegetation along an altitudinal gradient in the Udzungwa Mountains National Park, Tanzania. *African Journal of Ecology* 44: 478–490.

Lozada, M., Ladio, A., & Weigandt, M. (2006). Cultural transmission of ethnobotanical knowledge in a rural community of northwestern Patagonia, Argentina. *Economic Botany* 60(4): 374–385.

LRMP. (1986). *Land Utilization Report. Land Resource Mapping Project*. Kenting Earth Science Canada and Department of Topography, Government of Nepal, Kathmandu. pp 112.

Lucena, R.F.P., Medeiros. P.M., Araujo. E.L., Alves. A.G.C., & Albuquerque, U.P. (2012). The ecological apparency hypothesis and the importance of useful plants in rural communities from Northeastern Brazil: An assessment based on use value. *Journal of Environmental Management* 96: 106–115.

Lucena, R.F.P.D., Araujo, E.D.L., & Albuquerque, U.P. (2007). Does the local availability of woody Caatinga plants (Northeastern Brazil) explain their use value? *Economic Botany* 61: 347-361.

Macarthur, R.H., & Pianka, E.R. (1966). On optimal use of a patchy environment. *American Naturalist* 100(916): 603–609.

Macfarlane, A. (1976). *Resources and Population: A study of the Gurungs of Nepal*. Cambridge university press, Cambridge. 364 p.

Maclean, I.M.D., & Wilson, R.J. (2011). Recent ecological responses to climate change support predictions of high extinction risk. *Proceedings of the National Academy of Sciences of the United States of America* 108: 12337–12342.

Maffi, L. (2005). Linguistic, cultural and biological diversity. *Annual Review of Anthropology* 29: 599–617.

Mafimisebi, T.E., Oguntade, A.E., Fajemisin, A.N., & Aiyelari, O.P. (2012). Local knowledge and socio-economic determinants of traditional medicines' utilization in livestock health management in Southwest Nigeria. *Journal of Ethnobiology and Ethnomedicine* 8:2 https://doi.org/10.1186/1746-4269-8-2.

Maharjan, K.L., & Joshi, N. (2007). *A Poverty Analysis in Baitadi District, Rural Far Western Hills of Nepal: An Inequality Decomposition Analysis.* Available from: https://mpra.ub.uni-muenchen.de/35384.

Mahwasane, S.T., & Boadua, L.M.N. (2013). An ethnobotanical survey of indigenous knowledge on medicinal plants used by the traditional healers of the Lwamondo, Limpopo province, South Africa. *South African Journal of Botany* 88: 69–75.

Majupuria, T., & Joshi, D. (2009). *Religious and useful plants of Nepal & India: medicinal plants and flowers as mentioned in religious myths and legends of Hinduism and Buddhism*. Rohit Kumar publishers, Saharanpur, India 312 p.

Malla, S.B. & Shakya, S.R. (1984). Medicinal plants of Nepal. In: Majupuria, T.C. (Ed.), *Nepal Natures' Paradise.* White Lotus Ltd., Bangkok, Thailand, pp. 261–297.

Manandhar, N.P. (2002). *Plants and People of Nepal*. Oregon, Timber press Inc. Portland, 599 p.

Mani, M.S. (1978). *Ecology and Phytogeography of the High Altitude Plants of the Northwest Himalaya.* Oxford & IBH Publishing Company, New Delhi, India.

Manzardo, A.E. (1977). Ecological constraints on trans-Himalayan trade in Nepal. *Contributions to Nepalese Studies* 4: 63-81.

Manzardo, A.E., Dahal, D.R. & Rai, N.K. (1976). The Byashi: an ethnographic note on a trading group in far western Nepal. *Contribution to Nepalese Studies* 3: 83–118.

Manzardo, A.E., Dahal, D.R., & Rai, N.K. (1977). *Land and migration in Far-western Nepal*. INAS press, Kathmandu.

Maren, I.E., Bhattarai, K.R., & Chaudhary, R. (2013). Forest ecosystem services and biodiversity in contrasting Himalayan forest management systems. *Environmental Conservation* 41(1): 73-83.

Martin, G.J. (1995). *Ethnobotany: A method manual*. Chapman and Hall, London, 268 p.

McCune, B., & Grace, J.B. (2002). *Analysis of Ecological Communities*, MjM Software Design, Gleneden Beach, US.

McGeoch, L., Gordon, I. & Schmitt, J. (2008). Impacts of land use, anthropogenic disturbance, and harvesting on an African medicinal liana. *Biological Conservation* 141: 2218-2229.

McMillen, H. (2012). Ethnobotanical knowledge transmission and evolution: the case of medicinal markets in Tanga, Tanzania. *Economic Botany* 66(2): 121–131.

McNeely, J.A., & Peet, D. (1985). Culture, the missing element in conservation and development. In: *Culture and Conservation: the human dimension of environmental planning*, McNeely JA and Peet D (eds). 1-10, Croom Helm, London.

McVicar, T.R., & Körner, C. (2012). On the use of elevation, altitude, and height in the ecological and climatological literature. *Oecologia* 171: 335-337. http://dx.doi.org/0.1007/s00442-012-2416.

Mehra, B.S., & Mathur, P.K. (2001). Livestock grazing in the Great Himalayan National Park Conservation Area-A Landscape Level assessment. *Himalaya* 21(2): 14. http://digitalcommons.macalester.edu/himalaya/vol21/iss2/14.

Menzel, A.F.P. (1999). Growing season extended in Europe. *Nature* 397: 659. http://www.nature.com/nature/journal/v397/n6721/pdf/397659a0.pdf.

Messerli, B., & Ives, J.D. (1997). *Mountains of the world: A global priority*. New York: Parthenon.

Metz, J.J. (1997). Vegetation dynamics of several little disturbed temperate forests in east central Nepal. *Mountain Research and Development* 17: 333-351.

Miehe, G., Miehe, S, Böhner, J., Bäumler, R., Ghimire, S.K., Bhattarai, K., Chaudhary, R.P., Subedi, M., Jha, P.K, & Pendry, C. (2015). *Vegetation Ecology,* In: Miehe, G., Pendry, C., Chaudhary R.P. (Eds.), *Nepal: An introduction to the natural history, ecology and human environment of the Himalayas*, pp 385-472. RBGE, UK.

Miehe, G., Miehe, S., & Schlutz, F. (2009). Early human impact in the forest ecotone of southern High Asia. *Quaternary Research* 71: 255-265.

Milliken, W. & Albert, B. (1997). The use of medicinal plants by the Yanomami Indian of Brazil, Part II. *Economic Botany* 51: 264-278.

Moerman, D.E. (1979). Symbols and selectivity: a statistical analysis of Native American medical ethnobotany. *Journal of Ethnopharmacology* 1: 111-119.

Moerman, D.E. (1991). The medical flora of native North American: An analysis. *Journal of Ethnopharmacology* 31: 1-42.

Moerman, D.E. (1998). Native North American food and medicinal plants: epistemological considerations. In: Etkin, N.L., Harris, D.R., & Houghton, P.J. (Eds.), *Plants for Food and Medicine* pp 69-74. Royal Botanical Gardens, UK.

Momsen, J. (2004). *Gender and Development*. Routledge, London.

MPFS. (1988). *Master Plan for the Forestry Sector (MPFS), Nepal*. Ministry of Forests and Soil Conservation, Kathmandu, Nepal.

Muller, J.G., Boubacar, R., & Giombo, I.D. (2015). The ''How'' and ''Why'' of Including Gender and Age in Ethnobotanical Research and Community-Based Resource Management. *Ambio* 44: 67–78.

Muller-Dombois, D., & Ellenberg, H. (1974). *Aims and methods of vegetation ecology*. John Wiley, New York.

Munthe, J., Dongol, B., Hutchison, J.H., Kean, W.F., Munthe, K., & West, R.M. (1983). New fossil discoveries from the Miocene of Nepal include a Hominoid. *Nature* 303(5915): 331–333.

Mutchnick, P.A., & McCarthy, B.C. (1997). An ethnobotanical analysis of the tree species common to the subtropical moist forest of the Petén, Guatemala. *Economic Botany* 51: 158–183.

Nawa, K. (2002). Ethnic Categories and Their Usages in Byash, Far Western Nepal. *EBHR* 18: 36-57.

Negi, V.S., Pathak, R., Sekar, K.C., Rawal, R.S., Bhatta, I.D., Nandi, S.K., & Dhyani, P.P. (2017). Traditional knowledge and biodiversity conservation: a case study from Byash valley in Kailash Sacred Landscape, India. *Journal of Environmental Planning and Management* https://doi.org/10.1080/09640568.2017.1371006.

Nield, R. (1985). *Fuelwood and fodder-problems and policy.* Water and Energy Commission Secretariat. Kathmandu, Nepal. p 44.

Oakley, E.S. & Gairola, T.D. (1977). *Himalayan Folklore: Kumaon and west Nepal*. *Bibliotheca Himalayica* II (10): 315. Ratna Pustak Bhandar, Kathmandu.

Ojha, H., Persha, L., & Chhatre, A. (2009). *Community forestry in Nepal: a policy innovation for local livelihood.* IFPRI/CGIAR. 00913.

Oke, T.R. (1987). *Boundary Layer Climates*. Metheuen & Co., New York.

Olsen, C.S. (1998). The trade in medicinal and aromatic plants from central Nepal to Northern India. *Economic Botany* 52: 279-292.

Omar, S., Lemmonier, B., Jones, N., Ficker, C., Smith, M.L., Neema, C., Towers, G.H.N., Goel, K., & Arnason, J.T. (2000). Antimicrobial activity of extracts of eastern North American hardwood trees and relation to traditional medicine. *Journal of Ethnopharmacology* 73: 161-170

Pal, T.B. (2009). *A study on Yartsagumba collection in Darchula district of Nepal*. MS thesis, Central Department of Economics, Tribhuvan University, Nepal.

Palmer, T. (2004). The Inclusion of recently introduced plants in the Hawaiian ethnopharmacopoeia. *Economic Botany* 58: 280–293.

Pandey, A., Kotru, R., & Pradhan, N. (2016). Kailash Sacred Landscape: bridging cultural heritage, conservation and development through a transboundary landscape approach. In: Verschuuren, B., & Futura, N. (eds.) *Asian sacred natural sites: philosophy and practice in protected areas and conservation*. Routledge, NY.

Pandey, G.D. (1989). *Nityananda Smarak Samiti*, pp 546–547. Varanasi, India.

Pandey, T., Bhatta, G., Kandel, D.R. & Basnet, R. (2017). Collection and digitization of Herbarium Specimens from Kailash Sacred Landscape, Nepal. *Plant Resources* 15: 4-13.

Paniagua-Zambrana, N., Camara-Leret, R., Bussmann, R.W., & Macia, M.J. (2014). The influence of socioeconomic factors on traditional knowledge: a cross scale comparison of palm use in northwestern South America. *Ecology and Society* 19(4): 9. https://www.ecologyandsociety.org/vol19/iss4/art9/

Pant, S.D. (1935). *The social economy of the Himalaya*. George Allen and Unwin, London, p 264.

Pant, S.R. & Panta, I.R. (2004). Indigenous knowledge on medicinal plants in Bhagawati VDC, Darchula, Nepal. *Botanica Orientalis* 4: 79–81.

Pant, S.R., Dhami, N.R., & Panta, I.R. (2005). Wild edible plants of Lekham area, Darchula, Far Western Nepal. *Scientific World* 3: 73-77.

Parmesan, C., & Yohe, G. (2002). A globally coherent fingerprint of climate change impacts across natural systems. *Nature* 421: 37–42.

Paudel, B., Zhang, Y.I., Li, S.C., Liu, L.S., Wu, X., & Khanal, N.R. (2016). Review of studies on land-use and land cover change in Nepal. *Journal of Mountain Science* 13(4): 643-660.

Paudel, K.P., & Anderson, P. (2010). Assessing rangeland degradation using multi temporal satellite images and grazing pressure surface model in upper Mustang, Trans-Himalaya, Nepal. *Remote Sensing of Environment* 114: 1845–1855.

Pelto, G., Pelto, P., & Messer, E. (1989). *Research methods in nutritional anthropology*. United Nations University Press, Tokyo, Japan.

Pfeiffer, J., & Butz, R. (2005). Assessing cultural and ecological variation in ethnobotanical research: the importance of gender. *Journal of Ethnobiology* 25: 240-287.

Phillips, O. & Gentry, A.H. (1993a). The useful plants of Tambopata, Peru I: statistical hypothesis tests with a new quantitative technique. *Economic Botany* 47: 15–32.

Phillips, O. (1996). Some qunatitiative methods for analyzing ethnobotanical knowledge. In: Alexiades M.N. & Sheldon J.W. (Eds.), *Selected guidelines for ethnobotanical research: a field manual*, pp 171-197. New York Botanical Garden, New York.

Phillips, O., & Gentry, A.H. (1993b). The useful plants of Tambopata , Peru : Ⅱ . additional hypothesis testing in quantitative ethnobotany. *Economic Botany* 47: 33–43.

Phillips, O., Gentry, A.H., Reynel, C., Wilkin, P., & Galvez-Durand B. (1994). Quantitative ethnobotany and Amazonian conservation. *Conservation Biology* 8: 225-248.

Pielou, E.C. (1975). *Ecological Diversity*. Wiley, London, UK.

Pieroni, A., Giusti, M.E., & Quave, C. (2011). Cross-cultural ethnobiology in the western Balkans: medical ethnobotany and ethnozoology among Albanians and Serbs in the Pester Plateau, Sandžak, South-Western Serbia. *Human Ecology* 39: 333–349.

Poertner, E., Junginger, M., & Muller-Boker, U. (2011). Migration in Far West Nepal. *Critical Asian Studies* 43(1): 23–47.

Polunin, A. & Stainton, A. (1984). *Flowers of Himalaya*, 580 p. New Delhi, India.

Popovic, Z., Matic R., Bojovic, S., Stefanovic, M. & Vidakovic, V. (2016). Ethnobotany and herbal medicine in modern complementary and alternative medicine: An overview of publications in the field of I&C medicine 2001–2013. *Journal of Ethnopharmacology* 181: 181-192.

Pouliot, M., Pyakurel, D., & Smith-Hall, C. (2018). High altitude organic gold: the production network for *Ophiocordyceps sinensis* from far-western Nepal. *Journal of Ethnopharmacology* https://doi.org/10.1016/j.jep.2018.02.028.

Pradhan, K. (1998). Origin of Ramapithecus in Nepal. *Ancient Nepal* 107:15–29.

Prance, G.T. (1972). An ethnobotanical comparison of four tribes of Amazonian Indians. *Acta Amazônica* 2(2): 7–27.

Prance, G.T., Balée, W., Boom, B.M., & Carneiro, R.L. (1987). Quantitative ethnobotany and the case for conservation in Amazonia. *Conservation Biology* 1: 296-310.

Putnam, A.M. (1975). The Tea Shop as an Arena of Ethnic Interaction in Nepal. *Contribution to Nepalese Studies* 2: 11-17.

Pyakurel, D., Srivastavam, S., & Smith-Hall, C. (2017). *Quantification of medicinal plant trade from Darchula District, Nepal*. 58th Annual meeting of Society of Economic Botany, June 4-9, 2017, Braganca, Portugal.

Pyke, G.H. (1984). Optimal foraging theory a critical review. *Annual Review of Ecology and Systematics* 15: 523–575.

Quave, C.L., & Pieroni, A. (2015). A reservoir of ethnobotanical knowledge informs resilient food security and health strategies in the Balkans. *Nature Plants* 14021: 1-6.

Ramakrishnan, P.S. (1996). Conserving the sacred: from species to landscapes. *Natural Resources* 32: 11-19.

Ramos, M.A., Medeiros, P.M., Almeida, A.L.S., Feliciano, A.L.P., & Albuquerque, U.P. (2008). Use and knowledge of fuelwood in an area of Caatinga vegetation in NE Brazil. *Biomass & Bioenergy* 32: 510–517

Rana, H.K., Sun, H., Paudel, A., & Ghimire, S.K. (2018). *Saussurea ramchaudharyi* (Asteraceae), a new species from Nepal. *Phytotaxa* 340(3): 271-276. DOI: 10.11646/phytotaxa.340.3.7.

Rasul, G., Choudhary, D.M., Pandit, B.H. & Kollmair, M. (2012). Poverty and livelihood impacts of a medicinal and aromatic plants project in India and Nepal: an assessment. *Mountain Research and Development* 32(2): 137-148.

Rawat, G., Rawal, R.S., Chaudhary, R.P. & Pieli, S. (2013). *Strategies for the management of high altitude rangelands and their interfaces in the Kailash Sacred Landscape*. ICIMOD, Vol. 30, Kathmandu, Nepal.

Rawat, G.S., Rawal, R.S., Chaudhary, R.P., & Peili, S. (2014). Strategies for the Management of High-altitude rangelands and their Interfaces in the Kailash Sacred Landscape. In: *High Altitude Rangelands and their Interfaces in the Hindu Kush Himalayas*, ICIMOD, Nepal.

Reddy, C.S., Pasha, S.V., Satish, K.V., Saranya, K.R.L., Jha, C.S., & Murthy, Y.V.N.K. (2018). Quantifying nationwide land cover and historical changes in forests of Nepal (1930-2014): implications on forest fragmentation. *Biodiversity and Conservation* 27: 91-107.

Regmi, D. (2008). Rock Glacier distribution and the lower limit of discontinuous mountain permafrost in the Nepal Himalaya. In: *Proceeding of the Ninth Int. Conf. Permafr. (NICOP).* 29 June–3 July 2008, Fairbanks, Alaska, pp. 1475–1480.

Regmi, M.C. (1971). *A study in Nepali Economic History*. Manjushree publishing house, New Delhi, India.

Reyes-García, V., Huanca, T., Vadez, V., Leonard, W., & Wilkie, D. (2006). Cultural, practical, and economic value of wild plants: a quantitative study in the Bolivian Amazon. *Economic Botany* 60(1): 62–74.

Rhoades, D.G., & Cates, R. (1976). Toward a general theory of plant antiherbivore chemistry. *Recent Advance in Phytochemistry* 10: 168–213.

Ribeiro, J.E.S., Carvalho, T.K.N., Ribeiro, J.P.O., Guerra, N.M., Silva, N., Pedrosa, K.M., Alves, C.A.B., Sousa Júnior, S.P., Souto, J.S., Nunes, A.T., Lima, J.R.F., Oliveira, R.S., & Lucena, R.F.P. (2014). Ecological apparency hypothesis and availability of useful plants: Testing different use values. *Ethnobotany Research & Applications* 12: 415–432.

Rimal, B., Zhang, L., Fu, D., Kunwar, R., & Zhai, Y. (2017a). Monitoring Urban Growth and the Nepal Earthquake 2015 for Sustainability of Kathmandu Valley, Nepal. *Land* 6: 1-23 DOI:10.3390/land6020042.

Rimal, B., Zhang, L., Keshtkar, H., Wang, N., & Lin, Y. (2017b). Monitoring and Modeling of Spatiotemporal Urban Expansion and Land-Use/Land-Cover Change Using Integrated Markov Chain Cellular Automata Model. *ISPRS International Journal of Geo-Information* 6: 1-21. DOI:10.3390/ijgi6090288.

Rist, S., Delgado, F., & Wiesmann, U. (2003). The role of social learning processes in the emergence and development of Arymara land uses system. *Mountain Research and Development* 23: 263-270.

Robbe, E. (1954). *Report to the government of Nepal on forestry*. EPTA/FAO 209, Rome Italy.

Rokaya, M.B., Munzbergova, Z., Shrestha, M.R., & Timsina, B. (2012). Distribution Patterns of Medicinal Plants along an Elevational Gradient in Central Himalaya, Nepal. *Journal of Mountain Science* 9: 201–213. DOI: 10.1007/s11629-012-2144-9.

Rokaya, M.B., Munzbergova, Z., Shrestha, M.R., & Timsina, B. (2010). Ethnobotanical study of medicinal plants from the Humla district of western Nepal. *Journal of Ethnopharmacology* 130: 485–504.

Roy, R., Schmidt-Vogt, D., & Myrholt, O. (2009). Humla Development Initiatives for better livelihoods in the face of isolation and conflict. *Mountain Research and Development* 29(3): 211–219.

Rudel, T.K., Bates, D., & Machinguiashi, R. (2002). A tropical forest transition? Agricultural change, out–migration, and secondary forests in the Ecuadorian Amazon. *Annals of the Association of American Geographers* 92: 87–102.

Salick, J. (1995). Toward an integration of evolutionary ecology and economic botany: personal perspectives on plant/people interactions. *Annals of the Missouri Botanical Garden* 82: 68-85.

Salick, J., Biun, A., Martin, G., Apin, L., & Beaman, R. (1999). Whence useful plants? A direct relationship between biodiversity and useful plants among the Dusun of Mt. Kinabalu. *Biodiversity and Conservation* 8: 797–818. DOI: 10.1023/A:1008853413930.

Salick, J., Ghimire, S.K., Zhendong, F., Dema, S., & Konchar, K.K. (2014). Himalayan alpine vegetation, climate change and mitigation. *Journal of Ethnobiology* 34(3): 276-293.

Salick, J., Zhendong, F., & Byg, A. (2009). Eastern Himalayan alpine plant ecology, Tibetan ethnobotany, and climate change. *Global Environmental Change* 19: 147–155.

Saslis-Lagaudakis, C.H., Williamson, E.M., Savolainen, V. & Hawkins, J.A. (2011). Cross-cultural comparison of three medicinal floras and implications for bioprospecting strategies. *Journal of Ethnopharmacology* 135: 476–487.

Saatchi, S.S., Harris, N.L., Brown, S., Lefsky, M., Mitchard, E.T.A., Salas, W., Zutta, B.R., Buermann, W., Lewis, S.L., Hagen, S., Petrova, S., White, L., Silman. M., & Morel, A. (2011). Benchmark map of forest carbon stocks in tropical regions across three continents. *PNAS* 108 (24): 9899-9904. https://doi.org/10.1073/pnas.1019576108.

Sanchez-Azofeita, G.A., Quesada, M., & Rodriguez, J.P. (2005). Research priorities for neotropical dry forests. *Biotropica* 37(4):477–485. doi: 10.1111/j.1744-7429.2005.00066.x

Sato, H.P., & Harp, E.L. (2009). Interpretation of earthquake-induced landslides triggered by the 12 May 2008, M.9 Wenchuan earthquake in the Beichuan area, Sichuan Province, China using satellite imagery and Google Earth. *Landslides* 6: 153–159.

Scambos, T., Haran, T., Fahnestock, M.A., Painter, T.H., & Bohlander, J. (2007). MODIS-based Mosaic of Antarctica (MOA) data sets: Continent-wide surface morphology and snow grain size. *Remote Sensing of Environment* 111: 242–257.

Schickhoff, U. (2005). The upper timberline in the Himalayas, Hindu Kush and Karakorum: A review of geographical and ecological aspects. In: *Mountain Ecosystems: Studies in Treeline Ecology*, Broll, G., & Keplin, B. (eds.) Springer Berlin, Germany. pp. 275–354.

Searle, S., Speed, F.M., & Miliken, G.A. (1980). Population Marginal Means in the Linear Model: An Alternative to Least Squares Means. *The American Statistician* 34(4): 216-221.

Shah, N.C., & Joshi, M.C. (1971). An ethnobotanical study of the Kumaon region of India. *Economic Botany* 25: 414-422.

Shah, S., Tewari, A., & Tewari, B. (2009). Impact of human disturbance on forest vegetation and water resources of Nainital catchment. *Nature and Science* 7: 74-78.

Shaheen, H., Khan, S.M., Harper, D.M., Ullah, Z., & Allem-Qureshi, R. (2011). Species diversity, community structure, and distribution patterns in western Himalayan alpine pastures of Kashmir, Pakistan. *Mountain Research and Development* 31: 153–159.

Shaheen, H., Ullah, Z., Khan, S.M., & Harper, D.M. (2012). Species composition and community structure of western Himalayan moist temperate forests in Kashmir. *Forest Ecology and Management* 278: 138–145.

Shank, R.E., & Noorie, E.N. (1950). Microclimate vegetation in a small valley in eastern Tennessee. *Ecology* 11: 531–539.

Shannon, C.E., & Wiener, W. (1949). The Mathematical theory of communication: Unknown Distance Function. Urbana, IL: Illinois Press.

Sharma, D.R. (1997). Vir khamba (commemorative stone pillars for heroic individuals who contributed to the nation) of western Nepal. *Contribution to Nepalese Studies* 24: 57-70.

Shengji, P.J., Shen, P.Q., & Huang, J. (2002). Ethnomedicine and medical ethnobotany in China. In: Tran, C.K., Tran, V.O., & Do, Q., (Eds.), *International workshop on networking for research, conservation, sustainable use and development of medicinal plants in Vietnam & Laos*. S34–S39. CRE-DEP, Hanoi.

Shi, P., & Wu, N. (2013). The timberline ecotone in the Himalayan region: An ecological review. In: *High-altitude rangelands and their interfaces in the Hindu Kush Himalayas*, Wu, N., Rawat, G.S., Joshi, S., Ismail, M., & Sharma, E. (eds.), ICIMOD, Kathmandu, Nepal.

Shrestha, M. (2005). The human dimensions of Land-Use and Land-Cover Change in Lamjung, Nepal. *Himalaya* 25(1): 11. http://digitalcommons.macalester.edu/himalaya/vol25/iss1/11

Shrestha, S. (2001). The Vedic-Aryan Entry into Contemporary Nepal: A Pre-Historical Analysis Based on the Study of Puranas. *Ancient Nepal Journal* 1: 1–8.

Shrestha, T.B., Lillesø, J.P.B., Dhakal, L.P., & Shrestha, R. (2002). *Forest and Vegetation Types of Nepal*. Ministry of Forests and Soil Conservation, HMG/Nepal, NARMSAP, TISC, Kathmandu, Nepal.

Silva, A.C.O., & Albuquerque, U.P. (2005). Woody medicinal plants of the Caatinga in the state of Pernambuco. *Acta Botanica Brasılica* 19: 17–26.

Singh, H., Husain, T., Agnihotri, P., Pande, P.C., Khaton, S. (2014). An ethnobotanical study of medicinal plants used in sacred groves of Kumaon Himalaya, Uttarakhand, India. *Journal of Ethnopharmacology* 154: 98-108.

Singh, H., Kumar, M., & Sheikh, M.A. (2009). Distribution pattern of Oak and Pine along altitudinal gradients in Garhwal Himalaya. *Nature and Science* 7: 81-85.

Singh, M.P., Malla, S.B., Rajbhandari, S.B., & Manandhar, A. (1979). Medicinal plants of Nepal: retrospect and prospects. *Economic Botany* 33(2): 185–198.

Sokal, R.R., & Rholf, F.G. (1995). *Biometry*. Freeman and Company, New York.

Soldati, G.T., & Albuquerque, U.P. (2012). A new application for the optimal foraging theory: the extraction of medicinal plants. *eCAM,* 364564 http://dx.doi.org/10.1155/2012/.

Soldati, G.T., de Medeiros, P.M., Duque-Brasil, R., Coelho, F.M.G., & Albuquerque, U.P. (2016). How do people select plants for use? Matching the ecological apparency hypothesis with optimal foraging theory. *Environmental Development and Sustainability* 19: 2143-2161.

Srivastava, D. (2009). Resources of Nepalese medicinal and aromatic plants: status and development. *Plant Resources* 31: 127–131.

Stainton, A. (1988). *Flowers of the Himalaya: a supplement*. New Delhi.

Stepp, J.R., & Moerman, D. (2001). The importance of weeds in ethnopharmacology. *Journal of Ethnopharmacology* 75(1): 19–23.

Teklehaymanot, T., & Giday, M. (2007). Ethnobotanical study of medicinal plants used by people in Zegie Peninsula, Northwestern Ethiopia. *Journal of Ethnobiology and Ethnomedicine* 3:12.

ter Braak, C.J.F., & Smilauer, P. (2002). *CANOCO Reference Manual and CanoDraw for Windows User's Guide.* Software for Canonical Community Ordination (Version 4.5).

ter Steege, H., Pitman, N., Sabatier, D., Castellanos, H., VanDer Hout, P., Daly, D.C., Silveira, M., Phillips, O., Vasquez, R., van Andel, T., Duivenvoorden, J., Adalardo De Oliveira, A., Ek, R., Lilwah, R., Thomas, R., Van Essen, J., Baider, C., Maas, P., Mori, S., Terborgh, J., Núñez Vargas, P., Mogollon, H., & Morawetz, W. (2003). A spatial model of tree a-diversity and tree density for the Amazon. *Biodiversity and Conservation* 12: 2255–2277.

Thapa, S. (2017). *Richness and Distribution Pattern of Palatable and Unpalatable Plant Species in Subalpine-Nival Gradient in Chameliya Valley, North-West Nepal*. MSc Thesis, 69 p, submitted to Tribhuvan University, Kathmandu, Nepal.

The Plant List. Retrieved in April, 2018. www.theplantlist.org

Thomas, E. (2008). *Quantitative ethnobotanical research on knowledge and use of plants for livelihood among quechua, Yuracaré and Trinitarian communities in the Andes and Amazon regions of Bolivia.* Ph.D.-Dissertation, 496 p. Faculty of Bioscience & Engineering, Ghent University, Belgium.

Thomas, E., Vandebroek, I, Van Damme, P., Goetghebeur, P., Douterlungne, D., Sanca, S. & Arrazola, S. (2009). The relation between accessibility, diversity and indigenous valuation of vegetation in the Bolivian Andes. *Journal of Arid Environments* 73: 854–861.

Thomas, E., Vandebroek, I., Goetghebeur, P., Sanca, S., Arrázola, S., & Van Damme, P. (2008). The relationship between plant use and plant diversity in the Bolivian Andes, with special reference to medicinal plant use. *Human Ecology* 36(6): 861–879.

Thornthwaite, C. (1948). An approach toward a rational classification of climate. *Geographical Review* 38: 55–94.

Thornthwaite, C., & Mather, J. (1955). *The water balance.* Publication of Climatology, No. 8, Centerton, NJ.

Thorsen, R.S., & Pouliot, M. (2016). Traditional medicine for the rich and knowledgeable: challenging assumptions about treatment-seeking behavior in rural and peri-urban Nepal. *Health Policy Plan* 31: 314–324.

Timilsina, N., Ross, M.S., & Heinen, J.T. (2007). A community analysis of Sal (Shorea robusta) forests in the western Tarai of Nepal. *Forest Ecology and Management* 241: 223–234.

TISC. (2000). Forest and Vegetation Types of Nepal. *TISC Document Series No. 105*. Department of Forest, GoN/NARMSAP, International Year of Mountain Publication, Nepal.

Toba, S. (1975). Plant Names in Khaling. A Study in Ethnobotany and Village Economy. *Kailash* 3(2): 146-169.

Toledo, B.A., Colantonio, S., & Galetto, L. (2007). Knowledge and use of edible and medicinal plants in two populations from the Chaco forest, Cordoba province, Argentina. *Journal of Ethnobiology* 27(2): 218–232.

Toledo, B.A., Galetto, L., & Colantonio S. (2009). Ethnobotanical knowledge in rural communities of Cordoba (Argentina): the importance of cultural and biogeographical factors. *Journal of Ethnobiology and Ethnomedicine* 5:40. DOI:10.1186/1746-4269-5-40.

Toledo, V.M., Batis, A.I., Bacerra, R., Martinez, E., & Ramos, C.H. (1995). La silva util: ethnobotanica cuantitativa de los grupos indigenas del tropico humido de Mexico. *Interciencia* 20: 177–187.

Treyvaud-Amiguet, V., Arnason, J.T., Maquin, P., Cal, V., Vindas, P.S., & Poveda, L. (2005). A consensus ethnobotany of the Q'eqchi' Maya of Belize. *Economic Botany* 59: 29-42.

Trotter, R., & Logan, M. (1986). Informant consensus: a new approach for identifying potentially effective medicinal plants. In: Etkin, N.L. (Ed.), *Plants in Indigenous Medicine and Diet: Bio-behavioral Approaches*, pp 91-112. Redgraves publishers, Bedford Hills, New York.

Turner, N.J. & Clifton, H. (2009). It's so different today: climate change and indigenous life ways in British Columbia, Canada. *Global Environmental Change* 19(2): 180–190.

Uddin, K., Chaudhary, S., Chettri, N., Kotru, R., Murthy, M., Chaudhary, R.P., Ning, W., Shrestha, S.M., & Gautam, S.K. (2015a). The changing land cover and fragmenting forest on the Roof of the World: A case study in Nepal's Kailash Sacred Landscape. *Landscape and Urban Planning* 141: 1–10.

Uddin, K., Shrestha, H.L., & Murthy, M.S.R. (2015b). Development of 2010 national land cover database for the Nepal. *Journal of Environmental Management* 148: 82-90. DOI: 10.1016/j.jenvman.2014.07.047.

Umair, M., Altaf, M., & Abbasi, L.M. (2017). An ethnobotanical survey of indigenous medicinal plants in Hafizabad district, Punjab-Pakistan. *PLOS One* 12(6): e0177912. DOI: 10.1371/journal.pone.0177912.

UNCED. (1992). *The Rio Declaration on Environment and Development.* United Nations Conference on Environment and Development, Rio de Janeiro.

UNESCO. (2002). Retrieved from http://www.ethnologue.com/country/np/languages. UNESCO, Nepal.

UNFCO. (2013). *District profile: Baitadi.* Transition Support Strategy, RCHC Office, United Nations Field Coordination Office. Kathmandu, Nepal.

Uniyal, B., & Shiva, V. (2005). Traditional knowledge on medicinal plants among rural women of the Garhwal Himalaya, Uttaranchal. *Indian Journal of Traditional Knowledge* 4(3): 259-266.

UNWFP. (2006). United Nations World Food Program. *Food Security Bulletin* 38 (5): 1–8.

Valida, K.S. (1998). *Dynamic Himalaya*. University Press Ltd., Haidarabad, India, 178 p.

van Andel, T. (2000). *Non-timber forest products of the North-West District of Guyana: Part I.* Tropenbos-Guyana Series 8B. Print Partners Ipskamp B.V., 325 p. The Netherlands.

Vandebroek, I. (2010). The dual intercultural and intracultural relationship between medicinal plant knowledge and consensus. *Economic Botany* 64(4): 303-317.

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: 837-849.

Vittoz, P., Bayfield, N., Brooker, R., Elston, D.A., Duff, E.I., Theurillat, J.P., & Guisan, A. (2010). Reproducibility of species lists, visual cover estimates and frequency methods for recording high-mountain vegetation. *Journal of Vegetation Science* 21: 1035–1047.

Voeks, R.A. (1996). Tropical forest healers and habitat preference. *Economic Botany* 50: 381-400.

Voeks, R.A. (2007). Are women reservoirs of traditional plant knowledge? Gender, ethnobotany and globalization in northeast Brazil. *Singapore Journal of Tropical Geography* 28: 7-20.

Walker, B.H. (1992). Biodiversity and ecological redundancy. *Conservation Biology* 6: 18-23.

Walther, G.R., Post, E., Convey, P., Menzel, A., Parmesan, C., Beebee, T.J., Fromentin, J.M., Hoegh-Guldberg, O., & Bairlein, F. (2002). Ecological responses to recent climate change. *Nature* 416: 389-395.

Wang, X., Liu, Y., Ling, F., Liu, Y., & Fang, F. (2017). Spatio-temporal change detection of ningbo coastline using landsat time-series images during 1976–2015. *ISPRS International Journal of Geo-Information* 6: 68.

Weckerle, C.S., de Boer, H., Puri, R.K., van Andel, T., Bussmann, R.W., & Leonti, M. (2018). Recommended standards for conducting and reporting ethnopharmacological field studies. *Journal of Ethnopharmacology* 210: 125-132.

Weckerle, C.S., Huber, F.K., Yongping, Y., & Weibang, S. (2006). Plant Knowledge of the Shuhi in the Hengduan Mountains, Southwest China. *Economic Botany* 60(1): 3–23.

Wickramasinghe, A. (1997). Anthropogenic Factors and Forest Management in Sri Lanka. *Applied Geography* 17: 87-110.

Wilkinson, D.Y. (2987). Traditional medicine in America families: reliance on wisdom of elders. *Marriage and Family Review* 11: 65-76.

Winter, K.B., & McClatchey, W. (2008). Quantifying evolution of cultural interactions with plants: Implications for managing diversity for resilience in social-ecological system. In: Ethnobotany: A focus on Brazil. *Funct. Ecosyst. Communities* 2(Special Issue): 1-10.

WRI. (2005). *The wealth of the poor: managing ecosystems to fight poverty.* World Resource Institute, USA. http://www.wri.org/publication/world-resources-2005-wealth-poor-managing-ecosystems-fight-poverty.

WWG. (2007). Darchula (Nepal)-Dharchula (India) hot spot of illegal wildlife trade. *Wildlife Watch Group Bulletin* 15: 2-5. Kathmandu, Nepal.

Xu, J., Grumbine, R.E., Shrestha, A.B., Eriksson, M., Yang, X., Wang, Y., & Wilkes, A. (2009). The melting Himalayas: Cascading effects of climate change on water, biodiversity, and livelihoods. *Conservation Biology* 23: 520–530.

Xu, J., Shrestha, A., Vaidya, R., Eriksson, M., & Hewitt, K. (2007). *The melting Himalayas: Regional challenges and local impacts of climate change on mountain ecosystems and livelihoods.* ICIMOD, Kathmandu, Nepal.

Zhang, J.T., & Dong, Y.R. (2010). Factors affecting species diversity of plant communities and the restoration process in the loess area of China. *Ecological Engineering* 36: 345–350.

Zhang, J.T., & Ru, W.M. (2010). Population characteristics of endangered species Taxus chinensis var. mairei and its conservation strategy in Shanxi, China. *Population Ecology* 52: 407–416.

Zhang, J.T., Xu, B., & Li, M. (2013). Vegetation Patterns and Species Diversity Along Elevational and Disturbance Gradients in the Baihua Mountain Reserve, Beijing, China. *Mountain Research and Development* 33: 170–178.

Zhao, P., Lu, D., Wang, G., Wu, C., Huang, Y., & Yu, S. (2016). Examining spectral reflectance saturation in landsat imagery and corresponding solutions to improve forest aboveground biomass estimation. *Remote Sensing* 8: 469.

Zomer, R.J., & Oli, K.P. (2011). *Kailash sacred landscape conservation initiative: feasibility assessment report.* ISBN: 978 92 9115 211 7. ICIMOD: Kathmandu.

Zomer, R.J., Trabucco, A., Metzger, M., & Oli, K.P. (2013). *Environmental stratification of Kailash Sacred Landscape and Projected Climate Change Impacts on Ecosystems and Productivity*. Working Paper 2013/1, ICIMOD: Kathmandu.

Zomer, R.J., Trabuccoa, A., Metzger, M.C., Wang, M., Oli K.P., & Xu, J. (2014). Projected climate change impacts on spatial distribution of bioclimatic zones and ecoregions within the Kailash Sacred Landscape of China, India and Nepal. *Climatic Change* 125(3-4): 445-460. DOI: 10.1007/s10584-014-1176-2.

Zomer, R.J., Ustin, S., & Ives, J. (2002). Using satellite remote sensing for DEM extraction in complex mountainous terrain: Landscape analysis of the Makalu Barun National Park of eastern Nepal. *International Journal of Remote Sensing* 23 (1): 125-143.

Zong, S., Wu, Z., Xu, J., Li, M., Gao, X., He, H., Haibo, D., & Wang, L. (2014). Current and Potential Tree Locations in Tree Line Ecotone of Changbai Mountains, Northeast China. *The Controlling Effects of Topography* 9 (8): e106114.