Ethnobotanical Utilization of Forest Resources in Sindh Forest of Kashmir Himalaya, India

Muneesa Banday, M. A. Islam, Nazir A. Pala, Megna Rashid, Zubair A. Malik, Peerzada Ishtiyak, M. Maqbool Rather, Rainer W. Bussmann

Research

Abstract

*Background***:** This study was focused on the ethnobotany of Manasbal range of the Sindh Forest Division of Jammu and Kashmir (India) to assess, document and to provide a comprehensive inventory of plants used by the people of this rural area. Such an investigation and documentation along with the associated traditional knowledge are crucial to raise the socio-economic status of underprivileged population in this rural area and for the conservation of biological resources.

Methods: Multi-stage random sampling technique was employed in the selection of villages and respondents for the household survey. Interview schedules for both village as well as respondents' survey were prepared based on literature referred, reconnaissance survey of the study area, and discussion with local people/ consultation with the experts.

Results: A total of 135 plant species belonging to 121 genera and 58 families were being utilized as forest resources. The family Compositae had the highest representation with 13 species followed by Leguminaceae (11) and Poaceae (10). Fourteen different use categories of forest resources were reported. The forest species collected by the people were mostly herbs (103) followed by trees (18), shrubs (12) and climbers (2). The maximum number of species (54) was utilized as medicine, followed by fodder (51), vegetables (18), fuelwood and (16) edible fruits.

Conclusion: The present study confirmed that the Manasbal range of the Sindh Forest Division is an interesting area for the study of traditional plant use. This study further suggests that the local denizens have an in-depth knowledge of use of local plant resources and that these exploit diverse NTFPs substantially to support their day-to-day needs. Hence, livelihood diversification through forestry interventions using existing resources is needed as important strategy of poverty reduction and socioeconomic development of backward local people. The study has documented the baseline data for further studies in the field of ethnobotany, medicinal plants and ethno-pharmacology

Keywords: Ethnobotany; Forest; Livelihood; Resources; Edible; Medicinal

Correspondence

Muneesa Banday[1], M. A. Islam[1], Nazir A. Pala[1*], Megna Rashid[1], Zubair A. Malik[2], Peerzada Ishtiyak[1], M. Maqbool Rather[1], Rainer W. Bussmann[3]

[1]Faculty of Forestry, Benhama Ganderbal, SKUAST-Kashmir, India
[2]Department of Biology, Govt. HSS Harduturoo Anantnag (J&K) India 192201
[3]Department of Ethnobotany, Institute of Botany, Ilia State University, Tbilisi, Georgia

[*]Corresponding Author: nazirpaul@gmail.com

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Background

Multifarious use of plant species as edible, medicinal and other purposes has been documented from different parts of the India and the world (Shah *et al*. 2013; Guissou *et al*. 2015; Seyoum *et al*. 2015; Singh and Bharti 2015). Focusing on the present-day

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situation of ever-increasing exploitation of plants and natural resources, the main reason for showing interest towards ethnobotany is its vast outcome that is beneficial for every living being (Singh and Bharti 2015). Food plants serves as alternatives to staple food during periods of food deficit and are the valuable supplements for a nutritional balanced diet for the communities residing in and around the forests (Shrestha *et al.* 2005; Deshmukh and Waghmode 2011). The World Bank has estimated that 1.6 billion people around the world depend to some degree on forests for their livelihoods (Sraku-Lartey 2014). Forest resources play an important role in food security, fodder/ livestock security, agricultural support, bio-energy security, housing security, cottage industry, health security, socio-cultural security, income security, and employment security for local people in developing countries (Shit and Pati 2012). These include collection of edible fruits, flowers, tubers, roots and leaves for food and medicines firewood for cooking (and/or selling in the market), materials for agricultural implements, house construction and fencing fodder (grass and leave) for livestock and grazing of livestock in forest and collection of a range of marketable non-timber forest products. Moreover, a significant percentage of the country's underprivileged population happened to be living in its forested regions (Saha and Guru 2003). Therefore, such an extensive dependence of huge population resulting in over-exploitation and unsustainable harvest practice can potentially degrade these forests.

It has been estimated that more than 40 per cent of the poor in India are living in forest fringe villages (MoEF 2009). India has forest dweller population of over 100 million belonging to 550 communities of 227 ethnic groups, of which some 60 per cent live in forest areas and depend on forests (Nautiyal *et al.* 2000). Forests play an important role in the viability and survival of indigenous households in India, by virtue of their importance in social, cultural and economic survival (Phondani *et al.* 2010). These indigenous communities draw their sustenance largely from forests for food, medicine and other requirements (Pandey 2009). Forests represent a whole way of life for tribal peoples and as such their life and economy are, therefore, intimately interwoven with the forests and forest wealth (Phondani *et al.* 2010). Tribal mountain communities have been dependent on forest resources for their needs besides they are also involved in forest management without destroying the resource base (Saha and Sundriyal 2013).

In the Himalayan region, dependence of many communities on NTFPs is an important strategy for their survival (Sundriyal and Sundriyal 2004; Sahan and Sundriyal 2013). Nearly 1.6 million person-years of employment in India are derived from NTFP, while the forestry sector in total provides 2.3 million person-years of employment (Rasul *et al.* 2008). Understanding forest products consumption is thus fundamental for assessing human-environment interactions and designing effective conservation policies. Households' socio-economic characteristics dictate both what the forest resources are utilized for and the extent to which they are harnessed (Ofoegbu *et al.* 2017). Rural communities in Himalayan region, especially those residing near the forest areas have higher dependency on the forest resource consumption and Kashmir is no exception. Forest resources are the common thread in all aspects of life including birth, marriage, livelihood, or death (Islam *et al.* 2015). Forest resources are the source of revenue, employment, shelter, housing materials, cloth, ornament, fuel, fodder, grazing, timber, food, vegetables, medicines, fertilizer, fiber, floss, oilseed, cottage industries and handicrafts and other Non-Timber Forest Products (NTFPs) in the rural areas of Kashmir. Therefore, the present study was conducted in ten forest fringe villages purposively selected from Manasbal range of the Sindh forest division of Jammu and Kashmir to generate baseline information regarding the utilization of ethnobotanical forest resources collection, consumption and utilization.

Materials and methods

Study area

The present study was conducted in ten forest fringe villages purposively selected from Manasbal range of the Sindh Forest Division of Jammu and Kashmir (India). The villages selected were Wangat from Wangat forest block; Arhama and Anderwan from Chittergul block; Chuntvalivar and Chanthan from Lar block; Barnebugh from Barnebugh; Preng, Worpash, Baba wayil and Bailawussan from Gutlibagh (Figure 1). The Sindh forest division lies on the geographical coordinates of 34°7'0" to34°28'0"N and 74°42'0" to 74°26'0" E in the mountainous and rugged terrain of Kashmir valley. The total area of the demarcated forest of the division is 37,901 ha. This tract (Sindh Forest Division) is as thickly populated as any other hilly area of the valley, primarily by rural population. The area experiences both temperate and sub-alpine conditions and is well known for excessive annual rainfall (700 mm) and temperature varying from 5°C to 20°C (Banday *et al.* 2019). The main tree species in the range is kail (*Pinus wallichiana*) although fir (*Abies pindrow*) is also found mixed with kail at exposed sites and deodar (*Cedrus deodora*) at isolated ones. Regeneration of *Abies pindrow* is almost nonexistent whereas *Pinus wallichiana* is seen having colonized around certain blanks. These forests are subjected to damage by unrestricted grazing by both nomadic and local grazers (Banday *et al.* 2019). Patches of

Betula utilis can be found above the zone of *Abies pindrow.* Agriculture is the main land-use in the sampled villages having net sown area ranging between 34.01 ha to 345.75 ha.

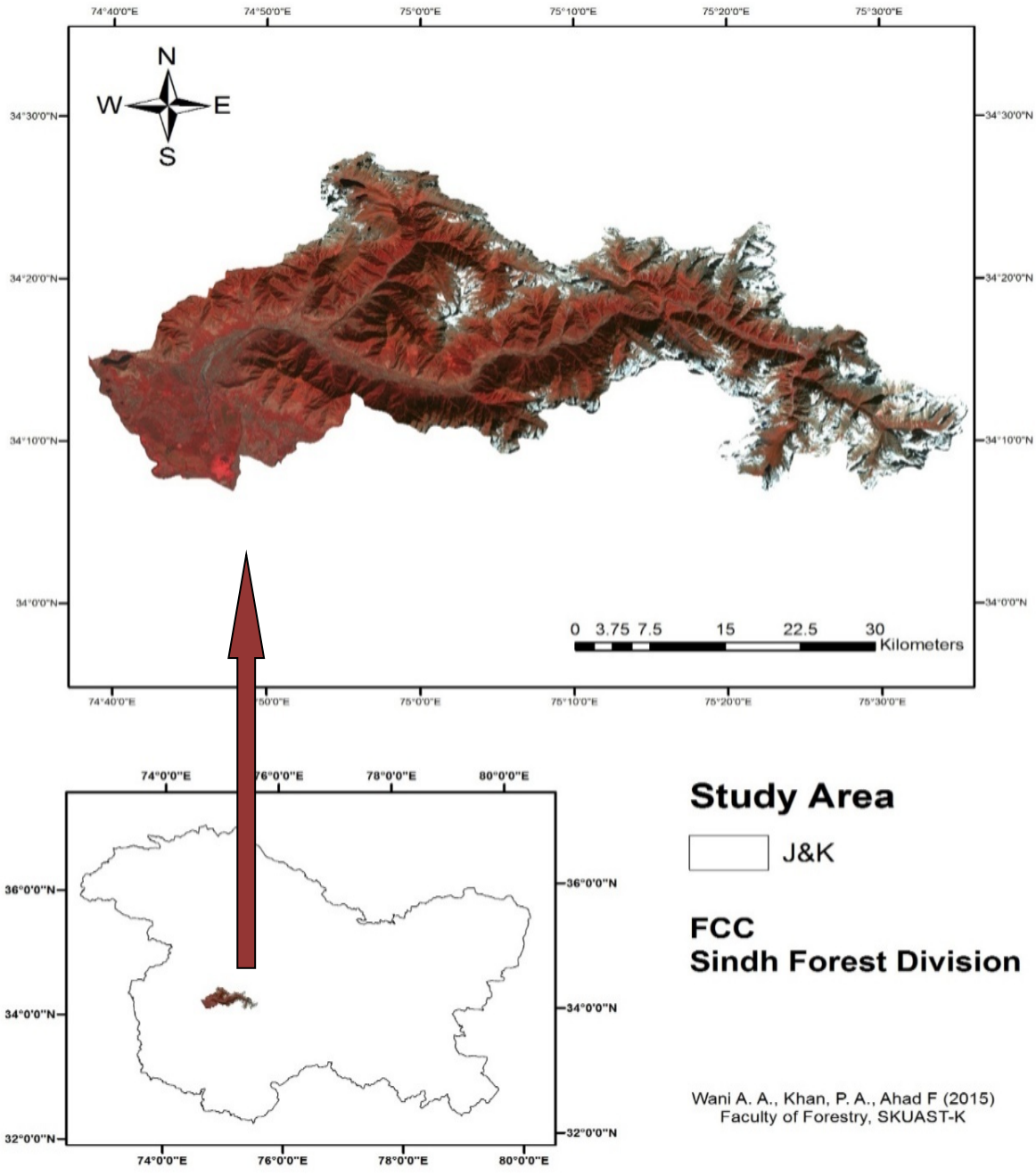

Figure 1. Map of the study area showing location of data collection

Selection of sample villages and respondents

Multi-stage random sampling technique (Ray and Mondol 2004) was employed in the selection of villages and respondents for the household survey. Out of the total eighteen forest fringe villages only ten of the range having around 50% sampling intensity were selected in the first stage. In the second stage, a total of 208 households were selected randomly having sampling intensity of 5% of the total number of the households in the sample villages. Household heads or eldest members were treated as the respondents. Before interviewing the respondents regarding the utilization of ethnobotanical resources, a prior verbal consent was sought from the concern panchayat head as well as the concerned individual

informants by briefing clearly about the objectives and purpose of the study.

Data collection

The present study included both qualitative and quantitative methods for data collection. Data were collected by using both secondary sources and primary field survey. Secondary sources included literature from various journals, research reports, forest department records, village records, internet, previous research, annual reports and other related documents from different governmental and non-governmental agencies. Primary sources included structured interviews with selected respondents and non-participant observations (Mukherjee 1993). The primary data were collected at individual/ household and village level whereas the secondary data have been collected for block, village and household/ individual level.

Structured interviews

The primary data were collected by personal interviews of the respondents through well-structured pre-tested interview schedules at both the village and household level. Interview schedules for both village as well as respondents' survey were prepared based on literature referred, reconnaissance survey of the study area, and discussion with local people/ consultation with the experts. The interview schedules so prepared were employed to collect information on availability of forest resources, utilization, and consumption pattern. The schedule was administered to the respondent in local language and the responses were recorded in English. The questionnaire covered aspects like available plant species in the locality, collection used as ethnobotanical, plant parts used etc. The plant species were identified mostly in the field with their local names and by consulting available secondary literature. However, for reference and documentation of the collected plants/specimens was given a collector number in the field itself starting from 3001.

Results and Discussion

The study documented the utility of 135 species belonging to 121 genera under 58 families (Table 1). The plants included a few species of pteridophytes and fungi also. The family Compositae had the highest representation of 13 species followed by Leguminaceae (11) and Poaceae (10), Rosaceae (7), Lamiaceae (6), Polygonaceae (5) and so on (Table 1) Thirty-two (32) families were monotypic. The forest resources were utilized under fourteen different use categories by the inhabitants of this rural area to meet their daily needs (Figure 2).

Among the use categories, medicines or medicinal utility comprised maximum number (54) of species followed by fodder (51) vegetables (18), fuel wood (16), edible fruits (12), timber (9), spices and condiments (6), tea (6), dye/ tannins (5), edible mushrooms (2), meswak (2), cottage industry (2), mouth fresheners (2) and incense (1). Almost, all the parts were extensively collected and consumed by the sampled households with maximum (58) as leaves followed by root (23), stem/ shoot (22), fruit (19), branches (16), flower (12), bole (12), entire plant (10), seed (7), rhizome (5), aerial part (5), cones (3), frond (2), bulb (2), basidiocarp (2), corm (1), resin (1) and nuts (1) (Figure 3). Out of the 135 species collected by the local people, maximum (101) were derivatives of herbs followed by tree (18), shrubs (12), climber (2), fungi (2) (Figure 4). The forest fringe or indigenous communities in developing countries depend on NTFPs for their subsistence needs of food that supplement and complement agricultural crops, fuels for cooking and a wide range of traditional medicines, fodder, other hygiene products, clothing and construction products particularly during adverse seasons and income (Bauri *et al*. 2015; Sharma *et al*. 2015; Verma and Paul 2016).

Different parts of plants were documented for medicinal and other ethnobotanical usage. As medicines, the frequently used plant parts were roots (41%), leaves (29%), flowers (14%), fruits (5%), seeds (8%) and entire plants (3%) (Figure 5a & 5b). Among the other ethnobotanical uses (other than medicinal) the commonly used plant parts include leaves (62%), fruits (21%), entire plant (11%) and roots & flowers (3% each). The roots and leaves were used more frequently than other parts. Roots are the most preferred parts used because they contain a higher concentration of bioactive compounds than other parts (Srithi *et al.* 2009). Similar results were reported by Keter and Mutiso (2012) from Kenya; Malik *et al.* (2015); Rathore *et al.* (2015); Singh *et al.* (2019) from Indian Western Himalaya, Akhtar *et al*. (2013) from Pakistan, and Kunwar et al. (2006) from Nepal. Our results are also supported by other ethnobotanical studies conducted elsewhere in different regions of the Himalaya (Kala 2006; Abbas *et al.* 2017; Singh *et al*. 2009; Sharma *et al.* 2013; Ahmed *et al.* 2013; Amjad *et al*. 2015; Rana *et al.* 2019; Ahmad *et al.* 2014).

The local people of the study area exploit diverse NTFPs substantially to support their livelihoods. The forest fringe households exploit the forest resources on a regular basis and in meaningful quantities for direct household consumption to support agriculture and livestock rearing. The poorer households having limited farms and livestock exploit the forest resources in large scale for their subsistence, income, and safety-net in adverse times (Islam and Quli 2017).

Table 1. Diversity and utilization of forest resources in the study area

Family and scientific name	Local name	Collector number	Life form	Parts used and their Utility
Adoxaceae				
Sambucus wightiana Wall. ex Wight & Arn.	Phaktend / Dwarf elder	3048	Herb	Fruit –dye; Roots – medicinal (the decoction of roots is used as an effective diuretic).
Viburnum cotinifolium D. Don	Hapethmewe	3115	Shrub	Fruits are edible.
Viburnum grandiflorum Wall. ex DC.	Kul manchh	3128	Shrub	Fruits – edible Twigs – used as toothbrushes (*datoon* / *meswak*)
Agaricaceae				
Agaricus campestris L.	Hedur / Meadow mushroom	3114	Fungus	Basidiocarp – edible.
Amaranthaceae				
Amaranthus caudatus L.	Lisse / Amaranth	3005	Herb	Leaves are used as vegetable
Chenopodium album L.	Wopalhaakh / Lamb's quarter	3086	Herb	Leaves used as vegetables.
Amaryllidaceae				
Allium carolinianum DC.	Jangli Rohan / Wild garlic	3004	Herb	Entire plant - Vegetable, pickle, spice and fodder
Allium semenovii Regel	Jangli Praan / Wild onion	3047	Herb	Young leaves and bulbs used as vegetable.
Apiaceae				
Angelica glauca Edgew.	Choral / Archangel	3085	Herb	Roots – medicinal. Root powder is used to treat toothache and stomach disorders
Daucus carota L.	Jangli gazer gaasse/ wild carrot	3001	Herb	Shoot used as fodder.
Foeniculum vulgare Mill.	Janglibedyaan / Fennel	3113	Herb	Seeds- spices and mouth freshener; Aerial parts- fodder
Athyriaceae				
Diplazium sibiricum (Turcz. ex Kunze) Sa. Kurata	Kunjee	3046	Herb (fern)	Fronds – used as vegetables.
Berberidaceae				
Berberis lycium Royle	Kaw dach / Indian Lycium	3135	Shrub	Fruits- edible Entire plant- tanning dye and fencing/ hedge.
Boraginaceae				
Arnebia benthamii (Wall. ex G.Don) I.M.Johnst.	Ratanjot / Goazaban / Bearded borage	3045	Herb	Shoot, flowers and root – medicinal. Dried flowering shoot useful for tongue, heart and throat ailments. and tea of the roots is given to patients of pneumonia.
Brassicaceae				
Capsella bursa-pastoris (L.) Medik.	Kralimond / Shephard's purse	3002	Herb	Entire plant – vegetable and fodder.
Eruca vesicaria (L.) Cav.	Tomlgasse / Garden rocket	3044	Herb	Shoot – fodder.

Sisymbrium loeselii L.	Dandhhaakh/ tall hedge mustard	3084	Herb	Leaves – fodder.
Cannabaceae				
Cannabis sativa L.	Bhang / Indian hemp	3003	Herb	Leaves and flowers - medicinal (sedative, analgesic and anti-inflammatory)
Celtis australis L.	Brimij/ European nettle	3043	Tree	Leaves - fodder Branches / bole- fuelwood Fruits - edible
Caprifoliaceae				
Dipsacus inermis Wall.	Wopalhaakh / Teasel	3049	Herb	Stem and leaves are used as vegetables.
Valeriana jatamansi Jones	Mushkbala / Indian valerian	3112	Herb	Roots – medicinal, used for obesity, epilepsy and snake poisoning.
Caryophyllaceae				
Silene vulgaris (Moench) Garcke	Bladder campion (attekramm)	3042	Herb	Leaves – vegetables.
Stellaria media (L.) Vill.	Naremneur/ Chick weed	3083	Herb	Shoot – fodder.
Colchicaceae				
Colchicum luteum Baker	Virkun posh / Golden collyrium	3087	Herb	Corms are medicinal; source of colchicine (mutagen); decoction of corms is used to treat general weakness and pain after child birth
Compositae				
Achillea millefolium L.	Pehlgasse / Sultanibootu / Achilles heel	3305	Herb	Leaves and flowers – medicinal. Their decoction is used to cure cold, fever, nose bleeding and liver complaints.
Arctium lappa L.	Hapathkoath / Burdock	3041	Herb	Roots are used as vegetable and medicine (diuretic and diaphoretic). Also used as an adulterant to *Saussurea lappa.*
Artemisia absinthium L.	Tethwan / Worm wood	3050	Herb	Entire plant – medicinal. Decoction of dried leaves is used to cure worm infection and stomach ache. It is also kept in delicate clothes like *pashmina shawl* in order to avoid insect attack.
Centaurea iberica Trevir. ex Spreng.	Krech / Knapweed	3051	Herb	Tender leaves – vegetables.
Cichorium intybus L.	Handi posh / Chicory	3082	Herb	Leaves used as vegetables.
Erigeron canadensis L.	Shaal lot / Canadian horse weed	3088	Herb	Shoots used as fodder; flowers – induce sneezing and relieve rhinitis.
Inula racemosa Hook.f.	Poshkarmool / Horse heel	3126	Herb	Roots- medicinal (antipyretic and antiseptic)

Jurinea macrocephala DC.	Guggaldhoop / Incense root	3040	Herb	Roots used for incense making while the oil from roots is used to get relief from gout and rheumatism.
Lactuca serriola L.	Doadekedijj / Lettuce	3111	Herb	Shoot - fodder.
Saussurea lappa (Decne.) Sch.Bip.	Koath / Costus	3081	Herb	Roots – medicinal, the decoction of dried roots is taken to cure back and joint pains. The dried root is chewed to cure tooth ache.
Senecio vulgaris L.	Groundsel	3116	Herb	Flowers and roots – medicinal. Crushed flowers are used as antiseptic on wounds, while dried roots are used to treat rheumatic pain.
Sonchus asper (L.) Hill	Dodij/ Prickly sow thistle	3125	Herb	Leaves - fodder.
Taraxacum officinale (L.) Weber ex F.H.Wigg.	Hand / Dandelion	3039	Herb	Leaves used as vegetable and fodder. The vegetable is considered rich in iron and frequently given to women after childbirth as a tonic. Roots are medicinal (tonic).
Convolvulaceae				
Convolvulus arvensis L.	Threed / Bield bind weed	3052	Herb	Aerial parts – fodder.
Cupressaceae				
Juniperus communis L.	Sarwe / Cedar	3110	Tree	Twigs and Leaves - burnt to produce smoke considered to repel insects Cones- Fuel Seeds - The oil extracted from the seeds is used against rheumatism
Dioscoreaceae				
Dioscorea deltoidea Wall. ex Griseb.	Kreensh/ Yam	3038	Herb	Tuber – vegetable.
Elaeagnaceae				
Elaeagnus parvifolia Wall. ex Royle	Autumn olive	3109	Shrub	Fruits - edible Wood - fuel wood
Equisetaceae				
Equisetum palustre L.	Gandamgondh / Horse tail	3037	Herb (fern)	Stem – medicinal, applied directly on skin to treat wounds.
Euphorbiaceae				
Euphorbia helioscopia L.	Gur sochal / Sun spurge	3080	Herb	Roots - anthelminthic, shoots useful for the treatment of constipation.
Euphorbia prostrata Aiton	Prostrate sand mat	3053	Herb	Entire plant - the decoction of the entire plant mixed with ghee is used for treatment of jaundice; Leaves – fodder
Geraniaceae				

Geranium wallichianum D.Don ex Sweet	Ringresh / Gul- e-snobar/ Himalayan crane's bill	3006	Herb	Roots - substitute for tea and also used as a hair dye.
Hamamelidaceae				
Parrotiopsis jacquemontiana (Decne.) Rehder	Pohu / Hatab / Witch hazel	3036	Shrub	Wicker and fuel wood are used for wicker and as wood
Hypericaceae				
Hypericum perforatum L.	St. John's wort	3089	Herb	Shoots – medicinal, helpful in nerve pain, altitude sickness and considered anti-depressant.
Iridaceae				
Iris hookeriana Foster	Mazar mund / Japanese iris	3054	Herb	Rhizomes – medicinal, the decoction of rhizomes given to cattle for the treatment of intestinal worms and nematodes.
Morchella esculenta (L.) Pres.	Kitch / Guchi /Morrels	3090	Fungi	Basidiocarp – edible, good for stomach problems (indigestion etc).
Juglandaceae				
Juglans regia L.	Duen / Himalayan walnut	3079	Tree	Nut - edible Roots – used for cleaning teeth and curing toothache The pericarp of unripe fruit is applied on skin to treat various skin diseases.
Lamiaceae				
Mentha arvensis L.	Pudine / Wild mint	3035	Herb	Leaves - Condiment / mouth freshener
Mentha longifolia (L.) L.	Pudine / Horse mint	3055	Herb	Leaves - Condiment
Nepeta cataria L.	Bradi-gassi / Cat mint/ Catnip	3078	Herb	Leaves - medicinal (treatment of cough, cold, cuts and wounds), also used in calming pet cats.
Prunella vulgaris L.	Kalveuth / Common self-heal	3117	Herb	Hot water decoction of leaves and flowers is used to cure headaches and fever.
Salvia moorcroftiana Wall. ex Benth.	Soler / Clary sage	3034	Herb	Roots and seeds – medicinal. Root- used in cough and cold; Seeds – used against dysentery.
Thymus vulgaris L.	Jawein / Garden thyme	3108	Herb	Stem, leaves and seeds – medicinal. All used to treat inflammation related to rheumatism, insect bites etc. The seeds are used as spice in the preparation of pickles.
Leguminaceae				
Amorpha fruticosa L.	False indigo	3056	Shrub	Flowers- Blue dye Leaves- fodder
Astragalus falcatus Lam.	Milk vetch	3077	Herb	Entire plant – fodder.
Glycyrrhiza glabra L.	Shangir / Liquorice	3033	Herb	Roots – medicinal, decoction of dried roots is administered orally as expectorant and dried roots are chewed as mouth freshener.

Lathyrus aphaca L.	Yellow pea	3091	Herb	Leaves and pods – fodder.
Medicago polymorpha L.	Posh gasse / Bur clover	3007	Herb	Leaves - fodder.
Robinia pseudoacacia L.	Kikar / Black locust	3076	Tree	Leaves- fodder Branches- fuel wood Bole - timber
Indigofera heterantha Brandis	Zand / Himalayan indigo	3107	Shrub	Flowers yield dye while branches are used for wicker work
Medicago sativa L.	Lasunghas / Lucerne	3032	Herb	Leaves – fodder.
Melilotus albus Medik.	Katsigasse / Sweet white clover	3075	Herb	Leaves – fodder.
Trifolium pratense L.	Batak neur / Red clover	3118	Herb	Leaves and stem – fodder.
Trifolium repens L.	Batak neur / White clover	3008	Herb	Leaves and stem - fodder.
Liliaceae				
Fritillaria cirrhosa D.Don	Sheethkarr / Chequered lily	3074	Herb	Bulbs – medicinal, used for asthma, bronchitis and also anti-pyretic.
Malvaceae				
Lavatera cachemiriana Cambess.	Sazposh / Kashmiri mallow	3106	Herb	Roots, leaves and flowers – medicinal. The leaves and flowers are used as mild laxative, while the roots are used for throat infections.
Malva neglecta Wallr.	Kaeshir Sochal/ Dwarf mallow	3073	Herb	Leaves – vegetables.
Malva sylvestris L.	Boatesochal / Mallow	3031	Herb	Leaves – vegetable; Flowers and fruits -medicinal (cure for whooping cough).
Melanthiaceae				
Trillium govanianum Wall. ex D.Don	Tri patri / Trinity flower	3009	Herb	Rhizome – medicinal, used for sexual and menstrual disorders.
Moraceae				
Ficus palmata Forssk.	Anjeer / Wild fig	3092	Shrub	Fruits - edible Latex - applied on skin diseases
Morus alba L.	Tull / White mulberry	3010	Tree	Leaves- fodder Branches/ bole- fuel wood Fruits - edible
Onagraceae				
Epilobium hirsutum L.	Willow herb	3105	Herb	Stem and leaves – fodder.
Oenothera rosea L'Hér. ex Aiton	Evening primrose	3072	Herb	Leaves – medicinal. Tea prepared from leaves is used to treat obesity.
Oxalidaceae				

Oxalis corniculata L.	Chokchini/ Creeping wood aorrel	3057	Herb	Leaves - fodder.
Papaveraceae				
Papaver rhoeas L.	Gul-e-lala / Red poppy	3011	Herb	Seed- for topping of local bread (Kulcha).
Phytolaccaceae				
Phytolacca acinosa Roxb.	Hapethmakae / Indian poke weed	3093	Herb	Roots- used for treatment of urinary disorders, viral infections, and edema. Young leaves – leaves cooked as vegetable Fruits – yield red ink
Pinaceae				
Abies pindrow (Royle ex D. Don) Royle	Bodul/ Silver fir	3012	Tree	Branches and cones – fuel; Boles - timber
Cedrus deodara (Roxb. ex D.Don) G.Don	Deodar	3058	Tree	Bole - timber
Picea smithiana (Wall.) Boiss.	Kachhul / Spruce	3103	Tree	Branches and cones- Fuel wood bole - timber
Pinus wallichiana A.B.Jacks.	Kaeyur / Blue pine	3030	Tree	Cones used as fuel wood used for timber resin from tree is used to heal the heel cracks
Plantaginaceae				
Picrorhiza kurroa Royle ex Benth.	Kutki / Hellebore	3013	Herb	Rhizome – medicinal, decoction of powdered dried rhizomes is administered to cure worms and stomach disorders.
Plantago lanceolata L.	Gulle / Narrow leaved plantain	3094	Herb	Leaves used as fodder and seeds as purgative.
Plantago major L.	Boadgulle / Greater plantain	3102	Herb	Leaves- fodder.
Veronica anagallis L.	Kreer / water speed well	3028	Herb	Shoots and leaves - fodder.
Veronica persica Poir.	Persian speed well	3014	Herb	Shoots and leaves - fodder.
Platanaceae				
Platanus orientalis L.	Bueun / Chinar	3071	Tree	Leaves - fodder, fuel branches - fuel wood bole- timber
Poaceae				
Aegilops tauschii Coss.	Goat grass	3059	Herb	Entire plant - fodder.
Avena fatua L.	Wan vishke / Wild oat	3015	Herb	Aerial parts – fodder.
Bromus japonicus Thunb.	Shoal gasse / Soft brome	3027	Herb	Entire plant - fodder
Cynodon dactylon (L.) Pers.	Dramun/ Bermuda grass	3129	Herb	Entire plant used as fodder and hay.
Echinochloa crus-galli (L.) P.Beauv.	Hama / Cockspur grass	3016	Herb	Shoot used as fodder.
Lolium perenne L.	Vottvishki / Rye grass	3095	Herb	Stem – fodder.

Poa annua L.	Annual meadow grass	3060	Herb	Stem and leaves – fodder.
Poa pratensis L.	Common meadow grass	3124	Herb	Stem and leaves – fodder.
Sorghum halepense (L.) Pers.	Dirham /Johnson grass	3029	Herb	Shoot - fodder.
Vulpia myuros (L.) C.C.Gmel.	Rat tail fescue	3017	Herb	Aerial part- fodder.
Podophyllaceae				
Podophyllum hexandrum Royle	Wannwangun / Ban kakri / May apple	3130	Herb	Fruits are edible and medicinal (treatment against stomach ulcers); Roots are used to overcome tumorous growth like warts in cattle etc.
Polygonaceae				
Bistorta affinis (D.Don) Greene	Mantsran / Fleece flower	3104	Herb	Roots used to make refreshing tea.
Polygonum plebeium R.Br.	Churkee / Alpine bistort	3123	Herb	Medicinal, root paste is used to check bleeding and cure ulcers.
Rheum emodi Wall.	Pambhchalen / Revandcheeni / Rhubarb	3101	Herb	Roots - medicinal (cure for mumps, root paste used locally to cure bone injuries); also used as dye. Leaves are cooked as vegetable
Rumex nepalensis Spreng.	Obuj / sorrel	3026	Herb	Leaf used as vegetable and its paste is applied on skin to get relief from the sting of *Urtica dioica.*
Rumex hastatus D. Don	Chu rki / Khatiemal	3096	Herb	Leaves used as vegetable and roots are medicinal (used for curing diarrhoea).
Portulacaceae				
Portulaca oleracea L.	Nunar / Common purslane	3070	Herb	Leaves used as vegetable that also have medicinal property of treating hypertension.
Primulaceae				
Anagallis arvensis L.	Chari sabun / Scarlet pimperel	3122	Herb	Entire plant – fodder.
Primula nivalis Pall.	Cowslip	3025	Herb	Leaves – fodder.
Pteridaceae				
Adiantum capillus-veneris L.	Geutheer	3069	Herb (fern)	Fronds – medicinal, used as a treatment for headache, insect bites and stings.
Ranunculaceae				
Aconitum heterophyllum Wall. ex Royle	Patrees / Monk's hood	3061	Herb	Roots are medicinal. Powdered roots in small doses are taken for curing diarrhoea, fever, dysentery and enlargement of spleen.
Ranunculus arvensis L.	Chirem / Meadow buttercup	3018	Herb	Leaves – fodder.
Rosaceae				
Cotoneaster nummularius Fisch. & C.A.Mey.	Open field cotoneaster	3097	Shrub	Branches - Wicker and fuel wood

Fragaria nubicola (Lindl. ex Hook.f.) Lacaita	Ishtaber / Wild strawberry	3121	Herb	Fruits are edible; dried roots are tea substitute.
Potentilla curviseta Hook.f.	Kashmir cinquefoil	3131	Herb	Leaves –fodder Stem – boiled to treat excessive bleeding.
Rosa moschata Herrm.	Kreer / Musk rose	3024	Shrub	Fruits are edible
Rosa webbiana Wall. ex Royle	Shingai / Wild rose	3062	Shrub	Fruits are edible; while petals are medicinal, used to prepare *Gulkand* used as medicine for cough, cold, throat infection.
Rubus fruticosus L.	Chaanch / Raspberry	3019	Shrub	Fruits are edible.
Rubus ulmifolius Schott	Chhaanch / Thorny black berry	3098	Shrub	Fruits are edible.
Salicaceae				
Populus deltoides Marshall	Rues phres	3132	Tree	Leaves - fodder branches - fuel wood bole - timber
Populus nigra L.	Kashuer phres	3120	Tree	Leaves- fodder Branches- fuel wood Bole- timber
Salix alba L.	Veer / White willow	3063	Tree	Twigs - tooth brush (*meswak* / datoon) Branches/ bole - fuel wood and small timber dried leaves - fodder during winter months bark – antiseptic for wounds
Salix fragilis L.	Kaeshir veer / Brittle willow	3100	Tree	Leaves- fodder Branches/ bole- fuel wood and timber
Santalaceae				
Viscum album L.	Common mistle toe	3023	Herb	Leaves – fodder. The leaves help in the increased milk production of cattle.
Sapindaceae				
Aesculus indica (Wall. ex Cambess.) Hook.	Haandeun/ Indian horse chestnut	3064	Tree	Branches- fuel wood / small timber Seeds- medicinal (antihelmenthic and oil from seeds is effective against rheumatism. Administered orally to cattle for stomach pain) Bark- tannins
Saxifragaceae				
Bergenia ciliata (Haw.) Sternb.	Zakhmihayaat / Pahand / Rock splitter	3068	Herb	Rhizome – medicinal. Dried powdered rhizome is used to cure wounds.
Scrophulariaceae				
Verbascum thapsus L.	Hapethtamokh / Mullein	3099	Herb	Roots are medicinal (astringent and emollient and used to treat cramps and migraine). A bright yellow dye is obtained

				from flowers. The dried stems are also dipped in wax/ oil to make torches.
Simaroubaceae				
Ailanthus altissima (Mill.) Swingle	Haankul / Tree of heaven	3065	Tree	Branches and boles-fuelwood
Solanaceae				
Atropa acuminata Royle ex Lindl.	Jalakafall / belladonna	3020	Herb	Roots and leaves – medicinal (Antiasthmatic, antispasmodic). Also helpful in rheumatism.
Datura stramonium L.	Datur / Jimson weed	3119	Herb	Leaves – medicinal; uuseful in asthma while harmful to cattle if taken in high doses as it has pulmonary dilating properties.
Solanum nigrum L.	Kanbey/ black night shade	3133	Herb	Leaves and fruits – medicinal. The boiled extracts of berries and leaves are used to cure liver diseases like jaundice.
Taxaceae				
Taxus wallichiana Zucc.	Poshtul / Himalayan yew	3066	Tree	Fruits - edible; Bark - medicinal (supposed to be anti-cancerous) and used to prepare tea by the nomads in the forest
Ulmaceae				
Ulmus villosa Brandis ex Gamble	Braen / Himalayan elm	3021	Tree	Leaves – fodder; Branches and bole - fuelwood
Urticaceae				
Urtica dioica L.	Soie / Bichhoobooti / Stinging nettle	3134	Herb	Shoots – medicinal, useful in rheumatism and neurological disorders. It is the main ingredient of nettle tea and nettle soup.
Verbenaceae				
Verbena officinalis L.	Vervain	3022	Herb	Aerial parts – medicinal, used to treat respiratory tract infections, and chest pain.
Violaceae				
Viola odorata L.	Bunafsha / Violet	3067	Herb	Flowers - medicinal. Decoction of flowers used to cure common cold and cough.

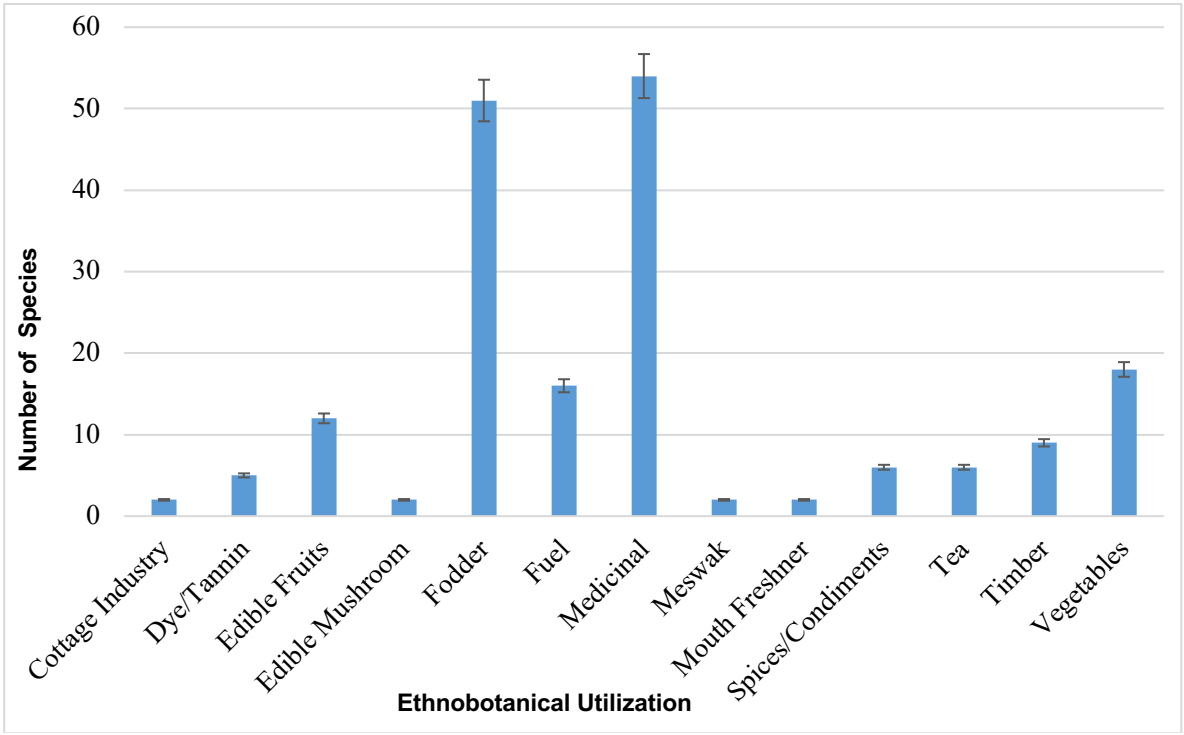

Figure 2. Proportion of forest resources by use category

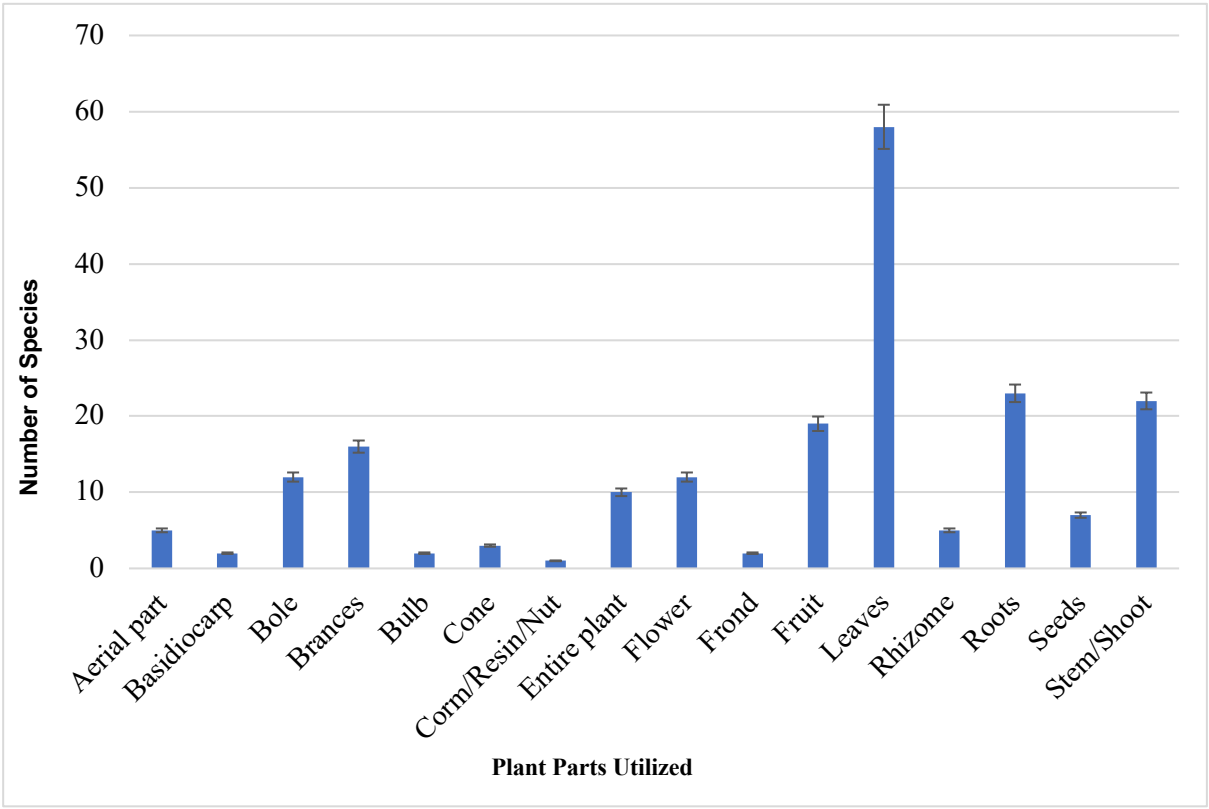

Figure 3. Proportion of forest resources by plant parts utilized

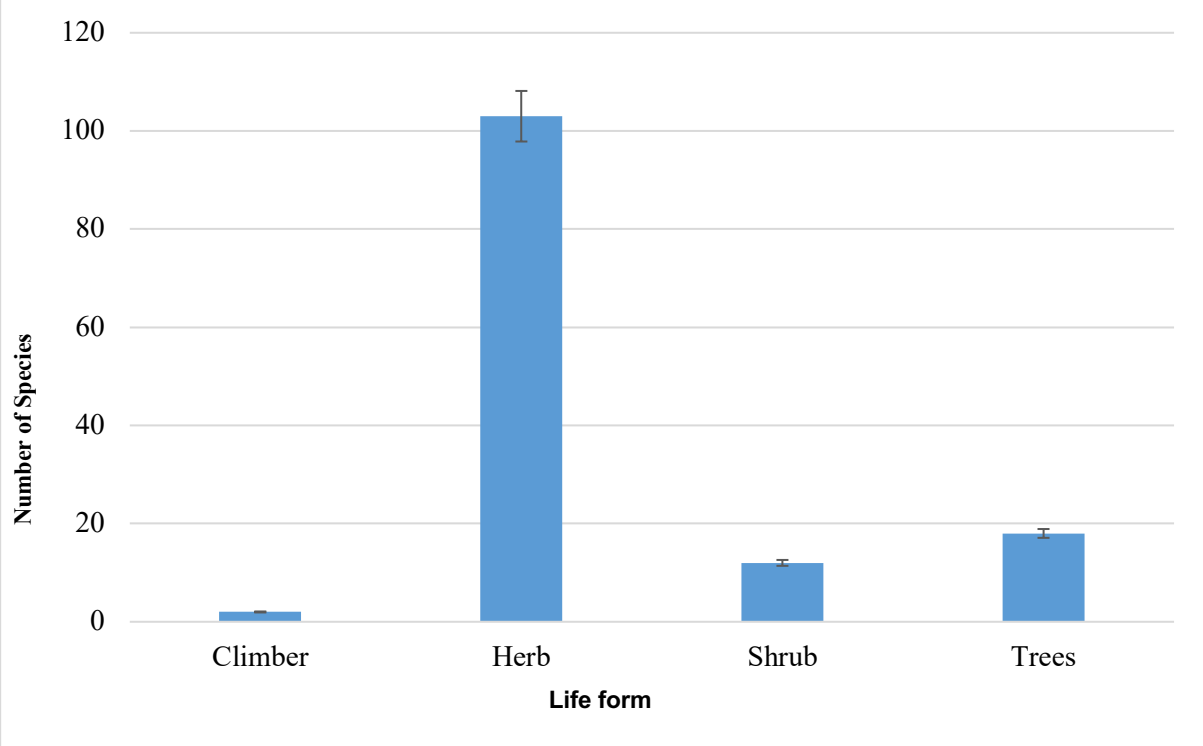

Figure 4. Life forms of the reported/documented plant species

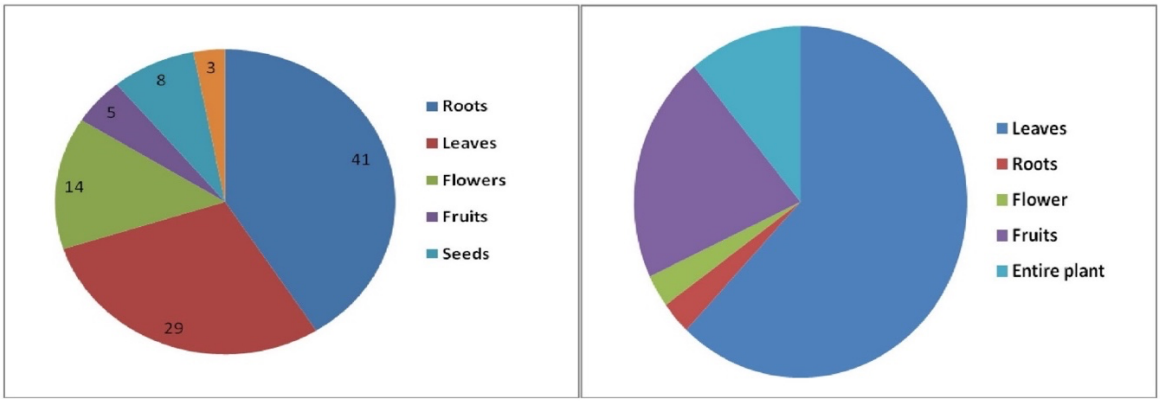

Figure 5a & 5b. Percentage of plant parts having ethnomedicinal (A) and other ethnobotanical (B) utilities in the study area.

Poverty, immense unemployment, and lack of alternative occupations are the major driving forces responsible for the over-exploitation of the forest resources. The diminishing forest resource base combined with a limited ability to take advantage of other farm and off-farm opportunities keep the poor at risk of further impoverishment (Angelsen and Wunder 2003). Since local forest communities depend more on forest resources, forest-based development interventions should be designed to improve household income and facilitate forest resource conservation. As the study shows that poor households depend more on forest resources for their livelihoods, socio-economic uplifting of the forest-dependent communities is essential to reduce the pressure on the reserve and promote conservation of biodiversity. Several studies (Shackleton and Shackleton 2004; Foppes and Ketphanh 2004; Das 2005; Yadav *et al*. 2010; Omkar *et al.* 2012; Islam and Quli 2016; Lynser and Tiwari 2016; Ibrahim *et al*. 2016) conducted across the world have reported substantial diversity of forest resources collected, consumed, and sold for household livelihood and food security. There is no vertical transfer of medicinal plant knowledge which is due to the lack of interest among the younger generation to learn and practice it, which might be attributed to the ever-increasing influence of modernization (Hunde *et al*. 2004; Uniyal *et al*. 2006; Ahmad and Pieroni 2016). The present study reports the multiferous uses for survival of the local inhabitants and other life-supporting commodities (Dubois 2003; Pandey 2009) and thus forests are

key sources for poor to sustain their livelihood (Shukla and Chakravarty 2012).

Conclusions

The local people of the study area exploit diverse NTFPs substantially to support their day-to-day needs. The forest fringe households exploit the forest resources on a regular basis and in meaningful quantities for direct household consumption to support agriculture and livestock rearing. As this was a preliminary study in the area and documentation was done for utilized species, the study suggests this kind of study for other unutilized species to know their ethnobotanical utility can be of utmost importance to know the other available species in the area. Traditionally, the local people are exploiting multiple forest resources for subsistence and livelihoods and deriving significant proportion of the employment and income for their households. Hence, livelihood diversification through forestry interventions using existing resources is needed as important strategy of poverty reduction and socioeconomic development of backward local people.

Declarations

Ethics statement: Prior informed consent was done before data collection.

Conflict of interests: The authors declare that they have no competing interests.

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