Ecology and Ethnobotany in and around Api Nampa Conservation Area (ANCA), Darchula, Nepal

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Abstract

Background: Far-Western mountainous Region of Nepal is a rich source of floral diversity and medicinal plants. The latter is frequently being used in traditional healing systems in the region. In the present study, we aimed to document richness and diversity of flowering plant species including medicinal species and their indigenous uses in Api Nampa Conservation Area (ANCA) of Darchula district, Far Western Nepal. To be precise, we explored the detail ethnobotanical accounts of *Hippophae* species of the area.

Methods: Fieldwork for this study was carried out twice in July 2019 and July 2020. Ghajir Kshetti, Khirsha and Lamthing villages of eastern ANCA (considered as a protected site, government managed) and Patha, Ranghadi, Kantai and Batheldhunga villages of northern ANCA (considered as community-managed site) were sampled. A total of ten quadrats each measuring 10 m x 10 m size in each site was laid to inventory the species and analyze the ecological traits. For ethnobotanical assessment, two field observations were made and 20 people, representing male, female, senior citizens were interviewed. Supplementary information was collected during informal group discussions held in the villages and in district center.

Results: We recorded 76 plant species including *Hippophae salicifolia* in two different study sites of ANCA, Darchula. The species belonged to 33 families and 62 genera. The dominant plant families were Pinaceae, Rosaceae, Poaceae, Ericaceae and Asteraceae. The comparative assessment showed that the protected site has greater number plant species 60 (78.94%) whereas the northern ANCA site has only 37 (48.68%) species. The highest IVI (26.95) was recorded for *Hippophae salicifolia* and minimum (2.37) for *Daphne papyracea*. As dominant, the *Hippophae salicifolia* was frequently used traditionally for primary health care, local livelihood, nutrition, cosmetics, and environmental management. Out of 76, 65 species were used for ethnobotany and 11 species for ethnomedicine.

Conclusions: Protected ANCA site is rich in plant species. The site and whole ANCA are dominated by useful plant species such as *Hippophae salicifolia*, *Alnus nepalensis, Elaeagnus parvifolia, Girardiania diversifolia, Ilex excelsa, Juglans regia,* etc. This study contributes to the wealth of medicinal plants and ethnobotany of ANCA, Darchula. Conservation of useful plant species complements the rural livelihood inhabiting the rugged and remote mountains of Far-Western Nepal.

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Key words: Api Nampa Conservation Area, Diversity, Darchula, Ethnobotany, Seabuckthorn.

Background

Nepal is ranked at around 25th position in the global context and 11th in the continental scale of biological diversity richness (BPP 1995; CBD 1997). Darchula is the Far-western mountainous district of the country, bordered with China at north and India at west. The district is famous for biodiversity and tourism, yet the resources are untapped because of the limited access. Moreover, the mountainous districts are very sensitive to climate change and curtailed by land-use and land cover change (Rimal *et al.* 2019) and are the least studied (Eriksson *et al.* 2009; Elliott 2012; Bhattarai *et al.* 2014).

Darchula district is one of the most inaccessible and underdeveloped areas of Nepal and faces numerous conservation and development challenges (Kunwar *et al.* 2017). 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 (Chaudhary *et al.* 2010) and an array of forest types (such as moist subtropical broadleaf to temperate oak forests) and alpine scrubs of conifers, *Ephedra*, *Juniper*, *Rhododendron*, *Hippophae*, and high-altitude pastures (Zomer & Oli 2011; Elliott 2012, Ghimire *et al.* 2021). The rugged terrain, geographic heterogeneity, and over harvesting of useful plants in the district (Kunwar *et al.* 2012; Kunwar *et al.* 2015) pose a serious threat to sustainable ecosystems with implications for future biodiversity and human development (Uddin *et al.* 2015). The harsh climate, poor accessibility, marginality, and high level of poverty manifest high dependency on natural resources leading to over-exploitation (Roy *et al.* 2009). Rush collection for quick economic return also led the plant resources vulnerable (Pal 2009; Dadal 2010).

With the gradual worsening quality of environment and the overriding poverty, locally available and useful plants pose a hope for future. People use locally available medicinal plants for their livelihood and primary health care as development, modern and health care facilities are limited in rural remote villages. Collection of medicinal plants and their uses is still persistent with some adaptation (Kutal *et al.* 2021). *Hippophae* has attracted a great deal of attention because of its concentrated ecological, medicinal, and socioeconomic benefits. Darchula district is rich in *Hippophae* species (commonly called as Seabuckthorn, locally known as Chungo) (Kunwar *et al.* 2018). However, the studies regarding the richness, diversity, distribution, usefulness, and conservation of Seabuckthorn are scare in the district. Topographic features of the district such as slope gradients, aspect, and elevation largely play a major role in structuring composition of plants (Holland & Steyne 1975). The present paper aims to analyze distribution, composition, usefulness, and conservation of flowering plants including *Hippophae* in ANCA and its vicinity in Darchula district, Far Western Nepal.

Materials and Methods

Study area

Api Nampa Conservation Area (ANCA) and its vicinity were selected as a study area for this study. The ANCA lies in the north-west Himalayan region of Nepal and lies in Darchula district. It lies at latitude of 29^0 50' 28'' N and longitude of 80^0 31' 43'' E. The climate is upper tropical, temperate to alpine. Above 3,000 m elevation, most of the area is ecologically sub-alpine or highland alpine region (Poudeyal *et al.* 2019). Cold and dry climate exists in the high alpine valleys just north of the southern arm of the Himalaya that cuts across the bottom of ANCA. The average maximum temperature is 18.6°C and minimum temperature goes below 0°C. Most precipitation falls between May and September (Chaudhary *et al.* 2010). The dominant plant species are *Alnus nepalensis, Artemisia gmelini, Cassiope fastigiata, Elaeagnus parvifolia, Girardiania diversifolia, Heracleum wallichii, Hippophae salicifolia, Ilex excelsa, Juglans regia, Juniperus indica, Pinus roxburghii* and *Rhododendron arboreum* (Subedi *et al.* 2020).

Sampling was conducted in Api Nampa Conservation Area (ANCA) and its northern and eastern sides. Eastern ANCA was sampled as a protected, government managed site whereas the northern side of ANCA is community managed. The northern area of the district is ruderal, bare and dry due to steep slope angles and mostly covered by snow in most of the months in a year (Anonymous 2010; Kunwar *et al.* 2018). Transhumance is still persistent in Darchula. People live 6 months in northern Darchula (> 3000 masl) in the summer and then descend to the lowland (Khalanga) for the rest of the year (Manzardo 1977).

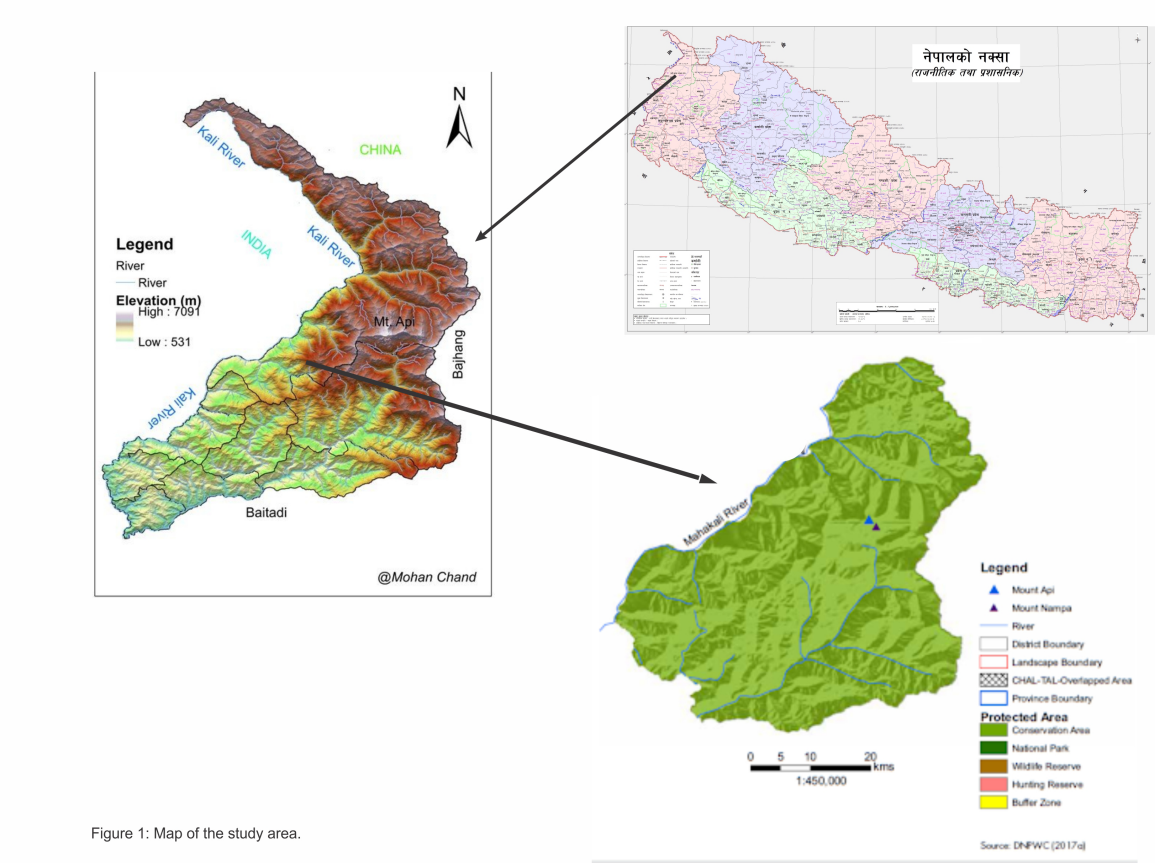

Figure 1: Map of the study area.

Figure 1. Map of the study area

Field visits and ecological study

Fieldwork for primary and qualitative and quantitative data collection was carried out twice between July 2019 and July 2020. Each fieldwork was lasted between 20-25 days. During the field visits, the data and information regarding composition of plant species, natural habitat, indigenous uses, and local conservation measures were collected. Plant samples were collected for voucher records and ethno-ecological studies. A total of 20 quadrats each measuring 10 m ×10m size were laid following stratified random sampling following Misra (1968). Ecological traits such as distribution, frequency, density, and Important Value Index (IVI) were studied following Curtis & McIntosh (1951) and Zobel *et al.* (1987).

Ethno-ecological survey and data analyses

To assess the distribution of plant use knowledge, a total of 20 respondents, 10 from each site, age ranged between 45 years and 75 years including 15 men and 5 women were randomly interviewed following Kunwar *et al.* (2019). The name of useful species and use, along with the distribution of the species, availability and mode of application was sought in the interview. A semi-structured questionnaire was used for interview and supplementary information was collected through informal meetings (Putnam 1975). While pursuing informal meeting and questionnaire surveys, information of vernacular names and dominant and most useful species as well as conservation of species was collected. The collected information was compared with the published literature (Bhattarai & Ghimire 2006; Rokaya *et al.* 2010; Bhatt & Kunwar 2020, 2021; Graham *et al.* 2000; Wali *et al.* 2019; Anonymous 2005; Pokharel *et al.* 2021; Kumar *et al.* 2002).

Collection and Identification

The plant species referred to be useful by respondents were collected, pressed, dried, mounted and preserved based on standard methods as given by (Forman & Bridson 1989). Before preservation all the collected vouchers were examined and identified with the help literature (Hooker 1872; Hara *et al.* 1978, 1982; Hara & Williams 1979; Grierson & Long 1983; Press *et al.* 2000). Furthermore, the species were confirmed by comparing with herbarium specimens deposited at KATH (National Herbarium and Plant Laboratories, Godawari, Lalitpur, Nepal), TUCH (Tribhuvan University Herbarium, Department of Botany, Kirtipur, Kathmandu), and Department of Botany, Siddhanath Science Campus, Mahendranagar. All voucher specimens were deposited at Department of Botany,

Siddhanath Science Campus, Mahendranagar. Scientific name of plants and their families were verified with referring to the plant list (http://www.theplantlist.org/).

Results and Discussion

Plant species composition

A total of 76 plant species were recorded under 33 families and 62 genera. The highest number of genera belongs to Rosaceae (6 genera) and Asteraceae (6 genera). Similarly, highest number of species belongs to Asteraceae (8 species) (Fig. 2). The dominant families were Pinaceae, Rosaceae, Poaceae, Ericaceae and Asteraceae. The higher numbers of dominant species were recorded at protected site. Such type of species composition was consistent to with the findings of Bhatt and Kunwar (2020) at two different study sites in Kanchanpur, Nepal. The highest number of species occurred by the Asteraceae (8 species) family and least number was occurred by Juglandaceae family (1 species). The present composition of the dominant family agreed with the findings of Kunwar *et al.* (2020) and Subedi *et al.* (2020) in the same district. The highest density of the species occupied by *Hippophae salicifolia* (4) and lowest density occupied by *Anaphalis contorta* (0.2). The result is consistent with earlier studies carried from the same areas as the studies reported *Hippophae* as one of the common species in ANCA, Darchula (Thapa 2017; Kunwar *et al.* 2020; Subedi *et al.* 2020). The greater density of the species in area indicated that the elevational range 2000 to 4500m is a good repository of *Hippophae*. The distribution pattern of the species contributed 41 (54.67%) were as trees, 20 (26.67%) herbs and 15 (20%) shrubs.

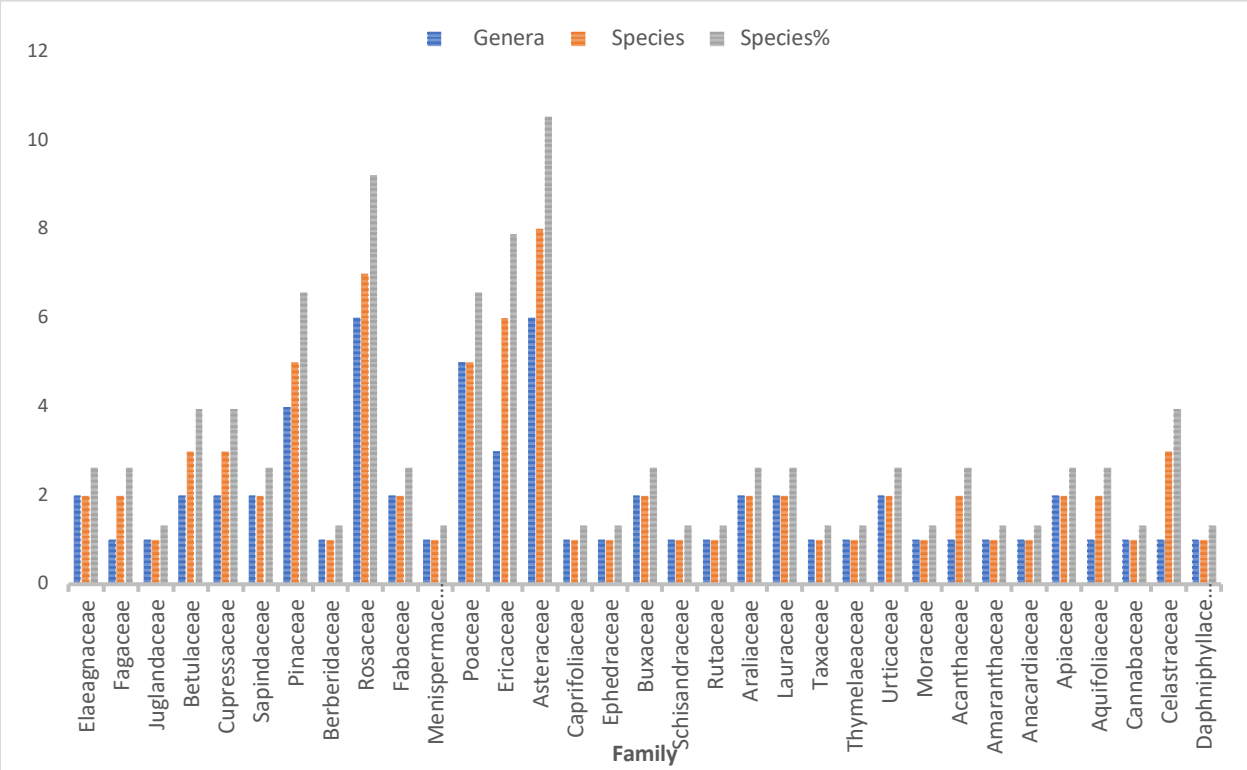

Figure 2. Composition of plant species on the basis of genera and species.

Dominance and distribution of plant species

A total of 12 plant species were reported as dominant species (IVI value > 9) based on their recorded IVI value. The recorded dominant species were *Alnus nepalensis, Artemisia gmelini, Cassiope fastigiata, Elaeagnus parvifolia, Girardiania diversifolia, Heracleum wallichii, Hippophae salicifolia, Ilex excelsa, Juglans regia, Juniperus indica, Pinus roxburghii* and *Rhododendron arboreum* (Table 1). Out of the recorded dominant species, 8 were trees, 3 were shrubs and 1 species was herb. Over 50% species were tree species, contrasting to the findings of Kunwar *et al.* (2019) however, conforms to findings of DNPWC (2019). A total of 383 genera were reported from high altitude areas of Darchula, however, the *Hippophae* was underreported (Elliot 2012).

Table 1 Dominant plant species in the study area.

Name of plants	Dominant Families	Importance Value Index (IVI)	Study sites*
Alnus nepalensis D. Don	Betulaceae	14.29	1
Artemisia gmelinii Webb ex Stechmann	Asteraceae	9.90	1,2
Cassiope fastigiata (Wall.) D.Don	Ericaceae	9.90	1
Elaeagnus parvifolia (Wall.ex Royle)	Elaeagnaceae	11.14	1,2
Girardiania diversifolia (Link) Friis	Urticaceae	11.14	1
Heracleum wallichii DC.	Apiaceae	9.90	1
Hippophae salicifolia L.	Elaeagnaceae	26.95	1,2
Ilex excelsa (Wall.) Hook. f.	Aquifoliaceae	12.45	1,2
Juglans regia L.	Juglandaceae	12.45	1,2
Juniperus indica Bertol.	Cupressaceae	14.29	1,2
Pinus roxburghii Sarg.	Pinaceae	9.64	1
Rhododendron arboreum Sm.	Ericaceae	11.14	1,2

***** (1 = Government managed protected site; 2 = Community managed forest)

Total 76 plant species were recorded in two different study sites of ANCA, Darchula district. Of total, 60 (78.94%) plant species were recorded from protected site and 37(48.68%) plants species were from site north of ANCA. From the total species, 21 (27.63%) were common in both sites (Annex 1)**.** Out of the total plant species the highest density (4) individuals per meter square was occupied by the *Hippophae salicifolia* and minimum (0.2) was covered by *Anaphalis contorta*. Similarly, the highest IVI (26.95) was occupied by the species *Hippophae salicifolia* and minimum IVI (2.37) was occupied by *Daphne papyraceae*. The observed data proved that the ANCA of Darchula district is dominated by *Hippophae salicifolia* (Annex 1).

The study area is rich in biodiversity because the people of this area showed a large repertoire of knowledge that helps them determine different plant use strategies in conjunction with ecology, culture, and geography. This knowledge is the result of the area's biodiversity, deep cultural importance of using local endemics and the compliance of using local resources in reference to the geo-ecological constraints. Geo-ecological constraints and limited accessibility in the district led the overexploitation of local resources (Heim & Gansser 1939; Manzardo 1977). Thus, the local availability of a plant is linked to its relative importance to a given community (Kunwar *et al.* 2018).

In comparative assessment, the community-managed area northern part of ANCA has a lower density of plants due to intensive use of plants and land use change interventions. Because of the steep slope and fragile geology in the northern side, forest degradation is serious and further vegetation loss is anticipated (Uddin *et al.* 2015). The harsh climate, poor accessibility, marginality, and high level of poverty manifest high dependency on natural resources leading to over-exploitation (Roy *et al.* 2009). Rush collection for quick economic return also led the plant resources vulnerable (Pal 2009; Dadal 2010). Fuel wood, fodder, and medicinal plant collection, summer grazing and climate change are major drivers impacting the ecology and biodiversity of the area. Their socio-ecological information and their interdependencies scale a better strategy for management to maintain sustainable development and biodiversity conservation in the limited access areas (Kunwar *et al.* 2019).

***Hippophae salicifolia* (Seabuckthorn in Darchula)**

As evident from the ecological findings, Darchula is one of those districts where *H. salicifoila* is abundantly found. *Hippophae* is the native plant of the mountain region of Nepal and the species is found within the altitudes ranging approximately from 1800m to 4500m (TISC 2001) and has been reported from more than 25 mountain districts like: Baglung, Darchula, Dolakha, Dolpa, Humla, Jajarkot, Jumla, Kaski, Manang, Mugu, Mustang, Ramechhap, Rasuwa, Solukhumbu, Taplejung etc. (Vaidya 1999; Gupta *et al.* 2000; Baral 2002; Ansari 2003). Seabuckthorn distributes throughout the country in the high mountains. However, the main area of distribution is Northwest Nepal where the ecological and physiographical conditions are favorable. National Herbarium and Plant Laboratories (KATH), Godavari has specimens of three species of *Hippophae*, namely, *H. salicifolia*, *H. tibetana*, and *H. rhamonoides*. However, only former 2 species are reported to be extensively present in Northwestern and central mountainous districts of Nepal (Nepal *et al.* 2001). The species has long been using in the mountainous districts of Nepal for various purposes. For the farmers living in the mountains, it offers the opportunity to maintain a

sustainable livelihood-providing healthy foods, variety of medicines and protecting their land from soil erosion (Lu 1992; Ansari 2003).

Economic Botany of *Hippophae*

Hippophae salicifolia is one of the most available plants in the study area. As the ecological apparency hypothesis initially proposed by Feeny (1976) inferred, the locally available plants are frequently consumed for local livelihood. Local people earn money by selling the juice, firewood of *Hippophae salicifolia* that helps in the economic development of local people in rural areas. The leaves and branches are also used as fodder, litter, and firewood collection (Rajchal 2008). Along with traditional uses, some new ones, such as condensed juice, mixed juice, candied fruits, cheese, butter, tea and health protection drinks are also being produced at local scale. In the Hindu-Kush Himalaya region, plant biomass is the most important source of energy (Bhattarai *et al.* 2004; ICIMOD 2006). It has proved to be a popular green energy plant because of its quality biomass and good source of firewood.

Hippophae salicifolia is one of the unique features of the study area where local people use the juice of fruit of this species for medicinal and food value, relief from hotness and use in winter by mixing it with boiled water for staying safe from common cold, health disorders such as headache, stomachache, skin problems, dysentery, cough, weakness and in reproductive health problems.

Local people use the juice of fruit for medicinal and food value because its juice is highly beneficial for human health. They use its juice in hot climate for getting relief from hotness and use in winter by mixing it with boiled water for staying safe from common cold. It is also used in high fever, brings relief from pain, and provides freshness. Juice of its fruit has been used in many other health disorders such as headache, stomachache, skin problems, dysentery, cough, weakness and in reproductive health problems. The comparative analysis of ethnomedicinal values in the study area are compared with the earlier studies (Anon 2005; Pokharel *et al.* 2021; Kumar *et al.* 2002; Vaidya 1999; Rongsen 1992) and presented in Table 2. The dependencies of local people on ethnomedicine in both the study sites were less similar.

Table 2. Comparative analysis of medicinal values of *Hippophae salicifolia* in the study area.

Ethnomedicinal use records in the present study	**Earlier reports of ethnomedicine with references**
Used as source of vitamin C.	Used as source of ascorbic acid (Rosch 2004).
Used as source of flavonoids and the oils.	Used as different sources of flavonoids and the oils (Li & Schroeder 1996).
Effective against skin problems, cardiovascular diseases, and immune system support.	Effective against, cardiovascular diseases, mucosa injuries, skin problems, cancer, and immune system support (Graham *et al.* 2000; Wali *et al.* 2019).
Used in burns, bedsores, eczema, etc.	Externally used to treating a wide variety of skin damage, burns, bedsores, eczema and radiation injury, antioxidant, cancer, cardiovascular, immune system, skin, and other treatments including cosmetic uses (Anon 2005; Pokharel *et al.* 2021).
Used as anticancerous.	It has been estimated that 30-40% of all cancers can be prevented by lifestyle and dietary measures alone (WCRF/AICR 1997).
Used as drugs.	Drug metabolizing, detoxifying and antioxidant enzymes are important cellular defenses against carcinogenic (Goel *et al.* 2003; Kumar *et al.* 2002).
Used as healing of wounds and dermatitis.	The oil from the pulp/peel of berries is rich in palmitoleic acid and oleic acid helpful for treating burns, healing wounds and skin diseases, such as atopic dermatitis (Kumar *et al.* 2002).
Used as oxidative processes.	Used to free radical-mediated oxidative processes contribute to atherogenesis (Eccleston *et al.* 2002; Ivanov & Nikitina 1973).
Juice of fruits used against gastritis.	Juice of fruits used against intestinal disorder (Pokharel *et al.* 2021).
Used against foul smell from the mouth.	Used as remedy vomiting, and also chewed to remove foul smell from the mouth (Maity *et al.* 2004).
Used against vomiting.	To remedy vomiting and as appetizer (Gairola *et al.* 2014)

Fruits are used for jaundice, pain, cough, constipation.	Fruits are used in skin diseases, as tooth pain reliever, killing warms, stomach disorders, removal of teeth staining (mixed with ash), in menstrual irregularity, in swelling & muscular pain, for cough & cold, blood pressure, Jaundice, to control dysentery, asthma, and to join broken and damaged parts of domestic animals. Other uses of the plant are to cure of poison effects, to high altitude sickness, and to lung troubles and constipation (Vaidya 1999).
Leaves are used as herbal tea and cure tuberculosis.	Leaf is applying as herbal tea and to be believed to cure tuberculosis. The concentrated juice is said to be good medicine for those children who cannot speak in due time (Vaidya 1999; Rongsen 1992).

Pharmacolgical uses of *Hippophae*

Hippophae possesses thorny berry which is a very rich source of vitamins and is called treasure of bio-activity substance because of its over 190 bio-active substances possessing unique medicinal properties (Maertz 2006). The most important pharmacological function of the plant oil is in diminishing inflammation, disinfecting bacteria, relieving pain, and promoting regeneration of tissue. The species has been shown to have a potent antioxidant activity, mainly attributed to its flavonoids and vitamin C content (Rosch 2004). Both the flavonoids and the oils have several potential applications (Li & Schroeder 1996). The berries seem to have preventive effects against, cardiovascular diseases, mucosa injuries, skin problems, cancer, and immune system support (Graham *et al.* 2000; Wali *et al.* 2019). External uses include treating a wide variety of skin damage, burns, bedsores, eczema and radiation injury, antioxidant, cancer, cardiovascular, immune system, skin and other treatments including cosmetic uses (Anonymous 2005; Pokharel *et al.* 2021).

Conclusions

A total number of 76 plant species including *Hippophae salicifolia* were recorded under 33 different families and 62 genera. Over 50% species were recorded as trees which indicated that trees were common in the study area. Government-managed protected site had greater number of plant species as compared to the community-managed rangeland. Intensive use of plants and land use change interventions made the community-managed area less diversified and enriched in plant species. As the *Hippophae salicifolia* was densely populated and distributed in and around the ANCA, the species has frequently been used for curing several ailments, nutritional values, and for producing food and cosmetics. The species with multiple uses are at the verge of extinction because of persistent use, human disturbance, and land use change. Conservation of useful plant species complements the rural livelihood inhabiting the rugged and remote mountains of Far Western Nepal.

Declarations

List of Abbreviation: Not applicable.

Ethics approval and consent to participate: Permission for data collection was obtained from the chairperson of ANCA and oral agreements were obtained from local informants about the aims and objectives of the study prior to interviews and all field data were collected through their oral consents. No further ethics approval was required.

Consent for publication: All the data of paper includes original so consent for publication is not required.

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

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

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Authors' contribution: DJ carried out fieldwork, collected data and identified plant species. RMK and MDB analyzed data and helped to prepare the draft for the manuscript. All authors equally participated in writing and giving feedback on the manuscript and approved the final version of the manuscript.

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Annex 1. Showing distribution pattern with Density and IVI of plant species in the study area.

Family	**Scientific name**	**Local Names**	**Life span**	**Site 1**		**Site 2**	
				RD	**IVI**	**RD**	**IVI**
Pinaceae	*Abies spectabilis* (D. Don) Spach	Talispatra	Tree	2.38	7.73	1.48	4.74
Sapindaceae	*Acer cappadocicum* Gled.	Tilelo	Tree	0.99	3.91	-	-
Sapindaceae	*Aesculus indica* (Wall. ex Cambess.) Hook	Paangar	Tree	-	-	2.38	7.99
Betulaceae	*Alnus nepalensis* D. Don	Utis	Tree	5.95	14.29	-	-
Amaranthaceae	*Amaranthus blitum* L.	Bethae	Herb	-	-	1.19	4.84
Asteraceae	*Anaphalis contorta* (D. Don) Hook. f.	BukiPhool	Herb	1.48	5.77	1.19	4.84
Asteraceae	*Anaphalis nubigena* DC.	Pearl	Herb	1.48	5.07	-	-
Poaceae	*Andropogon munroi* C.B. Clarke	Banso	Herb	2.97	7.60	1.19	4.84
Araliaceae	*Aralia cachemirica*Decne	Bankhor	Herb	1.48	4.74	-	-
Asteraceae	*Artemisia gmelini* Webb ex Stechmann	Ganaunepati	Shrub	3.57	9.90	1.48	4.74
Asteraceae	*Artemisia indica* (Wild.) Yomogi	Titepati	Herb	1.98	5.76	-	-
Fabaceae	*Astragalus onobrychis* L.	Milkvetch	Herb	1.98	5.76	-	-
Berberidaceae	*Berberies asiatica* Roxb. ex DC.	Chutro	Shrub	-	-	1.19	4.84
Betulaceae	*Betula alnoides* Buch.-Ham. ex D. Don	Lekhpainyu	Tree	1.48	4.74	-	-
Betulaceae	*Betula utilis* D. Don	Bhojpatra	Tree	1.48	4.74	-	-
Buxaceae	*Buxus wallichiana* Baill.	Papro	Tree	0.99	3.73	-	-
Asteraceae	*Carpesium nepalense* Less.	PadkeGhas	Herb	0.99	3.91	-	-
Ericaceae	*Cassiope fastigiata* (Wall.) D. Don	Phalu	Shrub	3.57	9.90	-	-
Pinaceae	*Cedrus deodara* (Roxb.) G. Don	Deodar	Tree	2.97	7.60	2.38	7.73
Cannabaceae	*Celtisaus trails* L.	Khadik	Tree	2.38	7.73	1.48	4.74
Poaceae	*Chrysopogon gryllus* (L.) Trin.	Daphleghas	Herb	0.99	3.91	-	-
Menispermaceae	*Cocculuslauri folius* DC.	Aadukolli	Shrub	-	-	1.19	4.84
Apiaceae	*Cortiade pressa* (D. Don) C. Norman	Bajari	Herb	1.48	4.74	-	-

Rosaceae	*Cotoneaster dammeri* C.K. Schneid.	Khareto	Shrub	1.48	5.07	-	-
Cupressaceae	*Cupressus torulosa* D. Don ex Lamb.	Raj sallo	Tree	1.48	5.07	-	-
Poaceae	*Cymbopogon distans* (Nees ex Steud.) W. Watson	Malabar geass	herb	1.98	5.76	-	-
Thymelaeaceae	*Daphne papyraceae* Wall. ex G. Don	Baduwa	Shrub	0.49	2.37	-	-
Daphniphyllaceae	*Daphniphyllum himalense* (Benth.) Müll.-Arg.	Rakchan	Tree	1.98	5.91	1.19	4.84
Urticaceae	*Debregeasia salicifolia* (D. Don) Rendle	Tusaro	Shrub	0.99	3.91	-	-
Fabaceae	*Desmodium heterocarpon* (L.) DC.	Chamleu	Shrub	2.38	7.73	1.98	5.76
Asteraceae	*Doronicum roylei* DC.		Herb	2.97	7.60	-	-
Poaceae	*Drepanostachyum falctum* (Nees) Keng f.	Banso	Tree	0.99	3.73	-	-
Asteraceae	*Dubyaea hispida* (D. Don) DC	Leopards bane	Herb	-	-	1.19	4.84
Elaeagnaceae	*Elaeagnus parvifolia* Wall. ex Royle	Guyalo	Tree	3.57	11.14	1.48	4.74
Ephedraceae	*Ephedra gerardiana* Wall. ex C.A. Meyer	Somlata	Shrub	0.49	2.37	-	-
Celastraceae	*Euonymus fimbriatus* Wall.	Pahenlyath	Tree	1.19	4.84	0.49	2.37
Celastraceae	*Euonymus frigidus* Wall		Tree	-	-	1.19	4.84
Celastraceae	*Euonymus porphyreus* Loes	Dandan	Tree	-	-	2.76	6.38
Moraceae	*Ficus nerrifolia* Sm.	Dudhilo	Tree	2.97	7.60	-	-
Urticaceae	*Girardianiadiversifolia* (Link) Friis	Sisno	Herb	3.57	11.14		
Araliaceae	*Hedera nepalensis* K. Koch	Belaghans	Herb	-	-	0.99	3.91
Apiaceae	*Heracleum wallichii* DC.	Chetare	Herb	3.57	9.90	-	-
Elaeagnaceae	*Hippophae salicifolia* L.	Sankhadhara	Tree	14.29	26.95	9.90	18.49
Aquifoliaceae	*Ilex dipyrena* Wall	Setokharsu	Tree	2.47	6.77	-	-
Aquifoliaceae	*Ilex excels* (Wall.) Hook. f.	Puwanle	Tree	4.76	12.45	0.99	3.73
Juglandaceae	*Juglansregia* L.	Okhar	Tree	4.76	12.45	2.38	7.73
Cupressaceae	*Juniperus indica* Bertol.	Dhupi	Tree	5.95	14.29	0.99	3.73
Cupressaceae	*Juniperus squamata* Buch.-Ham. ex D. Don	Dhupi	Tree	0.99	3.91	-	-
Asteraceae	*Ligulariaf ischeri* (Ledeb.) Turcz.		Herb	1.48	4.22	1.19	4.84
Caprifoliaceae	*Lonicera maackii* (Rupr.) Maxim.		Shrub	1.19	4.84	2.47	6.25
Ericaceae	*Lyonia ovalifolia* (Wall.) Drude	Angeri	Tree	-	-	2.38	7.73
Lauraceae	*Neolitse apallens* (D. Don) Momiy. & H. Hara		Tree	2.47	6.25	1.19	4.84
Lauraceae	*Perseaodor atissima* (Nees) Kosterm	Kaulo	Tree	-	-	2.38	7.99
Pinaceae	*Pinus roxburghii* Sarg.	Khotesalla	Tree	3.46	9.64	-	-
Pinaceae	*Pinus wallichiana* A.B. Jacks.	Gobresalla	Tree	1.48	4.74	-	-
Rosaceae	*Prinse piautilis* Royle	Dhatelo	Shrub	2.47	6.77	-	-
Rosaceae	*Prunus cerasoides* D. Don	Painyu	Tree	2.97	7.60	-	-
Rosaceae	*Prunus nepalensis* (Ser.) Steud.	Arato	Tree	1.48	4.74	-	-
Rosaceae	*Pyracantha crenulata* (D. Don) M. Roem.	Ghangaru	Shrub	0.99	3.91	-	-

Rosaceae	*Pyrus pasia* L.	Mel	Tree	-	-	1.19	4.84
Fagaceae	*Quercus lanata* Sm.	Banj	Tree	-	-	1.98	5.90
Fagaceae	*Quercus semecarpofolia* Sm.	Kharsu	Tree	1.48	4.74	-	-
Ericaceae	*Rhododendron anthopogon* D. Don	Sunpati	Shrub	1.98	5.91	-	-
Ericaceae	*Rhododendron arboreum* Sm.	Laligurans	Tree	3.57	11.14	1.48	4.74
Ericaceae	*Rhododendron barbatum* Wall. ex G. Don	Chimal	Tree	2.38	7.73	0.49	2.37
Ericaceae	*Rhododendron campanulatum* D.Don	Gurans	Tree	1.48	4.74	-	-
Buxaceae	*Sarcococca saligna* (D. Don) Müll-Arg.	Telparo	Shrub	-	-	2.38	7.99
Schisandraceae	*Schisandra grandiflora* (Wall.) Hook. f. & Thomson	Gofala	Herb	2.38	7.73	0.99	3.73
Rosaceae	*Sorbus lanata* D. Don	Naalo	Tree	-	-	2.38	7.73
Acanthaceae	*Strobilanthes buteraea* Nees		Shrub	0.49	2.37	-	-
Acanthaceae	*Strobilanthes tomentosa* (Nees) J.R.I. Wood	Kangaraito phool	Herb	2.47	6.77	-	-
Taxaceae	*Taxus contorta* Griff.	Lauthsalla	Tree	2.97	7.94	-	-
Poaceae	*Themeda anathera* (Nees ex Steud.) Hook.	Loonder	Herb	-	-	1.19	4.84
Anacardiaceae	*Toxicodendron wallichii* (Hook. f.) Kuntze	Bhamkilo	Tree	0.99	3.73	-	-
Pinaceae	*Tsuga dumosa* (D. Don) Eichler	Thingesalla	Tree	-	-	2.38	6.03
Rutaceae	*Zanthoxylum armatum* DC.	Timur	Tree	2.38	7.73	1.48	4.74