An Assessment of Floristic Diversity and Uses of Plant Resources in Madane Protected Forest Gulmi, Western Nepal

Bikram Jnawali[1]* & Ajay Neupane[2]
[1]Ministry of Social Development, Lumbini Province, Butwal, Nepal
[2] Mechi Multiple Campus, Tribhuvan University, Bhadrapur, Jhapa, Nepal
*Email: biksg468@gmail.com

Abstract

Madane Protected Forest (MPF) located in western Nepal is enriched with diverse biodiversity. MPF is pristine in terms of scientific research featuring floristic diversity and documenting traditional knowledge of locals. In this study, we aimed to document floristic diversity and usage of plant resources among locals of MPF. Altogether 50 plots were established along an elevational gradient of Bhedikhor–Banjhkateri cluster to document the floristic diversity. Plant-use data were obtained through 30 key informant interviews and five group discussions. Total of 185 species belonging to 154 genera from 74 families were recorded. Asteraceae was the dominant family followed by Poaceae, Rosaceae, and Lamiaceae. Several highly prioritized plants such as *Paris polyphylla, Dioscorea deltoidea, Tinospora sinensis, Swertia chirayita* were documented. *Hypericum cordifolium* (Hyperiaceae), an endemic species was also recorded for the first time from the MPF. Locals of MPF were directly or indirectly dependent on forest resources for meeting their daily requirements. Findings showed, locals gave more priority to those species that provide them with multitude of benefits. Habitat destruction, overharvesting of natural resources, wildfire, unmanaged road constructions are the major threats to the natural forest in MPF. We recommend that the forest officials of MPF should realize the urgency of conservation of this unique hub of biodiversity. Besides, a large area of this forest remained untouched in terms of scientific research so, a detailed survey or inventory should be done immediately to document the unique biodiversity.

Keywords: Biodiversity, Conservation, Disturbance, Exploration, Traditional knowledge

Introduction

The floristic study refers to the documentation of all plant species present in a given geographical region (Simpson, 2006). Study of the floristic diversity of the local or regional area is inevitable, because such studies help in botanical enumeration, updating nomenclature, documenting changes in ecological conditions, adding herbarium specimens in the existing herbaria and determining the nature and distribution of flora resources to be managed (Raghubanshi & Singh, 2003; Chalise et al., 2018). Knowledge of floral diversity of a particular area can reflect the total resources, their traditional uses, and conservation status which are very helpful for making conservation strategies and policies (Chaudhary et al., 2002; Bhanadari et al., 2018).

Plants are regarded as the most important component of natural resources upon which peoples and animals are highly dependent. Natural forest resources are an important component for maintaining the ecological balance of nature, stabilizing the water cycle, and serve as a source of income by attracting tourists, serve as recreational facilities, serve as carbon sequestration and regulate water resources (Tsegaye, 2006). Hence, to maintain ecological equilibrium and to meet the forest requirement, systematic floristic inventory and ecological exploration are important to judge the success of the conservation efforts of the natural forest (Dangol & Shivakoti, 2001). No such study was previously done in Madane Protected Forest (MPF) excluding the general survey of MPF conducted by Department of Forest during declaration of Protected Forest (DoF, 2011).

Major people of the rural area directly depend on forest resources for meeting their daily requirements as well as economic well-being (Gubhaju & Ghimire, 2009; Aryal et al., 2018).

The plant world provides society with a wide array of goods and services and plan-use practice is found to vary according to location, tradition,

climatic condition, vegetation type and, rooted belief system of locals (Kunwar & Bussman, 2008). The components of biodiversity are the source of all our food and nutrition and many of our medicines, vegetables, fibers, fuels, timbers, condiments, dye, fruit, meat, and building materials and industrial products (Ghimire, 2008; Rana et al., 2015). Hence plant resources can be the major source of rural income and an important source of revenue to the government (Ghimire, 2008). Humankind derives considerable benefits not only from the products of biodiversity but also from the services of ecological systems, such as water purification, erosion control, and pollination (NRC, 1999).

Realizing the importance of biodiversity cum watershed conservation, the ecological significance of biological corridor connecting to the Dhorpatan Hunting Reserve, the cultural importance of forest and, the surrounding area, the Government of Nepal has declared Madane Forest area as Madane Protected Forest (MPF) in 2013 AD. The MPF is known for its typical middle mountain forest ecosystem that holds 38.62% dense forest at a higher elevation (Thakuri et al., 2018; Kandel, 2018). The forest is an important watershed, providing drinking water to thousands of households and also serve as a major source of rivers of Gulmi, Arghakhachi, Baglung, and Pyuthan. Most of the traditional knowledge and information about plant resources of rural areas of Nepal are still unknown (Primack et al., 2013). Therefore, it is quite important to explore more and document floral diversity and traditional knowledge about forest resources of different communities of MPF before it is completely lost. Several studies have been conducted on floristic exploration in different parts of Nepal but no any in-depth research has been conducted in MPF till now. This small step, therefore, helps to conceptualized and assess the floristic composition along with multiple uses of key plant resources of the MPF. This type of study is essential to make proper conservation plans and sustainable utilization of plant resources (Uprety et al., 2016).

Materials and Methods

Study Area

Madane Protected Forest (MPF) is located in Gulmi district, Lumbini province of west Nepal. MPF lies in a distance of 30 km (west) from the district headquarter, Tamghas. It covers an area of 13,761 ha and ranges in elevation from 975 m (basin of Ghamir) to 2690 m (peak of Hawangdii). Climatically, the area lies between subtropical and temperate zone with minimum annual precipitation of 2021 millimeter (mm) (DoF, 2016). The area is enriched with unique biodiversity and beautiful landscape with a mild climate (Thakuri et al. 2018). MPF falls on two rural municipalities Madane and Malika. MPF consists of 56 community forest (CF) and 8 leasehold forest (LF). Our study area was Bhedikhor-Banjhkateri cluster in which the elevation ranges from 1700 m asl. (Bhedikhor) to 2500 m asl (Malika Mandir). Forest types found in MPF are classified as Schima-Castanopsis forest, Lower temperate Oak forest, Temperate mountain Oak forest, Chir pine forest, and Alder forest (DoF, 2011). Major ethnicities are Brahmin, Kshetri, Magar, Thakuri, Sanyashi, and Dalit.

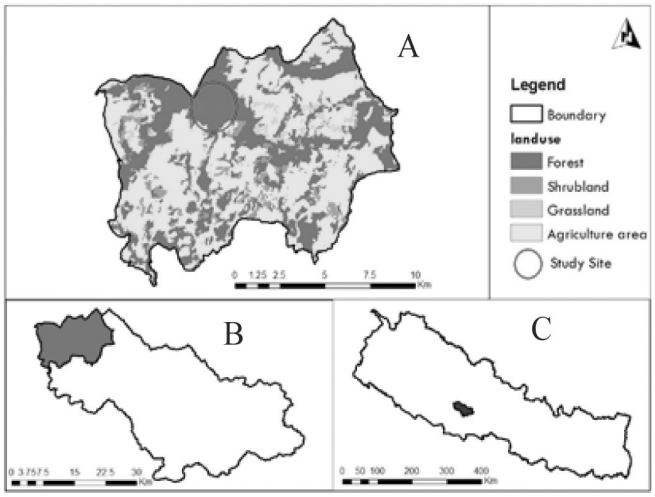

Figure 1: Map showing: A: study area inside Madane Protected Forest (MPF); B: MPF location inside Gulmi district and C: location of Gulmi district in Nepal map

Sampling and Data Collection

Permissions to carry out this research were obtained from the Ministry of Forest and Soil Conservation, Department of Forest, Government of Nepal,

and from Division Forest Office Gulmi. The field sampling was done in January and September of 2018. Study site was stratified into five horizontal transects roughly in an interval of 200 m from 1700-2500 m asl to cover the whole study area. A systematic random sampling approach was used to document floral diversity. On each transects 10 plots (10 m x 10 m) were sampled by maintaining an inter-plot distance of at least 20 m. All forms of plant species present in the plot were recorded and categorized based on their habit.

Altogether 50 plots were sampled in study the area. Plant species were collected from the study site with at least a local name with the help of an experienced local guide. Taxonomically important characters were noted in the field and samples for voucher specimens of each species on the state of either flowering or fruiting or both were collected. Identification of those specimens was done by following standard literature (Polunin & Stainton 1984; Stainton 1988; Press et al. 2000; Shrestha 2018), expert consultation, and comparing with specimen housed at TUCH and KATH. Herbarium specimens prepared were deposited at TUCH. Nomenclature and author citation of plant species followed the International Plant Name Index (https://www.ipni.org/). Information regarding plant-use was collected from the local communities by implying thirty key informant (senior citizens, local healer, school teacher, farmers) interviews and five group discussions with their prior verbal consent. Informants mainly include senior citizens, traditional healers, farmers, and local teachers. Respondents were within the age group of 20-70 years (male and female). Semi-structured questionnaires were used to obtain detailed information regarding knowledge on plant resources, use-value, harvesting methods, and conservation practices. Plant specimens and field photographs were shown during interviews and group discussions. The information collected included the local name of plants and different uses.

Results and Discussion

We recorded 185 species belonging to 154 genera under 74 families from the study area. Dominant families were Asteraceae with 14 genera followed by Poaceae (10 genera), Rosaceae (9 genera), Lamiaceae (8 genera), Fabaceae (7 genera) and Moraceae (6 genera) (Figure 1, Table 1). So far, the previous works are concerned, DoF (2011) has given a list of only 118 plant species from entire MPF (13671 ha.). It doesn't seem DoF conducted in-depth floristic assessment. Most of the recorded plant species in the study sites were angiosperms. A total of 148 species of dicotyledonous plants, 22 monocotyledonous plants, 14 pteridophytes, and one species of gymnosperm were documented in our study (Table 1).

Based on life form (habit) highest number belongs to herbs, followed by shrubs, trees, ferns grasses, and climbers whereas, the lowest number was recorded for epiphytes (Figure 2). The study area housed many plant species, which were categorized as rare, commercially threatened, endemic, vulnerable, and highly prioritized medicinal plants by different organizations. *Asparagaus racemosus*, *Cinnamomum glaucescens*, *Phyllanthus emblica*, and *Zanthoxylum armatum* found in the study area are the medicinal plants which fall under the prioritized list of plant resources (DPR, 2011) (Table 2). *Dioscorea deltoidea* found in the study area is included in CITES Appendix II and its trade is regulated by export permit (Joshi et al., 2017). Similarly, *Paris polyphylla, Rubia manjith* and *Swertia chirayita* fall under the vulnerable category of Conservation Assessment and Management Plan (CAMP) (Bhattarai et al., 2002) (Table 2). One endemic species, *Hypericum cordifolium* (Rajbhandari et al., 2016; Tiwari et al., 2019) was also recorded from MPF for the first time. To preserve these valuable natural resources, the exact information about their population status is needed to be documented before they are completely lost (Acharya, 2012). Unfortunately, little knowledge of important plant resources, unscientific harvesting practices, lack of conservation awareness amongst the local communities are the main factors that may threaten valuable plant assets present in the area.

The information collected showed that the locals of MPF depend upon the forest for their primary

healthcare, fodder, food, fuelwood, timber, and other miscellaneous purposes. Out of 185 species recorded in Bhedikhor – Banjhkateri cluster, 130 species (70 %) were utilized by locals for different purposes. The highest number of plants were used as fodder followed by medicine, fruit and food, fuelwood, and timber. (Figure 4). The majority of the households of MPF were involved in the traditional agriculture system hence, forest areas at lower elevations were in the high pressure of uncontrol fodder, timber and, fuelwood collection, which was shifting towards upper core forest area. Oak was one of the most overexploited species found in the study area due to its multiple uses (fodder, timber, leaf litter and, fuelwood). Poisonous plant species recorded in the study area were *Buddleja paniculata* and *Sapium insigne*, which were used for fishing in local rivers (Joshi & Joshi 2006). *Desmostachys bipinnata* and *Artemesia indica* were among the few plants used in religious and traditional rituals. Some plants were of multiple uses, such as *Mahonia napaulensis, Phyllanthus emblica* used as fruit and medicine, *Asparagus racemosus* as medicinal and religious, *Urtica dioca* as vegetable and medicine, *Daphne bholua* as fiber and medicine. Few species of plants were used for making fiber such as *Daphne bholua*, *Girardiana diversifolia* (Table 1). People preferred to collect species with multiple uses and the population of those plants was more disturbed due to overharvesting and developmental activities (Chaudhary et al., 2002; Thapa & Chapman, 2010). We documented Nepali paper plant i.e., *Daphne bholua*, which is regarded as commercially threatened non-timber forest product (NTFP) of west Nepal (Adhikari et al., 2017). Although this plant was not yet used commercially for paper making, locals used it frequently for making cordage and medicinal purposes. There was very good population of *Daphne bholua* in MPF, which possesses a great possibility to be an alternative source of income for locals if it is used sustainably. Hence, concerned authorities; (Ministry of Forest, Division Forest Office, and local government) along with the stakeholders (locals of MPF and traders) should initiate an immediate research plan which can be very helpful for conserving the vast resource of this forest.

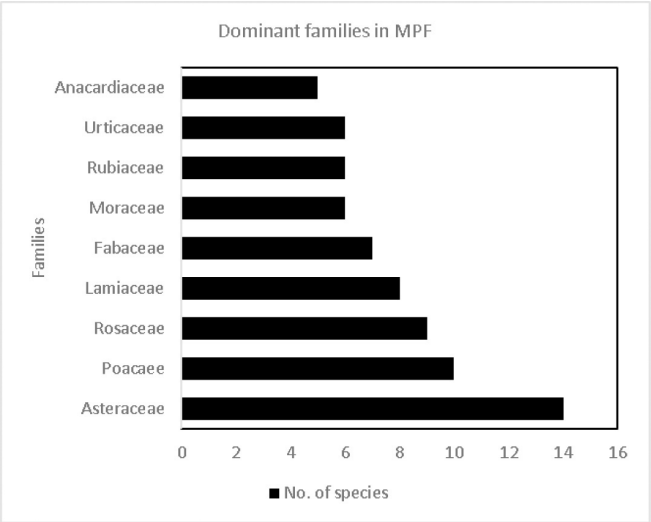

Figure 2: Highest number of family in MPF

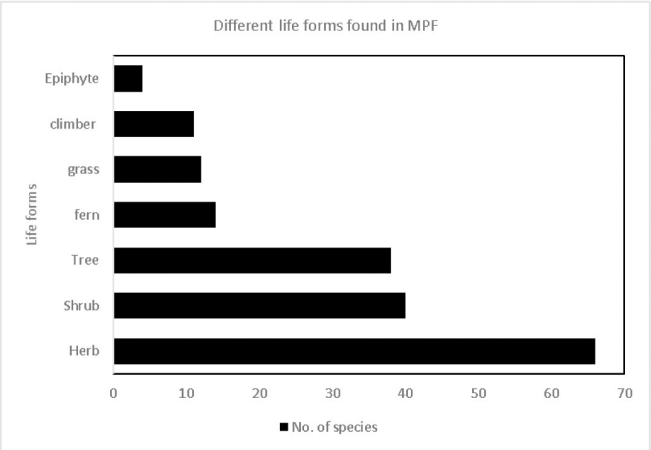

Figure 3: Different life forms of plant found in MPF

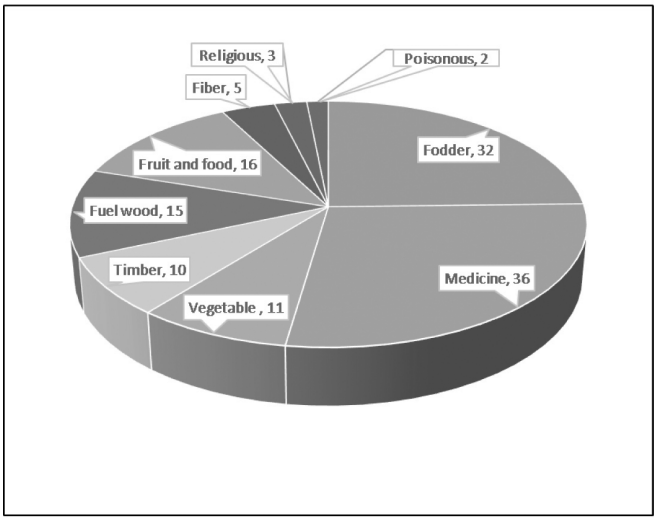

Figure 4: Different uses of plants in MPF

Table 1: List of plant species found in MPF and their uses

S.N.	Scientific name	Nepali name	Family	Habit	Life-form	Uses	Herbarium number
1	*Aconogonum molle* (D. Don) H. Hara	Halhale	Polygonaceae	Hb	Di	Vg	BG 23
2	*Adiantum philippense* L.		Pteridaceae	Fr	Fr	-	BG 01
3	*Ageratina adenophora* (Spreng.) King & H. Rob.	Kalo banmaraa	Asteraceae	Hb	Di	-	BG 85
4	*Albizia chinensis* (Osbeck) Merr.	Kalo siris	Fabaceae	Tr	Di	Tb	BG 07
5	*Albizia julibrissin* Durazz.	Rato siris	Fabaceae	Tr	Di	Tb	BG 19
6	*Albizia procera* (Roxb.) Benth.	Seto siris	Fabaceae	Tr	Di	Tb	BG 424
7	*Alnus nepalensis* D. Don	Uttis	Betulaceae	Tr	Di	Tb	BG 71
8	*Amaranthus spinosus* L.	Kade lunde	Amaranthaceae	Hb	Di	Vg	BG 76
9	*Amaranthus viridis* L.	Lunde	Amaranthaceae	Hb	Di	Vg	BG 02
10	*Anaphilis controta* (D. Don) Hook. F.	Buki	Asteraceae	Hb	Di		BG 34
11	*Anaphilis triplinervis* (Sims) C.B. Clarke	Buki	Asteraceae	Hb	Di		BG 37
12	*Androsace primuloides* D. Don		Primulaceae	Hb	Di		BG 38
13	*Argemone mexicana* L.	Thakal	Papaveraceae	Hb	Di		BG 18
14	*Artemisia indica* Willd.	Titepati	Asteraceae	Hb	Di	Md, Fdd,Rg	BG 05
15	*Artocarpus lacucha* Buch. - Ham	Badahar	Moraceae	Tr	Di	Frt	BG 11
16	*Arundinaria nepalensis* Trin., Gram. Pan	Ghas	Poaceae	Gr	Mo	Fw	BG 22
17	*Asparagus racemosus* Willd.	Kurilo	Asparagaceae	Hb	Mo	Md/Rg	BG 89
18	*Astragalus donianus* DC.		Fabaceae	Hb	Di	Fdd	BG 16
19	*Bauhinia purpurea* L.	Tanki	Fabaceae	Tr	Di	Fdd	BG 466
20	*Berberis asiatica* Roxb. ex. DC.	Chutro	Berberidaceae	Sh	Di	Frt	BG 30
21	*Berberis glaucocarpa* Stapf	Chutro	Berberidaceae	Sh	Di	Md	BG 41
22	*Berginia ciliata* (Haw) Sternb.	Pakhanbed	Saxifragaceae	Hb	Di	Md	BG 453
23	*Boehmeria platyphylla* Buch. - Ham ex. D. Don		Urticaceae	Sh	Di	Fdd	BG 101
24	*Brassaiopsis hainla* (Buch. - Ham) Seem.	Chuletro	Araliaceae	Tr	Di	Fdd	BG 04
25	*Brassiopsis polycantha* (wall.) Banerjee	Kalo chuletro	Araliaceae	Tr	Di	Frt, Md	BG 40
26	*Buddleja asiatica* Lour.	Bhimsen pati	Scrophulariaceae	Sh	Di	Ps	BG 51
27	*Calanthe sylvatica* (Thoura) Lindl.		Orchidaceae	Ep	Mo	Md	BG 53
28	*Carduus edelbergii* L.	Kazmi	Asteraceae	Hb	Di		BG 106
29	*Carex condensata* Nees		Cyperaceae	Gr	Mo		BG 109
30	*Castanopsis indica* (Roxb.) Miq.	Katush	Fagaceae	Tr	Di	Tb	BG 209
31	*Castanopsis tribuloides* (Sm.) A. DC.	Masure katush	Fagaceae	Tr	Di	Fw	BG 224

S.N.	Scientific name	Nepali name	Family	Habit	Life-form	Uses	Herbarium number
32	*Centella asiatica* (L.) Urb.	Ghodtapre/ bramhi	Apiaceae	Hb	Di	Md	BG 12
33	*Cersium* sp.		Asteraceae	Hb	Di	Md	BG 103
34	*Choerospondias axillaris* (Roxb.) B.L. Burtt & A.W. Hill	Lapsi	Anacardiaceae	Tr	Di	Frt, Tb	BG 81
35	*Cinnamomum glauscens* (Nees.) Nand. Mazz	Sugandha kokila	Lauraceae	Tr	Di	Md	BG 62
36	*Cinnamomum tamala* (Buch.-Ham.) Ness & Eberm	Sunkaulii	Lauraceae	Tr	Di	Md	BG 67
37	*Cissampelos pareira* L.	Batulopate	Menispermaceae	Cb	Di	Fdd	BG 97
38	*Clematis acuminata* DC.	Bagh laharo	Ranunculaceae	Cb	Di	Md	BG 107
39	*Clematis buchaniana* Wall.	Bagh lahara	Ranunculaceae	Cb	Di	Md	BG 426
40	*Coelogyne cristata* Lindl.	Orchid	Orchidaceae	Ep	Mo	Md	BG 24
41	*Colebrookea oppositifolia* Sm.	Bhogate	Lamiacea	Sh	Di	Fw	BG 44
42	*Colocasia fallax* Schott.	Ban karkalo / Ban Pindalu	Areaceae	Hb	Mo		BG 125
43	*Colquhounia coccinea* Wall.	Fulchiso/ syal kainchi	Lamiacae	Sh	Di	Fdd	BG 76
44	*Cotoneaster* sp.	Jarbuta /thate	Rosaceae	Sh	Di	Fdd	BG 225
45	*Crassocephalum crepidioides* (Benth.) S. Moore	Anikale jhar	Asteraceae	Hb	Di		BG 77
46	*Crateva unilocularis* Buch.-Ham	Sibligan	Capparaceae	Tr	Di	Vg, Md	BG 284
47	*Cuscuta reflexa* Roxb.	Akash beli	Convolvulacaea	Ep	Di	Md	BG 116
48	*Cyanotis vaga* (Lour.) Schult. & Schult.f.		Commelinaceae	Hb	Mo		BG 153
49	*Cynodon dactylon* (L.) Pers.	Dubo	Poaceae	Gr	Mo	Md, Fdd	BG 140
50	*Cyperus rotundus* L.	Mothe	Cyperaceae	Gr	Mo		BG 64
51	*Daphne bholua* Buch.-Ham. ex D.Don	Nilo baruwa	Thymalaceae	Sh	Di	Fbr, Md	BG 20
52	*Daphne papyreceae* Wall. ex Steud.	Seto baruwa	Thymalaceae	Sh	Di	Fbr, Md	BG 21
53	*Daphniphyllum himalayense* (K. Rosenthal)	Nepali chandan	Daphniphyllaceae	Tr	Di	Fdd	BG 203
54	*Datura suaveolens* Humb. & Bonpl. ex Willd	Dhature phul	Solanaceae	Sh	Di		BG 185
55	*Desmodium microphyllum* (Thunb.) DC.		Fabaceae	Hb	Di		BG 187
56	*Desmostachys bipinnata* (L.) Stapf	Kush	Poaceae	Gr	Mo	Rg, Fdd	BG 186
57	*Dichroa fabrifuga* Lour.	Ganaune pat	Hydragenaceae	Hb	Di		BG 29
58	*Didymocarpus pedicellatus* R.Br.	Ghyu dadu	Gesneriaceae	Hb	Di		BG 257
59	*Digitaria cilliaris* (Retz.) Koeler	Banso	Poaceae	Gr	Mo	Fdd	BG 191
60	*Digitaria longiflora* (Retz.) Pers.	Banso	Poaceae	Gr	Mo	Fdd	BG 163
61	*Dioscorea bulbifera* L.	Ban tarul/teme	Dioscoreaceae	Cb	Mo	Fd and	BG 59

S.N.	Scientific name	Nepali name	Family	Habit	Life-form	Uses	Herbarium number
						Vg	
62	*Dioscorea deltoidea* Wall. ex Griseb.	Griseb bhyakur/teme	Dioscoreaceae	Cb	Mo	Fd and Vg	BG 153
63	*Dipsacus inermis* Wall.	Mula pate	Dipsacaceae	Hb	Di		BG 78
64	*Dobinea vulgaris* Buch.-Ham. ex D.Don	Sangale	Anacardiaceae	Sh	Di	Fdd	BG 69
65	*Drepanostachym flacatum* (Ness) Keng F.	Nigalo	Poaceae	Hb	Mo	Fw	BG 132
66	*Drymaria cordata* (L.) Willd. ex Roem & Scolt	Abijalo	Caryophyllaceae	Hb	Di	Md	BG 58
67	*Elaeagnus parvifolia* Wall. ex Royale	Guelo	Elagnaceae	Tr	Di	Fd	BG 201
68	*Elsholtzia blanda* (Benth.) Benth.	Bansilam	Lamiaceae	Hb	Di		BG 307
69	*Engelhardia spicata* Lesch. ex Bl.	Mahuwa/plee	Juglandaceae	Tr	Di	Tb	BG 47
70	*Eregeron multiradiatus* (Lindl. Ex DC.) Benth. ex CB Clarke		Asteraceae	Hb	Di		BG 71
71	*Eurya acuminata* DC.	Jhyano	Theaceae	Tr	Di	Fdd	BG 283
72	*Eurya cerasifolia* (D.Don)	Kobuski pate/kalo jhya	Moraceae	Sh	Di	Fdd	BG 307
73	*Ficus auriculata* Lour.	Nimaro/tamala	Moraceae	Sh	Di	Fdd	BG 152
74	*Ficus lacor* Buch.- Ham.	Kabro/tangu	Moraceae	Tr	Di	Fd and Fdd	BG 144
75	*Ficus neriifolia* Sm.	Dudhilo/ nara/ nata	Moraceae	Tr	Di	Fd and Fdd	BG 231
76	*Flemingia strobilifera* (L.) W. T. Aiton	Bhatmase	Fabaceae	Hb	Di	Fdd	BG 147
77	*Fragaria nubicola* Lindl. ex Lacaita	Bhuin kafal	Rosaceae	Hb	Di	Frt	BG 159
78	*Fraxinus floribunda* Wall.	Lankuri	Oleaceae	Tr	Di	Tb	BG 357
79	*Galium aparine* L.		Rubiaceae	Hb	Di		BG 251
80	*Gaultheria fragrantissima* Wall.	Dhasingare	Ericaceae	Sh	Di	Md	BG 167
81	*Gentiana depressa* L.		Gentianaceae	Hb	Di		BG 95
82	*Geranium wallichianum* (D.Don) ex Sweet		Geraniaceae	Hb	Di		BG 97
83	*Girardinia diversifolia* (Link) Friis	Allo	Urticaceae	Sh	Di	Fbr, Md	BG 99
84	*Gnaphalium affine* D. Don	Buki ful	Asteraceae	Hb	Di		BG 133
85	*Gonatanthus pumilus* (D. Don) Engler & Krause	Patarkanch	Areaceae	Hb	Mo		BG 136
86	*Gonostegia hirta* (Blume) Miq		Urticaceae	Hb	Mo		BG 131
87	*Hedyotis scandens* Roxb.		Rubiaceae	Cb	Di		BG 298
88	*Hemiphragma heterophyllum* wall.		Scrophulariaceae	Hb	Di		BG 130
89	*Hydrocotyle* sp.	Ghodtapre	Apiaceae	Hb	Di	Md	BG 120

S.N.	Scientific name	Nepali name	Family	Habit	Life-form	Uses	Herbarium number
90	*Hypericum cordifolium* DC.		Clusiaceae	Hb	Di	Fdd	BG 331
91	*Ilex dipreyana* Wall.	Seto khasru	Aquifoliaceae	Tr	Di		BG 71
92	*Imperata cylindrica* (L.) P. Beauv	Siru	Poaceae	Gr	Mo	Fdd	BG 79
93	*Ixeris gracilis* (DC.) Stebb		Asteraceae	Hb	Di		BG 180
94	*Juncus articulatus* L.	Jwanee	Juncaceae	Gr	Mo		BG 101
95	*Justicia adhatoda* L.	Asuro	Acanthaceae	Sh	Di	Ps	BG 239
96	*Lepisorous bicolor* (Takeda) Ching, Bull		Polypodiaceae	Fr	Fr		BG 300
97	*Leucosceptrum canum* Sm		Lamiacea	Sh	Di	Fw	BG 29
98	*Lindera pulcherrima* (Ness) Hook.f.	Phosre	Lauraceae	Tr	Di	Fw	BG 09
99	*Litsea cubeba* (Lour.) Press.	Siltimur	Lauraceae	Sh	Di	Md	BG 211
100	*Lyonia ovalifolia* (Wall.) Drude	Angero	Ericaceae	Sh	Di		BG 46
101	*Macaranga indica* Wight	Malata/malato/ kalan	Euphorbiaceae	Tr	Di	Tb	BG 211
102	*Maesa chisia* Buch. -Ham ex D. Don	Bilaunii	Primulaceae	Sh	Di	Md	BG 132
103	*Mahonia napaulensis* DC.	Jamanemanro	Berberidaceae	Sh	Di	Frt,Md	BG 297
104	*Mussaenda roxburghii* Hook. f.		Rubiaceae	Sh	Di	Fdd	BG 119
105	*Myrica esculenta* Buch.-Ham. ex D. Don	Kaphal	Myricaceae	Tr	Di	Frt, Tb	BG 73
106	*Myrsine semiserrata* Wall.	Kalikath	Myrsinaceae	Tr	Di	Fw	BG 178
107	*Nepeta ciliaris* Benth.		Lamiaceae	Hb	Di		BG 294
108	*Nephrolepis cordifolia* (L.) C. Presl	Pani saro	Nephrolepidaceae	Fr	Fr	Md	BG 28
109	*Onychium japonicum* (Thunberg) Kunze		Pteridaceae	Fr	Fr		BG 47
110	*Onychium lucidum* (D. Don) Spreng.		Pteridaceae	Fr	Fr		BG 210
111	*Oplismenus compositus* (L.) P. Beauv.		Poaceae	Gr	Mo	Fdd	BG 129
112	*Osbekia stellata* Buch.-Ham.ex D. Don	Angeri	Melastomataceae	Sh	Di	Fdd	BG 38
113	*Osyris wightiana* Wall. ex Wight	Nundhiki	Santalaceae	Sh	Di	Fw	BG 70
114	*Paris polyphylla* Sm.	Satuwa	Liliaceae	Hb	Di	Md	BG 213
115	*Paspalum* sp	Likhebanso	Poaceae	Gr	Mo	Fdd	BG 301
116	*Persea odoratissima* (Nees.) Kosterm.	Kaulo	Moraceae	Tr	Di	Fdd	BG 255
117	*Persicaria capitata* (Buch.-Ham. ex D. Don)	Raktanyaule jhar	Polygonaceae	Hb	Di	Md	BG 298
118	*Persicaria nepalensis* (Meisn.) Miyabe		Polygonaceae	Hb	Di	Vg	BG 309
119	*Phyllanthus emblica* L.		Phyllanthaceae	Hb	Di	Frt, Md	BG 86
120	*Phyllanthus niruri* L.		Phyllanthaceae	Sh	Di		BG 389
121	*Pieris formosa* (Wall.) D. Don	Pore	Ericaceae	Tr	Di	Fw	BG 107

S.N.	Scientific name	Nepali name	Family	Habit	Life-form	Uses	Herbarium number
122	*Pilea scripta* (Buch.-Ham. ex D. Don) Wedd.	Gaulato / gablato	Urticaceae	Hb	Di	Fdd	BG 19
123	*Pinus wallichiana* A.B. Jacks	Gobre salla	Pinaceae	Tr	Gm	Tb	BG 74
124	*Plantago depressa* Willd.		Plantaginaceae	Hb	Di	Md	BG 37
125	*Pogostemon benghalensis* (Brum. f.) Kuntze		Lamiaceae	Hb	Di		BG 127
126	*Polygonatum griffithii* Baker		Asparagaceae	Hb	Di	Fdd	BG 134
127	*Polystichum aculeatum* (L) Schott.		Dryopteridaceae	Fr	Fr		BG 152
128	*Potentilla fulgens* Hook. F.	Bajradanti	Rosaceae	Hb	Di		BG 213
129	*Potentilla lineata* Trevir.	Bajradanti	Rosaceae	Hb	Di		BG 321
130	*Prunus cerasoides* D.Don	Paiyu	Rosaceae	Tr	Di	Rg	BG 92
131	*Pteris vittata* L.		Pteridaceae	Fr	Fr	Vg	BG 14
132	*Pteris wallichiana* J. Agardh		Pteridaceae	Fr	Fr		BG 303
133	*Pyracantha crenulata* (D. Don) M. Roem.	Ghangaru	Rosaceae	Sh	Di	Frt	BG 325
134	*Quercus glauca* Thunb.	Phalant	Fagaceae	Tr	Di	Fdd	BG 204
135	*Quercus lanata* Sm.	Banjh	Fagacea	Tr	Di	Fdd	BG 219
136	*Quercus semicarpifolia* Sm.	Khasru	Fagacea	Tr	Di	Fw	BG 27
137	*Randia tetrasperma* (Wall. ex Roxb.) Benth. & Hook.f. ex BranDis	Ghorikath/basantikath	Rubiaceae	Sh	Di		BG 74
138	*Ranunculus sceleratus* L.	Nakkore	Ranunculaceae	Hb	Di	Md	BG 117
139	*Reinwardtia indica* Dumort	Pyauli	Linaceae	Hb	Di	Fdd	BG 452
140	*Rhododendron arboreum* Sm.	Lali guransh	Ericaceae	Tr	Di	Fw	BG 401
141	*Rhus javanica* L.	Bhakimlo/ tipru	Anacardiaceae	Sh	Di	Fd	BG 395
142	*Rhus succedanea* L.	Rani bhalayio	Anacardiaceae	Sh	Di		BG 322
143	*Rosa laevigata* Michx.	Bangulab	Rosaceae	Sh	Di		BG 411
144	*Roscoea alpina* Royle		Araceae	Hb	Mo	Fdd	BG 320
145	*Rubia manjith* Roxb. ex Fleming	Majitho	Rubiaceae	Cb	Di	Md	BG 402
146	*Rubus ellipticus* Sm.	Ainshalu	Rosaceae	Sh	Di	Frt	BG 419
147	*Rubus rosifolius* Smith	Kalo ainselu	Rosaceae	Sh	Di	Frt	BG 498
148	*Rumex hastatus* D. Don	Iimili	Polygonaceae	Hb	Di	Md	BG 358
149	*Rumex nepalensis* Spreng.	Halhale	Polygonaceae	Hb	Di	Vg	BG 37
150	*Sapium insigne* (Royle) Benth. ex Hook. F	Khirro	Euphorbiaceae	Tr	Di	Ps	BG 222
151	*Sarcococca coriaceae* (Hook.) Sweet		Buxaceae	Sh	Di	Md	BG 159
152	*Saurauia napaulensis* DC.	Gogan	Saurauiaceae	Tr	Di	Fw	BG 403
153	*Schefflera* sp.	Kutsimal	Araliaceae	Sh	Di		BG 444
154	*Schima wallichii* Choisy	Chilaune	Theaceae	Tr	Di	Tb	BG 447
155	*Scurulla parasitica* L.	Ainjeru	Loranthaceae	Ep	Di		BG 156
156	*Selaginella vaginata* Spring		Selaginellaceae	Fr	Fr	Md	BG 31
157	*Semecarpus anacardium* L.f.	Bhalayo	Anacardiaceae	Sh	Di	Md	BG 459
158	*Senecio cappa* Buch-Ham. ex D. Don	Bhakre kane	Asteraceae	Hb	Di	Fdd	BG 261

S.N.	Scientific name	Nepali name	Family	Habit	Life-form	Uses	Herbarium number
159	*Sigesbeckia orientalis* L.		Asteracae	Hb	Di		BG 333
160	*Smilax ovalifolia* Roxb.	Kukur daino	Smilaceae	Cb	Di	Vg	BG 459
161	*Solanum erianthum* D. Don	Dursul	Solanaceae	Sh	Di		BG 234
162	*Solanum virginianum* L.	Kantakari	Solanaceae	Hb	Di	Md	BG 95
163	*Stellaria media* (L.) Vill.		Caryophyllaceae	Hb	Di		BG 325
164	*Swertia chirayita* (Roxb. ex Fleming) Karsten	Tite	Gentianaceae	Hb	Di	Md	BG 405
165	*Symplocos theifolia* D. Don	Dabdabe	Symplocaceae	Tr	Di	Fw	BG 461
166	*Taraxacum officinale* F. H. Camus		Asteraceae	Hb	Di		BG 163
167	*Tectaria gemmifera* (Fée) Alston		Tectariaceae	Fr	Fr	Vg	BG 357
168	*Tetrastigma serrulatum* (Roxb.) planch.	Pani lahara	Vitaceae	Cb	Di	Fbr	BG 181
169	*Thalictrum punduanum* wall		Ranunculaceae	Hb	Di	Fdd	BG 411
170	*Thelypteris dentata* (Forssk.) E.P. St. John		Thelypteridaceae	Fr	Fr		BG 497
171	*Themeda villosa* (Lam.) A. Camus	Camus khar/ kee	Poacaee	Gr	Mo	Fdd	BG 455
172	*Thunbergia coccinea* Wall.	Singarne lahera	Acanthaceae	Cb	Di		BG 318
173	*Thymas linearis* Benth		Lamiaceae	Hb	Di		BG 465
174	*Trichilia connaroides* (Wight & Arn.) Bentv	Ankha taruwa	Meliaceae	Tr	Di	Fw	BG 493
175	*Tinospora sinensis* (Lour.) Merr.	Gurjo	Menispermaceae	Cb	Cb	Md	BG 455
176	*Tridax procumbens* L.		Asteraceae	Hb	Di		BG 463
177	*Urtica ardens* Link.	Sisnu/ pulu	Urticaceae	Hb	Di	Vg, Md	BG 245
178	*Urtica dioica* L.	Lekh sisnu	Urticaceae	Hb	Di	Vg, Md	BG 24
179	*Vaccinium retusum* (Griff.) Hook. F. ex C.B. Clarke		Ericaceae	Hb	Di	Md	BG 06
180	*Vibernum cylindricum* Buch-Ham. ex D. Don	Malo	Sambucaceae	Sh	Di	Fw	BG 36
181	*Vibernum erubescens* Wall. ex Dc.	Bajrang	Sambucaceae	Sh	Di	Fw	BG 26
182	*Viola biflora* L.		Violaceae	Hb	Di	Md	BG 27
183	*Wikstroemia canascens* Wall. ex Mesin	Patuwa	Thymalaceae	Sh	Di	Fbr	BG 212
184	*Zanthoxyllum oxyphyllum* Edgew.	Ban timur	Rutaceae	Sh	Di	Md	BG 287
185	*Zanthoxylum armatum* DC.	Timur	Rubiaceae	Sh	Di	Md	BG 471

Note : Hr = herb, Sh = shrub, Tr = tree, Fr =fern, Gr = grass, Ep = epiphyte, Mo = monocot, Di = dicot, Vg = vegetable, Tb = timber, Md = medicine, Fdd = fodder, Rg = religious, Fw = fuelwood, Frt = fruit, Ps = poisonous, Fbr=fiber

Table 2: Prioritized plant species found in MPF

SN	Scientific name	Nepali name	Status
1	*Asparagus racemosus* Willd.	Satawari/ kurilo	Vulnerable (CAMP)
2	*Berginia ciliata* (Haw) Sternb.	Pakhanbed	Commercial threatened
3	*Choerospondias axillaris* (Roxb.) B.L. Burtt & A.W. Hill	Lapsi	Rare (DPR 2011)
4	*Cinnamomum glauscens* (Nees.) Nand. Mazz	Sugandha kokila	Protected
5	*Crateva unilocularis* Buch.-Ham.	Sibligan	Rare
6	*Daphne bholua* Buch.-Ham. ex D. Don	Lokta	Commercially threatened (Local assessment)
7	*Dioscorea deltoidea* Wall. ex Griseb.	Bhyakur/teme	CITES II, commercially threatened
8	*Paris polyphylla* Sm.	Satuwa	Vulnerable (CAMP)
9	*Phyllanthus emblica* L.	Amala	Medicinal Plants for research & development (DPR 2011)
10	*Rubia manjith* Roxb. ex Fleming	Majitho	Vulnerable (CAMP)
11	*Swertia chirayita* Roxb. ex Fleming) Karsten	Tite	Vulnerable (CAMP)
12	*Tinospora sinensis* (Lour.) Merr.	Gurjo	Vulnerable (CAMP)
13	*Zanthoxyllum armatum* DC.	Timur	Medicinal Plants for research & development (DPR 2011)

Conclusion

Since the declaration of protected forest in 2011, no botanical exploration was done in MPF. We conclude that MPF is a unique forest, rich in unique floral diversity due to its varying elevation and huge area. Altogether 185 plant species belonging to 74 families have been recorded from the Bajhkateri - Bhedikhor cluster which covers around 15% of land area out of total 13,671 ha area of MPF. Remaining area of MPF still untouched in terms of its floristic diversity and other scientific exploration. Several highly prioritized plant resources have been documented by this study which was previously unknown for MPF. We observed that the wetter northern face of MPF was very rich in orchid diversity during our research we recorded only two species of orchid from our experimental plot it means we did not focused more on epiphytic plant. This area might be the good area for orchid researcher. The local livelihood system depends heavily on traditions and values that are deeply rooted. Locals gave priority to those species that provide them with multitude of benefits. Habitat destruction, overharvesting of natural resources, wildfire, and unmanaged road construction are the major threats to the natural forest in MPF. Current conservation and management plans do not seem strict and effective, locals were unaware and less concerned regarding conservation and sustainability of MPF. We recommend that the forest officials of MPF should realize the urgency of conservation and locals should feel a sense of belonging of this unique hub of biodiversity by proposing effective and strict guidelines and policies to protect this forest. Local forest authorities should educate local peoples about the benefits they can get from sustainable usage of forest resources and should show ways to generate income. In addition, as large areas of this forest remained untouched in terms of scientific research, a detailed survey or inventory research should be done immediately in near future to document all the unique biodiversity of this forest. Conclusion

Author Contributions

BJ designed the research method. Both BJ and AN collected the data and analyzed the data. BJ led the writing.

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References

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

Adhikari, B., Pendry, C. A., Måren, I. E., Bhattarai, K. R. & Chaudhary, R. P. (2017). Distribution and preliminary conservation assessements of commonly used forest species in the Nepalese Himalayas. *Banko Janakari, 27*(1), 43-54.

APG IV. (2016). An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG IV. *Botanical Journal of the Linnean Society*, *181*(1), 1-20.

Aryal, K. P., Poudel, S., Chaudhary, R. P., Chettri, N., Chaudhary, P., Sharma, E., & Kotru, R. (2018). Diversity and use of wild and non-cultivated edible plants in the Western Himalaya. *Journal of Ethnobiology and Ethnomedicine*, *14*(1), 1-18.

Bhandari, P., Budhamagar, S., & Shrestha, K. K. (2018). A checklist of flowering plants of Panchase Protected Forest, Kaski district, central Nepal. *Journal of Natural History Museum*, *30*, 55-84.

Bhattarai, N., Tandon, V., & Ved, D. K. (2002). Highlights and outcomes of the Conservation Assessment and Management Plan (CAMP) workshop. In: N. K. Bhattarai and M. Karki (Eds.). *Sharing Local and National Experience in Conservation of Medicinal and Aromatic Plants in South Asia. Proceedings of the Regional Workshop at Pokhara, Nepal*. IDRC/ MAPPA, India and Ministry of Forests and Soil Conservation, Nepal.

Chalise, P., Paneru, Y. R., & Ghimire, S. K. (2018). Floristic diversity of vascular plants Gyasumbdo valley, lower Manang, Central Nepal. *Journal of Plant Resources*. *17*(1), 42-57.

Chaudhary, R. P., Nepal, M., Gupta, V. N. P., & Subedi, B. P. (2002). Traditional Use of Plants by the Indigenous peoples of Makalu-Barun Region, eastern Nepal. In R. P. Chaudhary, Bhim P. Subedi, O. R. Vetaas, & T. H Aase (Eds). *Vegetation and Society: their Interaction in the Himalayas*. (pp. 83-97). Tribhuvan University, Nepal and University of Bergen Norway.

Dangol, D. R., & Shivakoti, G. P. (2001). Plant Diversity of Western Chitwan Floristic Approach. *Journal of Natural History Museum, 20*, 129-147.

DOF. (2011). *Madane Protected Forest Management Work Plan*. Government of Nepal, Ministry of Forest and Soil conservation (In Nepali).

DOF. (2016). *Madane Protected Forest an Introduction*. Government of Nepal, Ministry of Forest and Soil conservation (In Nepali).

DPR. (2011). *Prioritized Medicinal Plants for Economic Development in Nepal*. Department of Plant Resources, Nepal.

Ghimire, S. K., Sapkota, I. B., Oli, B. R., & Parajuli, R. R. (2008). *Non-Timber Forest Products of Nepal Himalaya: Database of Some Important Species found in the Mountain Protected Areas and Surrounding Regions., Kathmandu, Nepal*, WWF Nepal Program.

Gubhaju, M. R., & Ghimire, S. K. (2009). Diversity and population Status of Non–Timber forest Products (NTFPs) in community forest of Dovan, Palpa. *Journal of Natural History Museum*, *24*(1), 22-47.

Joshi, N., Dhakal, K. S., & Saud, D. S. (2017). *Checklist of CITES Listed Flora of Nepal*. Department of Plant Resources, Nepal.

Kandel, P. (2018). Socio-economic baseline studies on Madane IBA (Important Biodiversity Area) of Gulmi district Nepal. A technical report. Kathmandu Forestry College. Joshi, R.A., and Joshi K. (2006). Piscicidal Plants of Nepal: Checklist, Ethnobotanical Uses and Indigenous Practices. *Ethnobotanical Leaflets 10*, 342-349.

Kunwar, R. M., & Bussmann, R. W. (2008). Ethnobotany in the Nepal Himalayas. *Journal*

of Ethnobiology and Ethnomedicine, *4*(24), 1-8.

NRC (1999). *Perspectives on biodiversity: valuing its role in an everchanging world* (pp. 129). National Academy Press. Available from: https://www.ncbi.nlm.nih.gov/books/NBK224412/.

Polunin, O., & Stainton, A. (1984). *Flowers of the Himalaya* (12th ed.). Oxford University Press.

Press, J. R., Shrestha, K. K., & Sutton, D. A. (2000). *Annotated checklist of the Flowering Plants of Nepal*. The Natural History Museum.

Primack, R. B., Paudel, P. K., & Bhattarai, B. P. (2013). *Coservation Biology A Primer for Nepal* (5th ed.). Dreamland Publication Pvt. Ltd.

Rajbhandari, K. R., Rai, S. K., & Bhatt, G. D. (2016). Endemic Flowering Plants of Nepal: An update. *Bulletin of Department of Plant Resources*. *38*, 106-144.

Rana, S. K., Oli, P. S., & Rana, H. K., (2015). Traditional Botanical Knowledge (TBK) on the use of medicinal plants in Sikles area Nepal. *Asian Journal of Plant Science and Research*, *5*(11), 8-15.

Shrestha, B. B., Shrestha, U. B., & Shrestha, S. (2010). Biodiversity conservation in community forests of Nepal; rhetoric and reality. *International journal of biodiversity and conservation*, *2*(5), 98-104.

Shrestha, K. K., Bhattarai, S., & Bhandari, P. (2018). *Handbook of Flowering Plants of Nepal (Volume 1 Gymnosperm and Angiosperms, Cycadaceae–Betulaceae)*. (1st ed.). Scientific Publishers, India.

Simpson, M. G. (2006). *Plant Systematics*. (3rd ed.). Elsevier Academy Press.

Singh, A. G., Kumar, A., & Tewari, D. D. (2012). An ethnobotanical survey of medicinal plants used in Terai forest of western Nepal. *Journal of Ethnobiology and Ethnomedicine*, *8*(19), 1-14.

Stainton, A. (1998). *Flowers of Himalaya, A supplement*. (7th ed.). Oxford University Press.

Thakuri, J. J., Nyegaard, T., & Joshi, A. B. (2018). *Bird Survey of Madane Protected Forest, Gulmi District, Western Nepal*. Field survey and report preparation. Bird Conservation Nepal.

Thapa, S., & Chapman, D. S. (2010). Impacts of Resource Extraction on Forest Structure and Diversity in Bardia National Park, Nepal. *Forest Ecology and Management*, *259*(3), 641-649.

Tiwari, A., Uprety, Y., & Rana, S. K. (2019). Plant Endemism in the Nepal Himalayas and Phytogeographical Implications. *Plant Diversity*, *41*(3), 174-182.

Tsegaye, T. (2006). An overview of the forest ecosystems of Ethiopia: functions, trends and future directions. In M. Seyoum and C. Stoop (Eds.). *Environment for Survival Taking Stock of Ethiopia's Environment* (pp. 18-34). *Proceedings of the First Green Forum Conference*. Green Forum.

Uprety, Y., Poudel, R. C., Chaudhary, R. P., Oli, B. N., Bhatta, L. D., & Baral, S. P. (2016). *Sustainable Utilization and Conservation of Non–timber Forest Products, Major Species of Kailash Sacred Landscape Nepal*. Ministry of Forests and Soil Conservation (MoFSC), Government of Nepal; Research Centre for Applied Science and Technology (RECAST), Tribhuvan University; and International Centre for Integrated Mountain Development (ICIMOD). Nepal.