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Role of non-timber forest products (NTFPs) in sustaining forest-based livelihoods: a case study of Ribdi village of West Sikkim, India

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The study aimed at documenting the indigenous knowledge on the use of non-timber forest products (NTFPs) by the local community of Ribdi village, West Sikkim, India. It also assesses the information on the important and frequently cited species for future sustainable management. The information was gathered through semi-structured interviews and questionnaire based household surveys. A total of 61 species belonging to 56 genera and 36 families were reported to be used as NTFPs. Asteraceae, Athyriaceae and Lauraceae were the dominating families with 4 species each with mainly tree type growth forms (47%). The highest numbers of species were used for medicinal purpose in curing many diseases and ailments. The Informant consensus factor (ICF) revealed the most used category among all, i.e., construction and handicrafts (0.62). The present study has thus documented the maximum use of *Lithocarpus pachyphyllus*, among all the species with highest value of Relative Frequency Citation (RFC) and Use Value (UV). In this investigation, local community dependence on forest resources for nutrition, health, food, and other daily use products was significant. This signifies the rich community knowledge about these resources. In addition, enhancing the capacity and awareness of local communities in NTFPs conservation, sustainable harvesting and value addition through training techniques can aid in sustainable development of the region.

Keywords: Himalayas, Medicinal plants, Non timber forest products (NTFPs), Sikkim, Traditional knowledge, Wild edibles

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Forests are the largest trove of natural resources sustaining almost one-third population of the world. Apart from agricultural practices, people living at the fringes of forests depend on non-timber forest products (NTFPs) to meet food, fodder, fiber, medicine and other needs[1]. In India, it is estimated that 275 million people living in rural areas depend on NTFPs for subsistence and cash livelihood[2]. NTFPs are becoming a key matter of international concern and attention as a means of poverty alleviation, development, participatory conservation and food security[3]. But the 77% of global studies reported the loss of local and indigenous knowledge caused by globalization, modernization, and market integration which is likely to critically threaten biodiversity conservation[4].

In India, more than 3000 plant species produce economically useful NTFPs[5]. Himalayan regions being rich in biodiversity due to its wide-ranging geographical, physiological, topographical, climatic and ecological zones within the region[6], immense arrays of NTFPs are found[7]. A large number of NTFPs are used for food purpose especially by the tribal communities in the Himalaya[8]. The frequent threats to these NTFPs are the unsustainable harvesting and loss of habitat due to factors such as land use changes, deforestation and over-grazing[9,10].

In Sikkim, the documentation on NTFPs is inadequate compared to the other Himalayan states of India[11,12]. There is a need for establishing the data on NTFPs in present day scenario. As identifying the groups of plants and the reason for its utilization can help in defining and implementing priorities for conservation and sustainable management strategies[13]. Moreover, this study of NTFPs can provide an opportunity for ecologists, ethnobiologists, economists and social scientists to assimilate their respective approaches to determine the true value of forest products and modify the present policies for the land use pattern[14]. Therefore, the present study aimed at documenting the indigenous knowledge on the use of NTFPs by the local community of Ribdi village,

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West Sikkim, India. It also assesses the information on the important and frequently cited species for extensive circulation, future sustainable management and also to improve the socio-economic condition of the localities.

Methodology

Study area

Ribdi is a small village situated in the western part of Sikkim, India having an area of 355.91 hectares located nearby Barsey Rhododendron Wildlife Sanctuary, which is a protected area for the conservation of rhododendron species. The geographical coordinates (latitudes and longitudes) of this village are 27° 10' 10''N and 88° 6' 27''E (Fig. 1). The village encompasses very high hill type climatic conditions being located at an altitudinal range of 2200-3100 amsl. During the month of June-July, this place experiences heavy rainfall and slight snow fall during winter months. The annual mean rainfall ranges between 2301-2800 mm and the annual mean temperature ranges between 10.1-16.0°C.

Ribdi has a total population of 1034 persons with 229 households. The dominant community is Sherpa followed by other communities such as Rai, Subba, Chettri, Pradhan, Tamang, Bishwakarma, Manger, etc. Most people are involved in farming and possess their own agricultural land. They are either directly or indirectly involved in the agricultural activities. This village has a suitable climate especially for the production of potato and other vegetables such as cabbage, peas, radish, green leafy vegetables, etc. Potato is the major cash crop within this village. On the sides of the roads, the villagers have planted rhododendron species such as *Rhododendron arboreum, Rhododendron griffithianum, Rhododendron grande*, etc. During the flowering season, the roadside appears dazzling with a variety of colored blooming flowers. The remote location of the village distant from the market areas and the availability of only one

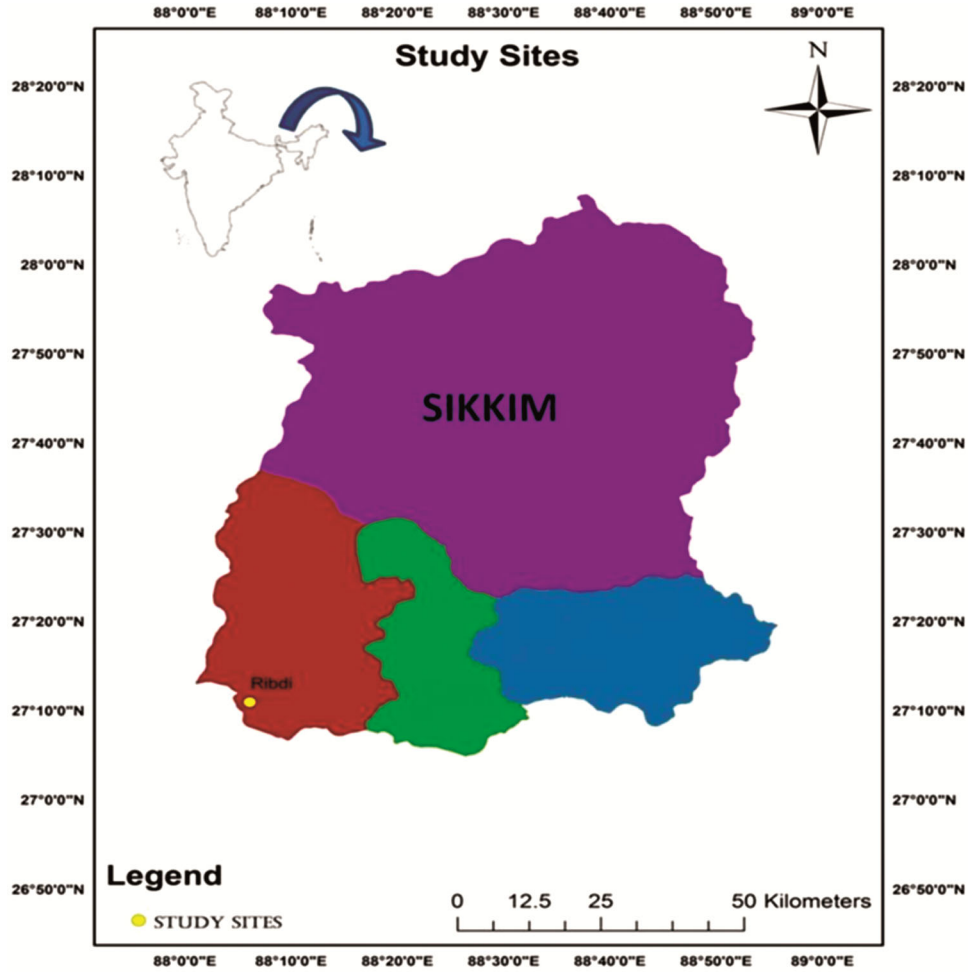

Fig. 1 — Showing study site on the map of Sikkim

primary health centre with limited medical facility can be a prime reason for the dependency of locals on the nearby forest resources.

Data collection

Initially secondary literature sources were reviewed for detail information about the diverse floral and other components of the village. Field data on the various uses of forest resources (NTFPs) was collected from Ribdi. Field work was conducted through semi-structured interviews and questionnaire-based household surveys documenting the uses of forest resources as medicinal, wild edible, fodder, fuel wood, construction and handicrafts and for religious purpose within the village (a questionnaire is provided as supplementary file). The questionnaire was designed to compile data on NTFPs available and used mostly by the locals, documenting local name, uses, parts used and mode of utilization. Socio-economic status of the informants such as age, gender, occupation, educational background, family member was also recorded. 22% of total households were surveyed, i.e., 50 households in Ribdi village. Households for survey were selected on the basis of village leaders recommendation and locals willingness to be interviewed. The plant species were identified by field guide using local names and later confirmed by experts at BSI, Gangtok and the accepted names were checked in The Plant List and the herbariums were deposited at Sikkim Centre Herbarium, GBPNIHESD, Pangthang, East Sikkim.

Data analysis

Relative Frequency Citation (RFC)

RFC is a quantitative techniques used to evaluate the local importance of each species. It is given by RFC=FC/N (0<RFC<1), where FC is the number of informants mentioning the use of the species and N is the total number of informants participating in the survey[15,16].

Informant Consensus Factor (ICF)

The consensus in information relating to use category was estimated using ICF, *ICF* (0-1)=*N*ur-*N*t/*N*ur-1, where *N*ur is the total number of reports of the use category in the questionnaire and *N*t is the total number of species used in this category[17].

Use Value (UV)

Use Value was calculated for each species based on the number of uses the plant species were being used in the village. It is given by UV= ΣUi/N, where Ui is the number of uses mentioned by each informant for a given species and N is the total number of informants[18].

Results and Discussion

Compiled data on families, genera, species and growth form

A total of 61 species of plants are documented being used as NTFPs by the locals of Ribdi village. These species belong to 56 genera and 36 families (Table 1). They are used for several purposes sustaining the livelihood of locals in the area. Among the 36 recorded families Asteraceae, Athyriaceae and Lauraceae were the dominating families with 4 species each. Cupressaceae, Ericaceae, Poaceae and Rosaceae were each represented by 3 species each. Actinidiaceae, Apiaceae, Araliaceae, Betulaceae, Fagaceae, Magnoliaceae, Rutaceae and Saxifragaceae were represented by 2 species each and others were monospecific. Among the growth forms, the species were mostly tree (47%), followed by herb (28%), shrub (13%), fern (7%) and climber (5%) (Fig. 2).

Demographic data

A total of 50 households were surveyed in the village of Ribdi, west Sikkim. Out of which 56% were males and 44% were females. According to the age groups, 18% were between 20-29 years of age, 20% between 30-39 years, 28% between 40-49 years, 16% between 50-59 years and 18% were above 60 years. The majority of the informants were illiterate (48%), 44% of informants had attended elementary schools, 6% of informants had passed high school and 2% had graduated from college. In context of the community surveyed, 66% of informants were Sherpas, 16% Rai, 6% Limboo, 4% Tamang and 2% each were Pradhan, Chettri, Bishwakarma and Manger. Among the informants, 80% were farmers followed by carpenters (6%), housewives (4%), teachers (4%), tourist guide (2%), field assistant (2%) and self employed (2%). Thus most of the informants were illiterate and practiced farming in their own agricultural lands.

Data on different use categories of forest resources

Forest resources (NTFPs) were grouped into different use categories on the basis of the resources being utilized by the locals of Ribdi village. These use categories were medicinal plants, wild edibles plants,

Table 1 — List of Non-timber forest products (NTFPs) documented from Ribdi village, West Sikkim, India

Sl. No	Scientific name	Local name	Family	Growth form	Uses	IUCN Global status	Voucher Specimen Number
1	*Actinidia callosa* Lindl.	Thekiphal	Actinidiaceae	Climber	Wild Edible	NE	GBP-HR 227
2	*Allantodia laxifrons* (Rosenst.) Ching	Titay Ningro	Athyriaceae	Fern	Wild Edible	NE	GBP-HR231
3	*Allantodia maxima* (D.Don) Ching	Sawaney Ningro	Athyriaceae	Fern	Wild Edible	Least Concern	GBP-HR275
4	*Allantodia stoliczkae* (Bedd.) Ching	Lekh Kalo Ningro	Athyriaceae	Fern	Medicinal; Wild Edibles	NE	GBP-HR232
5	*Alnus nepalensis* D.Don	Uttis	Betulaceae	Tree	Fodder, Fuelwood, Construction and Handicrafts	Least Concern	GBP-HR234
6	*Artemisia* sp.	Phurmang	Asteraceae	Herb	Religious	NE	GBP-HR262
7	*Artemisia vulgaris* L.	Titeypati	Asteraceae	Herb	Medicinal; Religious	NE	GBP-HR221
8	*Astilbe rivularis* Buch.-Ham. ex D.Don	Buro Okhati	Saxifragaceae	Herb	Medicinal	NE	GBP-HR238
9	*Bergenia ciliata* (Haw.) Stenb.	Pakhanbed	Saxifragaceae	Herb	Medicinal	NE	GBP-HR216
10	*Betula alnoides* Buch.-Ham. ex D.Don	Saur	Betulaceae	Tree	Fodder, Construction and Handicrafts	Least Concern	GBP-HR260
11	*Brassaiopsis hispida* Seem.	Phutta	Araliaceae	Tree	Fodder	NE	GBP-HR258
12	*Centella asiatica* (L.) Urb.	Brahmi	Apiaceae	Herb	Medicinal	Least Concern	GBP-HR215
13	*Chromolaena odorata* (L.) R.M.King & H.Rob.	Banmara	Asteraceae	Herb	Medicinal	NE	GBP-HR220
14	*Cinnamomum glanduliferum* (Wall.) Meisn.	Mallagiri	Lauraceae	Tree	Wild Edible; Religious	NE	GBP-HR263
15	*Cinnamomum impressinervium* Meisn.	Seesi	Lauraceae	Tree	Fodder	NE	GBP-HR264
16	*Clematis buchananiana* DC.	Pinasay Lahara	Ranunculaceae	Climber	Medicinal	NE	GBP-HR253
17	*Cryptomeria japonica* (Thunb. ex L.f.) D.Don	Dhupi	Cupressaceae	Tree	Religious;Construction and Handicrafts	Near Threatened	GBP-HR252
18	*Cynodon dactylon* (L.) Pers.	Dubho Jhar	Poaceae	Herb	Fodder	NE	GBP-HR265
19	*Daphne papyracea* Wall. ex G. Don	Lokota	Thymelaeaceae	Shrub	Construction and Handicrafts	NE	GBP-HR254
20	*Diplazium dilatatum* Blume	Lekh Chiplay Ningro	Athyriaceae	Fern	Wild Edible	NE	GBP-HR237
21	*Docynia indica* (Wall.) Decne.	Mehel	Rosaceae	Tree	Wild Edible	NE	GBP-HR228
22	*Elaeagnus latifolia* L.	Musleri	Elaeagnaceae	Tree	Wild Edible	NE	GBP-HR241
23	*Eurya japonica* Thunb.	Jhingunay	Pentaphylacaceae	Tree	Fodder, Fuelwood	NE	GBP-HR242
24	*Evodia fraxinifolia* (Hook.) Benth.	Khanakpa	Rutaceae	Tree	Medicinal; Wild Edible	NE	GBP-HR249
25	*Ficus neriifolia* Sm.	Dudhilo	Moraceae	Tree	Religious	NE	GBP-HR244
26	*Hemiphragma heterophyllum* Wall.	Nasay Jhaar	Plantaginaceae	Herb	Medicinal; Wild Edible	NE	GBP-HR222
27	*Heracleum wallichii* DC.	Chimphing	Apiaceae	Shrub	Medicinal; Wild Edible	NE	GBP-HR240

(*contd.*)

Table 1 — List of Non-timber forest products (NTFPs) documented from Ribdi village, West Sikkim, India (*contd.*)

Sl. No	Scientific name	Local name	Family	Growth form	Uses	IUCN Global status	Voucher Specimen Number
28	*Himalayacalamus hookerianus* (Munro) Stapleton	Pareng	Poaceae	Herb	Construction and Handicrafts	NE	GBP-HR236
29	*Hypericum uralum* Buch Ham. ex-D. Don	Paheli Mehendi phul	Hypericaceae	Shrub	Medicinal	NE	GBP-HR266
30	*Juglans regia* L.	Okhar	Juglandaceae	Tree	Wild Edibles	Least Concern	GBP-HR235
31	*Juniperus recurva Buch.-Ham. ex D.Don*	Shukpa	Cupressaceae	Tree	Religious	Least Concern	GBP-HR267
32	*Laportea bulbifera* (Siebold & Zucc.) Wedd.	Patley Sisnu	Urticaceae	Herb	Medicinal; Wild Edible	NE	GBP-HR233
33	*Leucosceptrum canum* Sm.	Ghurpis	Lamiaceae	Tree	Fuelwood	NE	GBP-HR259
34	*Lithocarpus pachyphyllus* (Kurz) Rehder	Bantay	Fagaceae	Tree	Wild Edible; Fodder; Fuelwood; Construction and Handicrafts	NE	GBP-HR268
35	*Litsea cubeba* (Lour.) Pers.	Sil Timbur	Lauraceae	Shrub	Medicinal; Wild Edible	NE	GBP-HR255
36	*Lyonia ovalifolia* (Wall.) Drude	Angeri	Ericaceae	Tree	Fuelwood	NE	GBP-HR226
37	*Magnolia campbellii* Hook.f. & Thomson	Ghogey Chanp	Magnoliaceae	Tree	Construction and Handicrafts	Least Concern	GBP-HR243
38	*Magnolia doltsopa* (Buch.-Ham. ex DC.) Figlar	Rani Chanp	Magnoliaceae	Tree	Construction and Handicrafts	DD	GBP-HR229
39	*Mahonia napaulensis* DC.	Kesari	Berberidaceae	Tree	Medicinal; Religious	NE	GBP-HR251
40	*Nasturtium officinale* R.Br.	Simrayo	Brassicaceae	Herb	Medicinal; Wild Edible	Least Concern	GBP-HR218
41	*Panax pseudoginseng* Wall.	Ginseng	Araliaceae	Herb	Medicinal	NE	GBP-HR269
42	*Paris polyphylla* Sm.	Satuwa	Melanthiacaeae	Herb	Medicinal	NE	GBP-HR270
43	*Persea americana Mill.*	Kawlo	Lauraceae	Tree	Wild Edible; Fodder;Religious; Construction and Handicrafts	NE	GBP-HR248
44	*Pieris formosa* (Wall.) D. Don	Ballu	Ericaceae	Shrub	Medicinal; Fuelwood	NE	GBP-HR271
45	*Polygonum molle* D. Don	Thotney	Polygonaceae	Shrub	Fodder	NE	GBP-HR239
46	*Prunus cerasoides* Buch.-Ham. ex D.Don	Payu	Rosaceae	Tree	Fuelwood	Least Concern	GBP-HR257
47	*Quercus thomsoniana* A.DC.	Phallant	Fagaceae	Tree	Fodder; Fuelwood	NE	GBP-HR272
48	*Rhododendron arboreum* Sm.	Laligurans	Ericaceae	Tree	Medicinal; Wild Edible; Fuelwood	NE	GBP-HR250
49	*Rubus ellipticus* Sm.	Aiselu	Rosaceae	Shrub	Wild Edible	NE	GBP-HR217
50	*Saurauia napaulensis* DC.	Gagun	Actinidiaceae	Tree	Fodder	NE	GBP-HR256
51	*Senecio scandens* Buch.-Ham. ex D.Don	Paheli	Asteraceae	Climber	Fodder	NE	GBP-HR224
52	*Swertia chirayita* Buch.-Ham. ex Wall.	Chirauto	Gentianaceae	Herb	Medicinal	NE	GBP-HR223
53	*Symplocos lucida* (Thunb.) Siebold & Zucc.	Kharane	Symplocaceae	Tree	Religious	NE	GBP-HR245

(*contd.*)

Table 1 — List of Non-timber forest products (NTFPs) documented from Ribdi village, West Sikkim, India (*contd.*)

Sl. No	Scientific name	Local name	Family	Growth form	Uses	IUCN Global status	Voucher Specimen Number
54	*Taxus wallichiana* Zucc.	Dengre salla	Taxaceae	Tree	Medicinal	Endangered	GBP-HR225
55	*Thuja* sp.	Cheptay Dhup	Cupressaceae	Tree	Religious	NE	GBP-HR230
56	*Tsuga dumosa* (D.Don) Eichler	Tengre salla	Pinaceae	Tree	Construction and Handicrafts	Least Concern	GBP-HR273
57	*Tupistra nutans* Wall. ex Lindl.	Nakima	Asparagaceae	Herb	Medicinal; Wild Edible	NE	GBP-HR247
58	*Viburnum erubescens* Wall.	Asaray	Adoxaceae	Tree	Fuelwood	NE	GBP-HR219
59	*Viscum articulatum* Burm. f.	Harchur	Santalaceae	Herb	Medicinal	NE	GBP-HR261
60	*Yushania maling* (Gamble) R.B.Majumdar & Karthik.	Malling Bans	Poaceae	Herb	Wild Edible; Fodder; Fuelwood; Construction and Handicrafts; Religious	NE	GBP-HR274
61	*Zanthoxylum acanthopodium* DC.	Bokay Timbur	Rutaceae	Tree	Medicinal; Wild Edible	NE	GBP-HR246

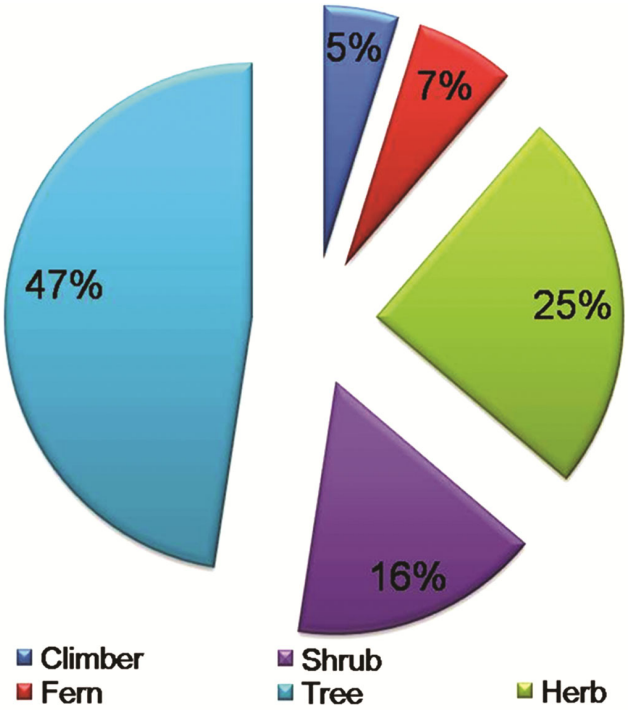

Fig. 2 — Growth form of plants utilized in Ribdi village

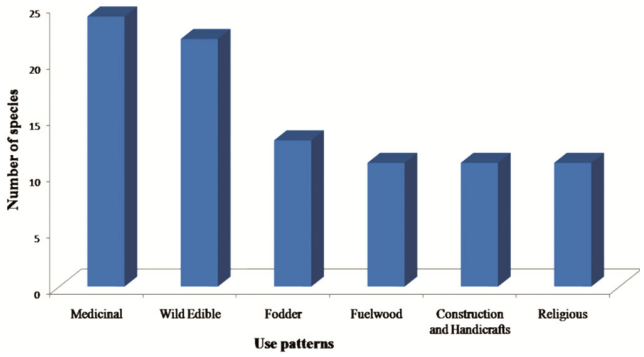

Fig. 3 — Different categories of uses of forest resources

fodder plant, fuel wood, construction and handicrafts and religious plants. In the study medicinal plants species accounted with the highest number of species, i.e., 24 species followed by wild edibles (22 species), fodder (13 species) and fuel wood, religious and construction and handicrafts which accounted for 11 species each being used in the studied village (Fig. 3). In the study conducted at the Khangchendzonga landscape, medicinal plants were among the important NTFPs, followed by wild edibles. The present study has thus demonstrated the similar result substantiating the previous findings.

For the documented 61 plant species, an overall 950 citations were recorded with 31 uses in the different categories. Among these, construction and handicrafts and medicinal were the most relevant categories of use (Fig. 4).

Medicinal plants

The locals of Ribdi are dependent on the medicinal plants for treatments of diseases and ailments as the traditional healing system has a strong origin in this area. Among the different communities in the village, Sherpa people are the majority involved in the art of healing[19]. According to the survey, 24 plant species are used for its medicinal value which belonged to 19

families with Apiaceae, Ericaceae, Rutaceae and Saxifragaceae being the dominant family. Most of the medicinal plants are herbs (54%) followed by tree (21%), shrub (17%), climber (4%) and fern (4%). Among the used parts, leaves are the most used (23%), root and rhizome accounted for 20% followed by fruit (17%), whole plant (14%), flower (13%), stem (10%) and shoot (3%). Leaves are the key photosynthetic organs in plants considered to be the natural pharmacy for synthesis of many active constituents which are active against certain diseases[20]. Also in a study conducted among the local communities in Rangit Valley, South Sikkim, India[21], leaves were the most used parts followed by root, rhizomes and shoots for the medicinal purpose. But in the study conducted among the *Limboo* tribes in Khanchendzonga Biosphere Reserve (KBR), roots, rhizomes and bulbs were the most used parts followed by leaves[22].

The investigated plants in the present study were used to cure human ailments have been distributed into 9 illness categories. Most of the plant species are used to treat dysentery, diarrhea and indigestion (25%), 19% species are used during fever, cough and cold, 11% species are applied on cuts, bruises and wounds, 11% species are used during vomiting and nausea, 11% species are used in skin diseases and scabies, 6% species are each used in high blood pressure, anti-diabetic and toothache, 5% species are used in headache (Fig. 5).

Swertia chirayita, locally known as *Chirauto* belonging to family Gentianaceae is cited the most (47 citations). The whole plant is used in the treatments of several ailments such as fever, cough, constipation, skin diseases, worms, acidity and liver disorder. In previous studies, *Swertia chirayita* was found to be used highly for treating fever, cold and cough in Sikkim Himalayas[23]. This plant has been identified as one of the valuable medicinal plants found in the temperate region of the state and is also threatened in the region[7,24,25]. It has very high demand in the pharmaceutical markets and has high potential for commercialization in Sikkim[22]. Therefore, this plant can be considered for large scale cultivation and, thus, to provide livelihood option to the local people in Ribdi village. *Heracleum wallichii*, popularly known as *Chimphing* has 20 citations owing to its usage in influenza, gastric problems, nausea and vomiting. It is a shrub belonging to Apiaceae family. Fruit is the most used parts and roots are also used

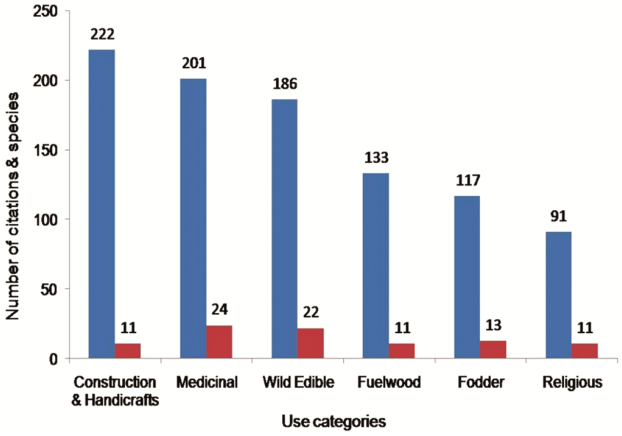

Fig. 4 — Use categories

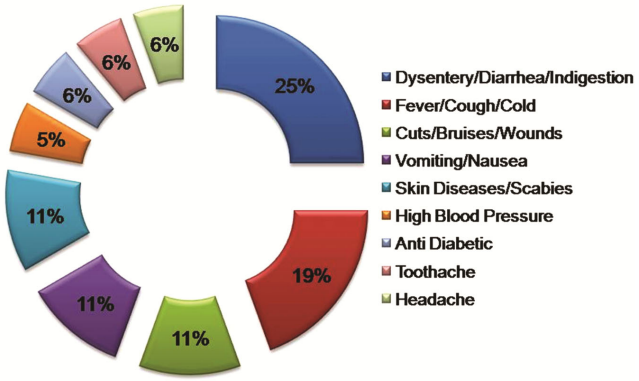

Fig. 5 — Different uses of medicinal plants

sometimes. *Artemesia vulgaris* (*Titeypati*) has 18 citations as this herb belonging to Asteraceae family is used mainly to stop bleeding during cuts and injuries. Leaves and stem are the used parts. In the KBR, 100% *Limboo* respondents reported the local use of *Swertia chirayita* and *Artemesia vulgaris* with its use in treating different diseases[22]. *Evodia fraxinifolia* had 17 citations. It is locally known as *Khanakpa*. The fruits are used in the treatment of typhoid and indigestion. It is a tree belonging to Rutaceae family. *Astilbe rivularis* (16 citations) is known by its name "*Buro Okhati*" is a very well known herb. Leaves, roots and rhizomes are the parts used to treat dysentery, diarrhea, toothache, etc. Other medicinal plants documented from the present study are *Litsea cubeba, Zanthoxylum acanthopodium, Chromolaena odorata, Viscum articulatum, Bergenia ciliata, Laportea bulbifera, Pieris formosa, Taxus wallichiana, Rhododendron arboreum, Clematis buchananiana, Tupistra nutans, Paris polyphylla, Centella asiatica, Panax pseudoginseng, Allantodia stoliczkae, Mahonia napaulensis, Hemiphragma*

heterophyllum, Hypericum sp. and *Nasturtium officinale*. In the previous study, *Swertia chirayita, Bergenia ciliata, Nardostachys jatamansi, Rhododendron arboreum* and *Astilbe rivularis* were among the 10 most important medicinal species reported with most diverse use categories in Sikkim Himalayas[26]. Sherpas are the highest number of informants in the present survey. According to Rai et al. (2014)[21], Sherpas of Ribdi-Bhareng use more herbal constituents in their therapy than zoo therapy. Therefore, these people have more ethnomedicinal knowledge on the usage of plants in the village than other communities.

Wild Edibles

A total of 22 species are recorded being collected from the forests and used for consumption purpose. These species belong to 16 families, with Athyriaceae and Lauraceae being the dominant families. The majority growth forms are tree (41%), followed by shrub (23%), fern (18%), herb (14%) and climber (4%). Fruit (55%) accounted highest for the parts used followed by young fronds and leaves (18%). Among the uses of these wild edibles, they are mostly consumed as raw fruit (9 species) followed by vegetables (8 species), pickle/chutney (4 species), wine (2 species) and tea (1 species) (Fig. 6). *Actinidia callosa* (*Thekiphal*) or Wild Kiwi is a climber belonging to family Actinidiaceae. It is cited most by majority of people in the studied village with 33 citations. The fruit is collected from nearby forest and consumed as raw fruit or processed into a wine. The locals also reported the initiatives taken by the State Horticulture department for the plantation of Kiwi brought from Himachal Pradesh and Arunachal Pradesh in the village, but unfortunately the plan has not been successful yet. *Diplazium dilatatum* (family Athyriaceae), commonly called *Lekh Chiplay Ningro*, is the fern collected from forests area and consumed as vegetable. This is the second most cited wild edible with 32 citations in the studied village. Young fronds and leaves are the parts collected and consumed. In Sikkim, varieties of *Diplazium* sp. are collected from forests and sold at local markets but in the present studied village this plant is collected for household consumption only. This plant is mostly cooked with churpee made from cow milk. They are not gathered for economic benefits though. *Laportea bulbifera* (*Patley Sisnu*) is a herb belonging to Urticaceae family. The leaves of this plant are consumed as vegetables and are mostly cooked with pork meat. It is cited for 21 times by the informants of Ribdi village. This plant is used by villagers to control the high blood pressure. This property has also been reported in previous studies[22].

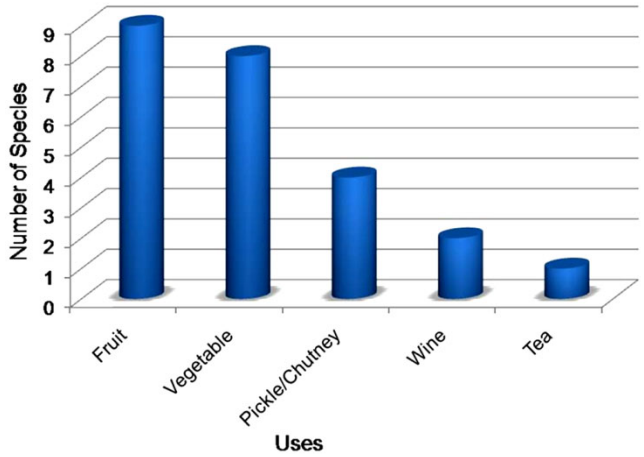

Fig. 6 — Different uses of wild edibles

The fruit of *Heracleum wallichii* (*Chimphing*) are mostly used as pickles and also as one of the important ingredients while making sausages. It is a shrub belonging to family Apiaceae. It is cited for 20 times. *Litsea cubeba* (*Sil Timbur*) is locally called "*Doom*" by the Sherpas of Ribdi village. The fruit of this plant is used as pickles and also had medicinal importance. It belongs to Lauraceae family. Other wild edibles reported from the present study are *Rubus ellipticus, Lithocarpus pachyphyllus, Evodia fraxinifolia, Tupistra nutans, Zanthoxylum acanthopodium, Yushania maling, Persea americana, Rhododendron arboreum, Allantodia maxima, Nasturtium officinale, Allantodia stoliczkae, Elaeagnus latifolia, Cinnamomum glanduliferum, Docynia indica, Hemiphragma heterophyllum* and *Juglans regia.*

Fodder Plant

In Ribdi village, cattle are domesticated in almost all the surveyed households. The fodders are obtained from their own agricultural land but are not adequate enough. As a result it is also gathered from the nearby forest for providing enough nourishment to their livestock. 13 species of fodder plants belonging to 9 families are documented from the survey which forms the basis of nutrition in the diet of domesticated animals. Betulaceae, Fagaceae, Lauraceae and Poaceae are the dominant families. These fodder plants were mostly tree (69%), followed by shrub (15%), herb and climber accounting for 8% each.

Lithocarpus pachyphyllus (*Bantay*) has the highest citation of 40. It is a tree belonging to Fagaceae family. The leaves of the plant are used as fodder and are collected from forests in the proximity. *Yushania maling* (*Mallingo*) is the second most cited fodder plant with 31 citations belonging to family Poaceae. It is locally called "*Jhapro*" in the studied village. It is also collected from the forests. *Eurya japonica* (*Jhingunay*) belonging to family Pentaphylaceae is a tree which is also used as fodder and were cited for 13 times. Other plants used as fodder are *Persea americana, Quercus thomsoniana, Polygonum molle, Cynodon dactylon, Senecio scandens, Brassaiopsis hispida, Alnus nepalensis*, *Saurauia napaulensis, Betula alnoides* and *Cinnamomum impressinervium*.

Fuel woods

Most of the households in the studied village had Liquid Petroleum Gas (LPG), yet fuel woods were used for cooking purpose. LPG is used occasionally but the fuel woods are used frequently in the studied village. Trees planted on the agricultural premises are used as fuelwoods, however it is also collected from the close by forest to meet the everyday demand. From present study, 11 plant species are documented which are used as a fuel wood belonging to 8 families. Ericaceae is the dominant family.

Fuelwood is the only source of energy for numerous people existing in the mountains[27]. It can be obtained at no cost and are easily accessible. *Alnus nepalensis* (*Uttis*) is the most cited (41 citations) tree species for the purpose of fuel wood in this area may be due to its adequate availability. It belongs to Betulaceae family. This plant has been reported in the previous studies as the preferred fuelwood species with high calorific value burning with gradual flame and producing less smoke[28]. The second most cited species is *Lithocarpus pachyphyllus* (*Bantay*) with 37 citations. It belongs to Fagaceae family. The other species used as fuel wood in this village are *Lyonia ovalifolia, Yushania maling, Pieris formosa, Eurya japonica, Rhododendron arboreum, Quercus thomsoniana, Viburnum erubescens, Leucosceptrum canum* and *Prunus cerasoides.* The alternative sources can be encouraged in this village to decline the fuel wood usage more efficiently in days to come.

Construction and Handicrafts

11 plant species are used for construction and handicrafts purpose, which belonged to 9 families. Betulaceae and Poaceae and Magnoliaceae are the dominant families. These are mostly tree (73%) followed by herb (18%) and shrub (9%). Under this category of uses, the plant species are mostly used for making furniture (24%), making handle for dagger (14%), rope (14%), basket (9%), container (9%), serving spoon (10%), boundary fence (10%), mats (5%) and prayer wheel (5%).

Yushania maling (*Mallingo Bans*), belonging to Poaceae family is the most cited (56 citations) bamboo species that is being used in the village for making baskets, containers, mats, animal sheds, house sheds, etc. Bamboos are of high importance as it is widely used for diverse purposes. The leaves are used as excellent fodder for livestock, stems are widely used for constructions and handicrafts purpose and young shoots are used as vegetables or pickles in the Himalaya region[26]. *Alnus nepalensis* (*Uttis*), belonging to Betulaceae family with 52 citations makes the second most species being used in the village for several purposes such as for making prayer wheel, handles for dagger, fence and in house construction. *Himalayacalamus hookerianus* (*Pareng*) belonging to family Poaceae was cited for 50 times, as it is being used for making baskets, containers and mats. This species are also planted nearby agricultural lands. The other species used in this category are *Lithocarpus pachyphyllus*, *Cryptomeria japonica, Tsuga dumosa, Betula alnoides, Magnolia campbellii, Magnolia doltsopa, Persea americana* and *Daphne papyraceae.*

Religious Plants

Sherpa being the dominant community in this village, majority of the informants are Buddhist followed by Hinduism. 11 species are documented being used for religious purposes which belong to 7 families. Cupressaceae is the dominant family. Among the growth forms, tree accounted for 73%, followed by herb (27%). Most of the species were used as incense.

Artemesia vulgaris (*Titeypati*) under the family Asteraceae is the most reported plant being used as incense in this village with 30 citations by the community following Buddhism. *Thuja* sp. (*Cheptay Dhup*) belonging to family Cupressaceae is the second most cited species (14 citations) used as incense. This species is seen mostly planted in the houses but are also collected from forest area. *Cinnamomum glanduliferum* (*Mallagiri*), *Artemesia (Phurmang)* and *Juniperus recurva (Shukpa)* are also used as incense. *Juniperus recurva* is found in high altitudes, so they

are either collected from high land sub alpine forests or are purchased from the markets. *Yushania maling* is used in making religious resemblances (*Torma*) and as a support for prayer flags (*Dhajas*). *Cryptomeria japonica, Persea americana, Ficus neriifolia, Mahonia napaulensis* and *Symplocos lucida* are other species being used in this category.

Quantitative analysis of the documented information

The present study suggest that construction and handicrafts has the highest number of uses among all the categories in the studied village (ICF=0.62), followed by the use of medicinal plants (0.61) and wild edibles (0.08) (Table 2). The highest value of ICF for construction and handicrafts could be owing to the remote geographical location of the village away from the market area and the locals utilize the nearby resources for making baskets, furniture, mats, fence, animal sheds, containers and for house construction. The ICF for medicinal plants could also attribute to the existence of traditional knowledge and lack of hospitals in the village. This could be the reason for the primarily use of medicinal plants from the nearby forests for different ailments and diseases.

RFC was analyzed quantitatively for the total 61 species documented from the study village, Ribdi. RFC for *Lithocarpus pachyphyllus* is the highest (1) followed by *Yushania maling* (0.96), *Alnus nepalensis, Swertia chirayita* (0.94), *Artemisia vulgaris* (0.84), *Himalayacalamus hookerianus* (0.72), *Heracleum wallichii* (0.7), *Actinidia callosa* (0.64), *Diplazium dilatatum* (0.62), *Zanthoxylum acanthopodium* (0.6), etc (Fig. 7). The highest RFC value indicates that these plant species are of importance and familiar among the local informants taking part in this study. It thus reflects the strong and long term association of inhabitants with these species (Table 3).

Table 2 — Usage categories and their ICF

Sl. No.	Usage Category	No. of Uses	% of uses	No. of Species	% of Species	ICF
1	Medicine	60	40.81	24	26.08	0.61
2	Wild Edibles	24	16.32	22	23.91	0.08
3	Fodder	13	8.84	13	14.13	0
4	Fuelwood	11	7.48	11	11.95	0
5	Construction & Handicrafts	28	19.04	11	11.95	0.62
6	Religious	11	7.48	11	11.95	0
		147	100	92	100	0.22*
						*mean of ICF

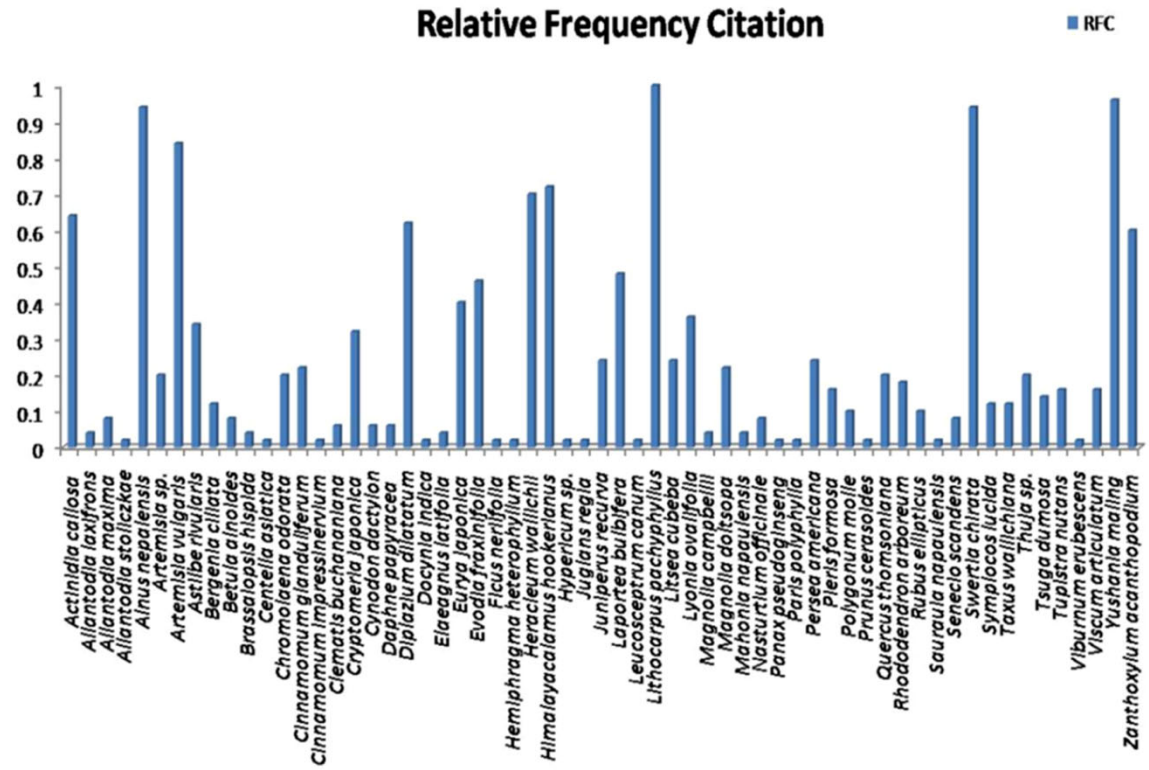

Fig. 7 — RFC for the documented NTFPs

Table 3 — Total Informants, RFC and UV of forest resources

Sl. No.	Species	Total informants	RFC	UV
1	*Actinidia callosa* Lindl.	32	0.64	0.66
2	*Allantodia* laxifrons (Rosenst.) Ching	2	0.04	0.02
3	*Allantodia maxima* (D.Don) Ching	4	0.08	0.06
4	*Allantodia stoliczkae* (Bedd.) Ching	1	0.02	0.02
5	*Alnus nepalensis* D.Don	47	0.94	1.9
6	*Artemisia* sp.	10	0.2	0.24
7	*Artemisia vulgaris* L.	42	0.84	0.98
8	*Astilbe rivularis Buch.-Ham. ex D.Don*	17	0.34	0.34
9	*Bergenia ciliata* (Haw.) Stenb.	6	0.12	0.14
10	*Betula alnoides* Buch.-Ham. ex D.Don	4	0.08	0.08
11	*Brassaiopsis hispida* Seem.	2	0.04	0.02
12	*Centella asiatica* (L.) Urb.	1	0.02	0.02
13	*Chromolaena odorata* (L.) R.M.King & H.Rob.	10	0.2	0.2
14	*Cinnamomum glanduliferum* (Wall.) Meisn.	11	0.22	0.24
15	*Cinnamomum impressinervium* Meisn.	1	0.02	0.02
16	*Clematis buchananiana* DC.	3	0.06	0.06
17	*Cryptomeria japonica* (Thunb. ex L.f.) D.Don	16	0.32	0.36
18	*Cynodon dactylon* (L.) Pers.	3	0.06	0.04
19	*Daphne papyracea* Wall. ex G. Don	3	0.06	0.04
20	*Diplazium dilatatum* Blume	31	0.62	0.62
21	*Docynia indica (Wall.) Decne.*	1	0.02	0.02
22	*Elaeagnus latifolia* L.	2	0.04	0.04
23	*Eurya japonica* Thunb.	20	0.4	0.4
24	*Evodia fraxinifolia* (Hook.) Benth.	23	0.46	0.52
25	*Ficus neriifolia* Sm.	1	0.02	0.02
26	*Hemiphragma heterophyllum* Wall.	1	0.02	0.02
27	*Heracleum wallichii* DC.	35	0.7	0.82
28	*Himalayacalamus hookerianus* (Munro) Stapleton	36	0.72	1.1
29	*Hypericum* sp.	1	0.02	0.02
30	*Juglans regia* L.	1	0.02	0.02
31	*Juniperus recurva Buch.-Ham. ex D.Don*	12	0.24	0.2
32	*Laportea bulbifera* (Siebold & Zucc.) Wedd.	24	0.48	0.56
33	*Leucosceptrum canum* Sm.	1	0.02	0.02
34	*Lithocarpus pachyphyllus* (Kurz) Rehder	50	1	2.14
35	*Litsea cubeba* (Lour.) Pers.	12	0.24	0.34
36	*Lyonia ovalifolia (Wall.) Drude*	18	0.36	0.34
37	*Magnolia campbellii* Hook.f. & Thomson	2	0.04	0.06
38	*Magnolia doltsopa (Buch.-Ham. ex DC.) Figlar*	11	0.22	0.22
39	*Mahonia napaulensis* DC.	2	0.04	0.02
40	*Nasturtium officinale* R.Br.	4	0.08	0.08
41	*Panax pseudoginseng* Wall.	1	0.02	0.02
42	*Paris polyphylla* Sm.	1	0.02	0.04
43	*Persea americana Mill.*	12	0.24	0.32
44	*Pieris formosa* (Wall.) D. Don	8	0.16	0.26
45	*Polygonum molle* D. Don	5	0.1	0.1
46	*Prunus cerasoides* Buch.-Ham. ex D.Don	1	0.02	0.02
47	*Quercus thomsoniana* A.DC.	10	0.2	0.24
48	*Rhododendron arboreum* Sm.	9	0.18	0.22

(*contd.*)

Table 3 — Total Informants, RFC and UV of forest resources (*contd.*)

Sl. No.	Species	Total informants	RFC	UV
49	*Rubus ellipticus* Sm.	5	0.1	0.22
50	*Saurauia napaulensis* DC.	1	0.02	0.02
51	*Senecio scandens* Buch.-Ham. ex D.Don	4	0.08	0.06
52	*Swertia chirayita* Buch.-Ham. ex Wall.	47	0.94	0.92
53	*Symplocos lucida* (Thunb.) Siebold & Zucc.	6	0.12	0.16
54	*Taxus wallichiana* Zucc.	6	0.12	0.08
55	*Thuja* sp.	10	0.2	0.02
56	*Tsuga dumosa* (D.Don) Eichler	7	0.14	0.14
57	*Tupistra nutans* Wall. ex Lindl.	8	0.16	0.16
58	*Viburnum erubescens* Wall.	1	0.02	0.02
59	*Viscum articulatum* Burm. f.	8	0.16	0.16
60	*Yushania maling* (Gamble) R.B.Majumdar & Karthik.	48	0.96	2.12
61	*Zanthoxylum acanthopodium* DC.	30	0.6	0.52

The forest resources used for various purposes were analyzed for UV index based on the average number of uses for each species (Fig. 8). *Lithocarpus pachyphyllus* had the highest UV (2.14), followed by *Yushania maling* (2.12), *Alnus nepalensis* (1.9) and *Himalayacalamus hookerianus* (1.1) (Table 3). *Lithocarpus pachyphyllus* and *Yushania maling* are used as wild edibles, as fodder, fuel wood, and also in construction and handicrafts. *Alnus nepalensis* is used as fodder, fuelwood, and in construction and handicrafts. *Himalayacalamus hookerianus* is used frequently for construction and handicrafts. The highest value indicates the higher number of uses these plants has in the studied village. The lowest UV value in some cases may be due to the insufficient information about the plant species in the informant. Photographs of some of the forest resources are given in Fig. 9.

While conducting the survey in the studied village, most of the informants reported about the human animal conflicts in this area, which is a serious present issue. Wild boar (*Sus scrofa*) has been raiding the agricultural and horticultural crops causing loss in the productivity. The fencing of the agricultural lands has not solved the problems yet. The dense forests of *Lithocarpus pachyphyllus* provides shelter and plenty amount of fruits which is a good indicator of faunal diversity[29]. According to the locals, when there is less productions of acorn (fruit of *Lithocarpus pachyphyllus)* in the forest, they invade agricultural lands but when the production is high in the forest, they do not raid the crops. *Sus scrofa* has shown highest consumption of acorns in previous studies[30]. It is an omnivore but it primarily feeds on the fruits, seeds, roots and tubers. The present study has revealed the highest RFC and UV for *Lithocarpus pachyphyllus* being used mostly for fodder and fuelwood in the studied village. The sustainable utilization of this plant along with its plantation in the forest area may help in the high production of acorns resulting in reducing the wild boar problem in the area.

The above mentioned plant species with high RFC and UV which are used for different purposes such as fodder, fuelwood, medicinal, construction and handicrafts can contribute significantly to the development of the local communities and can generate income opportunities in future. The Food and Agriculture Organization (FAO) was one of the foremost agencies to promote NTFPs through their programme on NTFPs[31].

The indigenous knowledge on NTFP utilization is well documented but there is a need to evaluate indigenous management systems for sustainable management[7]. Trainings on the cultivation, conservation and processing techniques for NTFPs should be carried out especially in the remote villages[25]. The locals are source of much information as they are aware of the collecting seasons and uses of many NTFP species. This knowledge needs to be documented and used as a reference for the management of NTFPs. Proper marketing with balance in the demand and supply is yet another required field that should be explored for promoting economic growth. As NTFPs are one of the provisioning services that people receive from the ecosystem, it can be renewed, and can be directly consumed, appropriated, and traded[31].

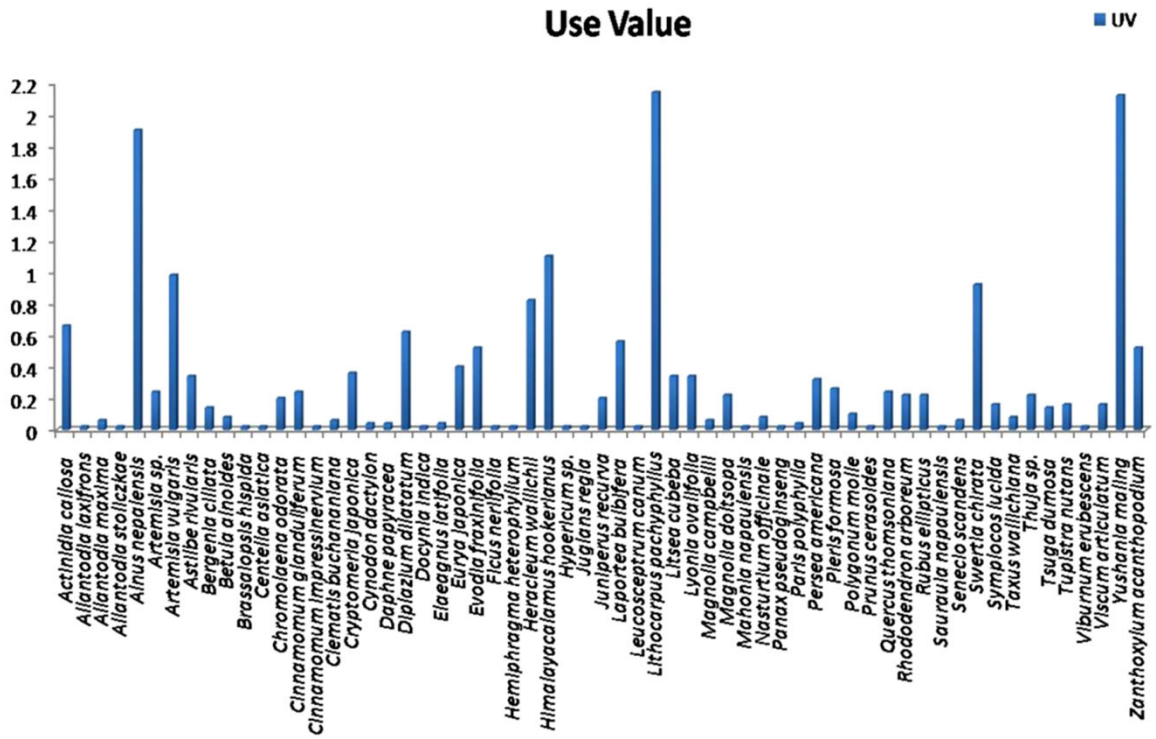

Fig. 8 — Use Value (UV) for the documented NTFPs

Fig. 9 — Some documented NTFPs (A) *Alnus nepalensis;* (B) *Betula alnoides;* (C) *Cinnamomum glanduliferum*; (D) *Cinnamomum impressinervium*; (E) *Lithocarpus pachyphyllus*; (F) *Daphne papyracea*; (G) *Magnolia doltsopa;* (H) *Lyonia ovalifolia;* (I) *Rhododendron arboreum;* (J) *Heracleum wallichii;* (K) *Rubus ellipticus;* (L) *Taxus wallichiana;* (M) *Diplazium dilatatum*

Conclusions

The present study contributes to the understanding of the inseparable relationship between the forest and the local people of Ribdi village, West Sikkim, India and its significance in their sustenance. A total of 50 households were surveyed to document the different use category of forest resources. Thus, the study documented 61 plant species used as NTFPs (medicinal plants, wild edibles, fodder, fuel wood, religious and construction and handicrafts) belonging to 56 genera and 36 families. The majority of the species were of medicinal value, pertaining to its traditional use in curing mostly diarrhea, dysentery and indigestion problems in the area. The study recorded the lack of proper sustainable harvesting, processing and commercialization of the species. There is a need to recognize the potential NTFPs for commercial cultivation which will profit the farmers and provide less pressure on the ecosystem. The study also encourages extensive research on the human wildlife issues the locals are confronting in the studied village.

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References

1 Chhetri DR, Parajuli P & Subba GC, Antidiabetic plants used by Sikkim and Darjeeling Himalayan tribe, India, *J Ethnopharmaco*l, 99 (2) (2005) 199-202.

2 Pandey AK, Tripathi YC & Kumar A, Non Timber Forest Products (NTFPs) for sustained livelihood: Challenges and Strategies, *Res J For*, 10 (2016) 1-7.

3 Ros-Tonen M, The role of non-timber forest products in sustainable tropical forest management, *Holz Roh- Werkst.* 58 (2000) 196–201.

4 Aswani S, Lemahieu A & Sauer WHH, Global trends of local ecological knowledge and future implications, *PLoS One*, 13(4) 2018 1-19.

5 Pradhan BK & Badola HK, Ethnomedicinal plant use by Lepcha tribe of Dzongu valley, bordering Khangchendzonga Biosphere Reserve, in North Sikkim, India. *J Ethnobiol Ethnomed*, 4 (2008) 22.

6 Dubey P, Socioculture factors and enabling policies for non-timber forest products-based micro enterprise development, *J Enterpreneurship*, 16 (2) (2007) 197-206.

7 Khoshoo TN, Plant diversity in the Himalayas: Conservation and Utilization, In: *G.B. Pant Memorial Lecture II*, 1992 (G.B. Pant Institute of Himalayan Environment and Development, Kosi, Almora-263443, India).

8 Uprety Y, Poudel RC, Gurung J, Chettri N & Chaudhary RP, Traditional use and management of NTFPs in Kangchenjunga Landscape: implication for conservation and livelihoods, *J Ethnobiol Ethnomed*, 12 (2016) 19.

9 Sundriyal M, Sundriyal RC, Sharma E & Purohit AN, Wild edibles and other useful plants from the Sikkim Himalaya, India, *Oecol Mont*, 7 (1998) 43-54.

10 Chaudhary RP, *Biodiversity in Nepal: Status and conservation,* (S Devi Saharanpur, UP, India and Teckpress Books Bangkok, Thailand) 1998.

11 Uprety Y, Boon EK, Poudel RC, Shrestha KK, Rajbhandary S, et al, Non-timber forest products in Bardiya district of Nepal: Indigenous use, trade and conservation, *J Hum Ecol*, 30(3) (2010) 143–58.

12 Pant S, Sammant SS & Arya SC, Diversity and indigenous household remedies of inhabitants surrounding Mornaula reserve forest in West Himalaya, *Indian J Tradit Know*, 8(4) (2009) 606-610.

13 Tamuli P & Sharma P, Ethno-medico-botany of the Dimase Kachari of North Cachar Hills district of Assam, *Indian J Tradit Know*, 9(4) (2010) 718-720.

14 Vodouhê FG, Coulibaly O, Greene C & Sinsin B, Estimating the local value of non timber forest products to Pendjari Biosphere Reserve dwellers in Benin, *Econ Bot*, 63(4) (2009) 397–412.

15 Sundriyal M & Sundriyal RC, Wild edible plants of Sikkim Himalaya: Marketing, Value addition and Implications for management, *Econ Bot*, 58(2) (2004) 300-315.

16 Vitalini S, Iriti M, Puricelli C, Ciuchi D, Segale A, et al, Traditional knowledge on medicinal and food plants used in Val San Giacomo (Sondrio, Italy): an alpine ethnobotanical study, *J Ethnopharmacol*, 145 (2013) 517-529.

17 Bibi T, Ahmad M, Tareen NM, Jabeen R, Rehman SU, et al, Ethnobotany of medicinal plants in district Mastung of Balochistan province-Pakistan, *J Ethnopharmacol*, 157 (2014) 79-89.

18 Logan MH, Informant consensus: a new approach for identifying potentially effective medicinal plants, In: *Plants in Indigenous Medicine and Diet: Bio behavioural Approaches*, edited by NL Etkin, (Bedford Hills, NY:redgrave publishers), (1986) 91-112.

19 Phillips O, Gentry AH, Reynel C, Wilkin P & Galvez-Durand, BC, Quantitative ethnobotany and amazonian conservation etnobotánica cuantitativa y la conservación de la amazonia, *Conserv Biol* 8 (1994) 225-248.

20 Rai PC, Sherpa P, Rana DB, Sherpa MT, Rai BB, et al, Traditional healers of Ribdi-Bhareng in western Sikkim: perspectives on their methods, belief and sustenance in community health care, *Pleione*, 8(2) (2014) 221-233.

21 Passalacqua NG, Guarrera PM & De Fine G, Contribution to the knowledge of the folk plant medicine in Calabria region (Southern Italy), *Fitoterapia*, 78 (2007) 52–68.

22 Idrisi MS, Badola HK & Singh R, Indigenous knowledge and medicinal use of plants by local communities in Rangit Valley, South Sikkim, India, *NeBio*, 1(2) (2010) 34-45.
23 Badola HK & Pradhan BK, Plants used in healthcare practices by Limboo tribe in South-West of Khangchendzonga Biosphere Reserve, Sikkim, India, Indian *J Tradit Know*, 12(3) (2013) 355-369.
24 Pradhan BK & Badola HK, Local knowledge on the use of *Swertia chirayita* as traditional medicine: Conservation challenges in Sikkim Himalaya, India, *Ethnobot Res Appl* 14 (2015) 345-355.
25 Sundriyal RC & Sharma E, *Cultivation of Medicinal Plants and Orchids in Sikkim Himalaya*, (HIMAVIKAS Occasional Publication) (Bishen Singh and Mahendra Pal Singh, Dehra Dun), 1995, 139.
26 Chettri N & Sharma E, Non-timber forest produce: utilization, distribution and status in the Khangchendzonga Biosphere Reserve, Sikkim, India, In: *Biodiversity of Sikkim: Exploring and conserving a global hotspot*, edited by Arrawatia, ML & Tambe S, (Information and Public Relations Department Government of Sikkim) 2011, 165-180.
27 O'Neill AR, Badola HK, Dhyani P & Rana SK, Integrating ethnoboilogical knowledge into biodiversity conservation in the Eastern Himalayas, *J Ethnobiol Ethnomed*, 13 (12) (2017) 1-14.
28 Sundriyal RC & Sharma E, Anthropogenic pressure on tree structure and biomass in the temperate forest of Mamlay Watershed in Sikkim, *Forest Ecol Manag*, 81 (1996) 113–34.
29 Dhanai R, Negi RS, Singh S & Parmar MK, Fuelwood consumption by villagers in different altitudinal gradient: a case of Takoligad watershed of Garhwal Himalaya, India, *Int J Curr Trends Eng Technol*, 5(1) (2015) 72-80.
30 Subba S, Pradhan A, Chamling N & Nepal S, Barsey Rhododendron Sanctuary "Rich Biological Diversity" in West Sikkim, India, *PANDA*, 9 (2017) 44-51.
31 Zeman J, Hrbek J, Drimaj, J, Plhal R, Kamler, J, et al, Wild boar impact to the natural regeneration of oak and acorn importance in its diet, *Acta Univ Agric Silvic Mendel Brun*, 64(2) (2016) 579-585.
32 FAO (Food and Agriculture Organization of the United Nations), Non-wood forest products for rural income and sustainable forestry, In: *Non-Wood Forest Products* (Rome, Italy), 1995, 7.
33 Maass JM, Balvanera P, Castillo A, Daily GC, Mooney HA, et al, Ecosystem services of tropical dry forests: Insights from long-term ecological and social research on the Pacific Coast of Mexico, *Ecol Soc* 10 (2005) 23.