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Pattern of Forest Resource Utilization in Some Villages of Pauri Garhwal, Uttarakhand, India

Neeraj Singh[1]* • Prabhawati Tiwari[1] • Ajendra Singh Bagri[1,2] • Vinay Rawat[1] • Bharti Rautela[1,3] • Dinesh Singh Rawat[1,4]

[1]*Department of Botany & Microbiology, HNB Garhwal University, Srinagar (Garhwal) - 246174, Uttarakhand, India*
[2]*Department of Botany, Pt LMS Govt. PG College, Rishikesh (Dehradun) - 249201, Uttarakhand, India*
[3]*Department of Botany, LSM Govt. PG College, Pithoragarh - 262501, Uttarakhand, India*
[4]*Department of Botany, Uttaranchal College of Science & Technology, Kulhan, Sahastradhara Road, Dehradun - 248001, Uttarakhand, India*

*Corresponding author: rananeerajsingh44@gmail.com

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Abstract: The Garhwal Himalaya, located in the Himalayan Biodiversity Hotpot, is facing a tremendous pressure especially in human habitation localities where majority of the inhabitants are dependent on the natural resources for their daily needs. The forest resource use patterns vary from one place to another depending upon the livelihood status of inhabitant of particular area. The present study deals the forest resource use pattern in five villages namely Ghidrasu, Daang, Kathur, Khon and Thapli situated in the fringe of a reserve forest of Pauri Garhwal, Uttarakhand, India. The average fodder consumption was found 1136.13±148.44 kg/ family/ month that ranged 1047.62–1334.56 kg/ family/ month. The average fuelwood consumption/ household/ month varied from 451.04 to 560.74 kg (average 486.30±43.90 kg). The average LPG consumption varied from 13.59 to 14.26 kg/ household/ month (average 13.85±0.25 kg) in the area. The total importance value (TIV) analysis revealed that *Aesculus indica*, *Euonymus pendulus*, *Lyonia ovalifolia*, *Myrica esculenta*, *Pinus roxburghii*, *Prunus cerasoides*, *Quercus oblongata*, *Rhododendron arboreum* and *Swida macrophylla* were the tree species of higher socioeconomic values hence needs especial concern and priority in conservation and management related activities.

Keywords: Rural economy, Natural resources, Himalayan forests, Socioeconomic profile, Agro-forestry, Energy consumption.

Introduction

The majority of rural households of the country depend on locally available natural resources to meet their daily needs especially fuelwood and fodder. In protected areas, the trans-boundary areas are more vulnerable in terms of encroachment such as tourist trekking, carrying of business items, animal grazing and collection of medicinal/wild plants, etc. (Chettri et al., 2021). Among the various forms of biomass, fuelwood and fodder are the most attractive and occupies a predominant place in the rural energy budget of the country (Kataki and Konwer, 2002). Collection of fuelwood and fodder from the nearby forest is the main step that turns the cycle of economy and livelihoods of the rural people across the Indian Himalayan Region (Patnaik, 1986; Dhyani et al., 2011), as the fodder produced on arable land is inadequate alone (Purohit and Samant, 1995; Nautiyal et al., 2018). Fuelwood is the only source of energy for inhabitants of the mountains (Sundriyal and

Sharma, 1996). In absence of an alternative energy source, the inhabitants remain solely dependent on forests in the Himalayan region in order to fulfill their energy needs (Bhatt and Sachan, 2004; Bhatt and Badoni, 1990).

Uttarakhand, one of the Himalayan states of India is well known for its rich natural resources. The main occupation of the population of Uttarakhand is agriculture and is based on traditional subsistence farming (Javed and Khan, 1995; Maikhuri et al., 2011). Extraction of natural resources from forests often leads to forest degradation. Much of the area is characterized by a unique geography that renders its rural areas inaccessible, thereby increasing its reliance on agriculture-based economy (Negi et al., 2009). Fragmented and small land holdings, sloping lands and rainfall-dependent farming aggravated by migratory grazing leads to very poor yield (Chauhan et al., 2016). Inaccessibility and limited supply of commercial fuel leads to its non-availability for the inhabitants of the state owing to their poor socioeconomic condition. The consumption of commercial energy in the form of kerosene and electricity accounts for only 1.41% of the total energy consumption (Kumar, 2005). In the recent times, tourism sector is also known to be the cause of destruction of forests in the Indian Himalaya (Chettri et al., 2002). Both geography and economy of the state makes it a unique case study for researchers.

Forests are essential to the life and livelihood of hill people, who live in or around the vicinity (Rawat et al., 2020; Parveen et al., 2018). They depend on forests for periodic requirement of fuel wood, fodder, medicines, timber, and so on. This dependence is seen as a part of livelihood and economy (Kala, 2007). In the Himalayan region, forests cater to 87% of fodder requirement directly (Pandey and Singh, 1984). Extensive and intensive surveys are required to update the information on the forest resources utilization patterns in several under explored bio-geographical regions of the Himalaya (Samant, 1998). Forest resource utilization patterns vary from place to place with change in altitude, vegetation and ethnic communities (Rawat et al., 2018). The examined community's preference is paramount in the selection of key species for both sustainable development as well as environmental conservation (Kala, 2007). While being mindful of these factors, an attempt has been made to study the forest resource utilization patterns in some villages of Pauri Garhwal, Uttarakhand.

Materials and Methods

Study area: Five villages i.e. Ghidrasu, Daang, Khon, Kathur and Thapli, situated at the periphery of the Adwani forest which comes under the Adwani forest range (Garhwal Forest Division, Pauri, Uttarakhand), were chosen for the present study (**Table 1**).

Table 1: Socioeconomic profile of five studied villages from Pauri Garhwal, Uttarakhand.

	Gidrasu	Daang	Kathur	Khon	Thapli
Location					
Altitude (m asl)	1607	1577	1636	1232	1690
Latitude	30°3'45.05"N	30°3'31.93"N	30°3'21.18"N	30°5'2.18"N	30°4'9.55"N
Longitude	78°44'2.61"E	78°44'1.56"E	78°41'0.29"E	78°39'46.23"E	78°44'12.40"E
Socioeconomic profile					
Number of HH	80	60	60	70	67
Number of HH surveyed (Nos.)	26	18	20	21	20
Number of HH surveyed (%)	32	30	33	30	30
Average family size (ind./HH)	4.3	4.7	5	4.8	4.5
Average land holding/family (ha)	0.55	0.75	0.95	0.63	0.49
Average annual income per family (Indian Rupees)	33,000	29,000	32,500	30,000	31,000
Literacy Rate (%)					
Literate Male (%)	85	82	84	85	81
Literate Female (%)	75	70	72	77	70
Education level (%)					
< 5 Grade	10	13	9	11	14
5–10 Grade	72	63	72	68	66
> 10 Grade	18	24	19	21	20
Sex Ratio (females/thousand males)	1200	1150	1360	1150	1250

HH= Household

The name of 'Adwani' forest is derived from the 'Adheshwar Mahadev Temple' (Lord Shiva Temple) which is located in the mid forest and is an important destiny for devotees and tourists in the area. The forest stands in this particular part include Pine, *Cedrus*, *Quercus* and *Rhododendron* tree species which form pure or mixed forest patches in the area. The selected villages are surrounded by terraced agricultural fields and forests where agricultural activities with animal husbandry are the main occupation to the majority of households. The study area falls in the temperate climate zone, however, the vegetation at lower elevations and dryer slopes represents both temperate and sub-tropical plant elements. The common tree species found in the area includes *Aesculus indica*, *Carpinus viminea*, *Cedrus deodara*, *Cinnamomum tamala*, *Cupressus torulosa*, *Euonymus pendulus*, *E. tingens*, *Ilex dipyrena*, *Lyonia ovalifolia*, *Myrica esculenta*, *Pinus roxburghii*, *Prunus cerasoides*, *Pyrus pashia*, *Quercus oblongata*, *Q. lamellosa*, *Rhododendron arboreum*, *Viburnum cotinifolium*, etc. Apart from the forested region, a rich number of trees sustained in agricultural fields, abandoned lands, etc. May and June are

the most sizzling time of the year as maximum temperature goes up to 35℃. The blistering climate begins toward the end of March and proceeds till monsoon. The precipitation occurs mainly during June–September and extreme precipitation normally occurs in July. The colder weather of year begins from October and proceeds till the end of February. The snowfall is of normal event during December and January, the coldest months of the period.

Methodology

Extensive field surveys were conducted to the study area during different seasons of the year 2018 to collect information on the socioeconomic attributes of households and resource utilization patterns by villagers. The data was collected through questionnaire method (Jain and Mudgal 1999). Approximately 30% of the total households were surveyed in each village (**Table 1**). The ethnobotanical data were collected from local informants of the area, including mostly local healers, pujaris (priests), vaidyas (traditional medical practitioner), elder men and women. The pattern of fuelwood and fodder consumptions were quantified following Bhatt et al. (1994), Gupta et al. (1997) and Singh et al. (2010).

Approximately 15 households from each village were surveyed to determine the preferences for tree species that they used for various purposes. Finally, all the tree species were ranked into 10 categories (rank 1–10); the most preferred one was ranked first (1), while the least one was ranked ten. The availability status (common, uncommon, rare) of each tree species was determined following field observation and their relative abundance in the nearby forests. Rare status mentions the species which were recorded in only populations or with a few individuals in the area.

The Total Importance Value (TIV) was estimated by dividing tree species into three categories of uses viz. primary, secondary and tertiary uses following Belal and Springuel (1996). Primary uses include the value of fodder, fuel wood, medicine, timber, agricultural tools and wild edibles while secondary uses include secondary direct benefits like fiber, oil, dye and tannin. Tertiary uses include the indirect benefits like ornamental, bee forage, shade, hedges, soil stabilization and nitrogen fixation. TIV was calculated by using the following formula;

$$\text{Total Importance Value (\%)} = \frac{U1 + U2 + U3â€¦â€¦â€¦â€¦â€¦.n}{\text{Number of uses of a species}} Ã— 100$$

Where, U is importance value for each particular use of a species.

Results

Socio-economic profile

An average 21 households were surveyed in each village representing 30% of the total households (**Table 1**). The overall average family size was recorded 4.66±0.27 persons per family in the study area. The average cultivated land per household varied from 0.49 ha to 0.95

ha (0.67±0.18 ha) across the five villages. The overall average family income from all sources (i.e. Government service, private service, income from livestocks, selling of forest and horticultural products, etc.) was found 31,100±1673 rupees per annum. The overall average literacy rate was found 78.10% in the five studied villages. The average literacy rate of males was found high (83.40%) in comparison to the females (72.80%). The majority of the population (67.60%) represented moderate education level (grade 5–10) while 20.40% of the population achieved above 10 grade education level. The lowest education level was mainly represented by older people. Sex ratio was 1222 females/ thousand males in the studied villages during the current study.

Fodder consumption pattern

The majority of the families (74.40%) were livestock-owning in the study area with average 4.04±0.45 cattle per household (**Table 2**). Average livestock population ((such as buffaloes and cows (milk), goats (milk as well as meat) and oxen (ploughing) ranged between 3.80 and 4.70 cattle per household in the area. The average fodder consumption was found 1136.10±148.48 kg per family per month. It ranged from 1047.62–1334.56 kg per family per month for five studied villages. The distance covered by the inhabitants to collect the fodder varied between 1 and 5 km.

Table 2: Patterns of fuelwood and fodder consumption in some villages of Pauri Garhwal.

	Gidrasu	Daang	Kathur	Khon	Thapli
Livestock and fodder consumption					
Livestock-owning families (%)	82	80	60	85	65
Livestock population per HH	3.8	4.2	3.5	4	4.7
Average fodder consumed/HH/month (kg)	1047.62	1186.8	942.86	1168.7	1334.56
Distance travelled for fodder collection (km)	1–5	1–4.5	1–4.4	1–4	1–5
Energy consumption by villagers					
Average fuelwood consumption/HH/month (kg)	474.04	487.14	560.04	458.74	503.53
Distance travelled for fuelwood consumption (km)	1–5	1–4.5	1–4.4	1–4	1–5
LPG using families (%)	64	58	61	57	56
Average LPG consumption/HH/month (kg)	13.74	13.85	14.26	13.79	13.59

Fuelwood consumption pattern

The average fuelwood consumption/ household/ month varied from 458.74 to 560.04 kg among the studied villages while the overall average was found 496.70±39.06 kg (**Table 2**). It varied from 15.03 to 18.69 kg/ household/ day in the area. The average distance travelled for fuelwood varied between 1 and 5 km. The fuelwood was mostly extracted from the forest as fallen dried twigs or logs. The average LPG consumption varied from 13.59 to 14.26 kg (13.85±0.25 kg)/ household/ month in the area.

Utility of tree species: A total of 24 tree species belong to 22 genera and 17 families were recorded from the nearby forest stands of the

selected villages (**Table 3**). Out of total, 13 species were common in occurrence followed by uncommon (7 species) and rare (5 species). The TIV analysis revealed that *Aesculus indica*, *Euonymus pendulus*, *Lyonia ovalifolia*, *Myrica esculenta*, *Pinus roxburghii*, *Prunus cerasoides*, *Quercus oblongata*, *Rhododendron arboreum* and *Swida macrophylla* were the tree species of higher socioeconomic values (TIV% > 80%) at local scale. *Cedrus deodara*, *Ilex dipyrena*, *Acacia dealbata*, *Picrasma quassioides* and *Quercus lamellosa* were with lowest TIV scores in the area. *Quercus oblongata* and *Rhododendron arboreum* were the most preferred (rank 1) tree species in the study area followed by *Pinus roxburghii*, *Viburnum cotinifolium*, *Myrica esculenta*, *Carpinus viminea*, *Cedrus deodara*, *Prunus cerasoides* and *Symplocos paniculata* (**Table 3**). Out of total, 96% tree species used as source of fuelwood, 75% fodder, 71% medicinal, 64% timber, 60% cattle bedding and 40% wild edible (**Table 4**). Apart from these uses, 64% tree species were also used for other purposes like resin, rituals, spices, etc.

Table 3: Availability, TIV (%) and ranking of tree species in some villages of Pauri Garhwal.

Name of species and Family	Availability	Local name	TIV (%)	*Rank
Quercus oblongata (Fagaceae)	Common	Banj	88.89	1
Rhododendron arboreum (Ericaceae)	Common	Burans	88.89	1
Pinus roxburghii (Pinaceae)	Common	Chir, Kulain	88.89	2
Viburnum cotinifolium (Caprifoliaceae)	Common	Bhatnoi, Guya	77.78	2
Carpinus viminea (Corylaceae)	Rare	Chamkharik	66.67	3
Cedrus deodara (Pinaceae)	Uncommon	Deodar	55.56	3
Myrica esculenta (Myricaceae)	Common	Kaphal	100.0	3
Prunus cerasoides (Rosaceae)	Common	Panyyan, Phaja	88.89	3
Symplocos paniculata (Symplocaceae)	Common	Lodh	77.78	3
Aesculus indica (Hippocastanaceae)	Uncommon	Pangar	100.0	4
Cinnamomum tamala (Lauraceae)	Uncommon	Dalchini, Tejpat	66.67	4
Cornus capitata (Cornaceae)	Common	Bhamora	77.78	4
Ilex dipyrena (Aquifoliaceae)	Common	Kandara	55.56	4
Euonymus tingens (Celastraceae)	Uncommon	Konk	77.78	5
Lyonia ovalifolia (Ericaceae)	Common	Aiyaar	88.89	5
Pyrus pashia (Rosaceae)	Common	Mehal, Melu	66.67	5
Swida macrophylla (Cornaceae)	Uncommon	Khagsi	88.89	5
Cupressus torulosa (Cupressaceae)	Uncommon	Surai	77.78	6
Machilus duthiei (Lauraceae)	Common	Kauwla	66.67	6
Euonymus pendulus (Celastraceae)	Uncommon	Bhambeli	88.89	7
Juglans regia (Juglandaceae)	Rare	Akhror	77.78	8
Picrasma quassioides (Simaroubaceae)	Rare	Karui, Kuth	11.11	9
Quercus lamellosa (Fagaceae)	Rare	Banj	11.11	9
Acacia dealbata (Mimosaceae)	Rare	–	33.33	10

*Ranking of tree species is based on preference of villagers for different utility values in the study area.

Discussion

In the present study, the majority of the families (74.40%) were livestock-owning in the study area with average 4.04±0.45 cattle per household. The local forests are main source of fodder to the cattle in the studied villages and in nearby regions (Nautiyal et al., 2018; Rawat et al, 2018). The results revealed that the average fodder consumption was 1136.10±148.48 kg per family per month. Malik et al. (2014) reported fodder consumption in the range of 837.90-1,800 kg/month/household with an average of 1180.07 kg/month/household from the villages of Kedarnath Wildlife Sanctuary. Similarly, the fodder consumption was reported to be ranging from 816 to 1,215 kg/month/household with an average of 1,015.5 kg/month/household in a study conducted by Sharma et al. (2009) from four temperate villages located in the other parts of Garhwal Himalaya.

The daily consumption of fuelwood in the study area was in the range of 16.78 kg/family/day–20.19 kg/family/day. The result is comparable to the earlier reports by Sharma et al. (2009) who documented the daily fuelwood consumption from 11.6 kg/ family to 24.6 kg/ family from selected villages of the Garhwal Himalaya. The higher fuelwood consumption rate (28.1 kg/ family to 30.6 kg/ family) was reported by Sharma et al. (2011) from Dudhatoli area of Garhwal Himalaya. This variation in fuelwood consumption in the two studies could be attributed to the factor of altitudinal difference because the warm regions need low energy to heat water in comparison to the colder regions. Bhatt and Sachan (2004) and Singh (2017) suggested that the altitudinal variations and climatic conditions could be major reasons for the difference in fuelwood consumption. Malik et al. (2014) also found that average fuelwood consumption/ family/ month were 514.2 kg at 2250 m elevation while it was just 270 or below for the villages situated below 1200 m.

Tree species like *Aesculus indica*, *Euonymus pendulus*, *Lyonia ovalifolia*, *Myrica esculenta*, *Pinus roxburghii*, *Prunus cerasoides*, *Quercus oblongata*, *Rhododendron arboreum* and *Swida macrophylla* revealed higher TIV in the area which corresponds to their socioeconomic importance in the area. Rawat et al. (2018) reported that the TIV of trees show high socioeconomic importance than other life forms (shrubs, herbs, climbers) from Tons Valley, Garhwal Himalaya. Because trees are the sole source of timber (100%), agricultural tools (100%) and fuel wood value (91%) besides being used for fodder and medicine (Samant et al., 2007; Singh & Gaur, 2008). It is evident from the Table 3 and 4 that the tree species like *Quercus oblongata*, *Rhododendron arboreum*, *Pinus roxburghii*, *Viburnum cotinifolium*, *Carpinus viminea*, *Cedrus deodara*, *Myrica esculenta*, etc. were most preferred species in the area. People's preference is mainly based on the availability of the species in the area and their

utility to them. Most of the high ranked tree species are fodder source in the area. Similar preference tendency was reported from other parts of the Garhwal Himalaya (Sharma et al., 2009, 2011; Malik et al., 2014; Rawat et al. 2018).

The dependence on the forest has to be reduced by providing villagers the knowledge of planting more trees that mature rapidly in degraded land and unarable land. Overgrazing and extensive lopping of the trees should be avoided. So, they get regenerated in a short time frame. The species with higher TIV and local preference should be considered in prioritization for conservation, plantation and social forestry which will be a crucial step to meet out the pressure on forests near to human settlements (Rawat et al., 2018).

Table 4: Utility value of different species in some villages of Pauri Garhwal.

Name of species	Fod.	Fue.	Cbd.	Agr.	Hou.	Tim.	Edi.	Med.	Mis.
Acacia dealbata	n.d.	+	n.d.	+	n.d.	n.d.	n.d.	n.d.	+
Aesculus indica	+	+	+	+	+	+	+	+	+
Carpinus viminea	+	+	+	+	+	+	n.d.	n.d.	n.d.
Cedrus deodara	n.d.	+	n.d.	+	–	+	n.d.	+	+
Cinnamomum tamala	+	n.d.	n.d.	+	+	n.d.	+	+	+
Cornus capitata	+	+	+	+	+	n.d.	+	+	–
Cupressus torulosa	+	+	–	+	+	+	n.d.	+	+
Euonymus pendulus	+	+	+	+	+	+	n.d.	+	+
Euonymus tingens	+	+	+	+	+	–	n.d.	+	+
Ilex dipyrena	+	+		+	+	+	n.d.	n.d.	n.d.
Juglans regia	n.d.	+	+	+	+	+	+	+	n.d.
Lyonia ovalifolia[#]	+	+	+	+	+	+	–	+	+
Machilus duthiei	+	+	+	+	+	+	n.d.	n.d.	n.d.
Myrica esculenta	+	+	+	+	+	+	+	+	+
Picrasma quassioides	n.d.	+	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Pinus roxburghii	n.d.	+	+	+	+	+	+	+	+
Prunus cerasoides	+	+	n.d.	+	+	+	+	+	+
Pyrus pashia	+	+	n.d.	+	n.d.	+	+	+	n.d.
Quercus lamellosa	n.d.	+	n.d.	+	n.d.	n.d.	n.d.	n.d.	+
Quercus oblongata	+	+	+	+	+	+	n.d.	+	+
Rhododendron arboreum[#]	+	+	+	+	+	+	+	+	–
Swida macrophylla	+	+	+	+	+	+	+	n.d.	+
Symplocos paniculata	+	+	+	+	+	n.d.	n.d.	+	+
Viburnum cotinifolium	+	+	+	+	+	n.d.	n.d.	+	+

Abbreviations used: *Fod. = Fodder, Fue. = Fuelwood, Cbd. = Cattle bedding, Agr. = Aricultural implements, Hou. = Household articles, Tim.= Timber, Edi. = Edible, Med. = Medicinal, Misl. = Miscellaneous. + = yes, n.d. = not determined, – = absent.* [#]*Young leafy twigs (sticky) are considered poisonous to cattle, while old twigs are collected as fodder.*

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References

Belal, A.E. and Springuel, I. (1996) Economic value of plant diversity in arid environments. *Nat. Resour.* 32(1): 33–39.

Bhatt, A.K. and Badoni, A.K. (1990) Fuel characteristics of some mountain firewood shrubs and trees. *Energy* 15(11): 1069–1070.

Bhatt, B.P. and Sachan, M.S. (2004) Firewood consumption along an altitudinal gradient in mountain villages of India. *Biomass Bioenerg.* 27(1): 69–75.

Bhatt, B.P. and Todaria, N.P. (1990) Fuel wood characteristics of some mountain trees and shrubs. *Biomass* 21(3): 233–238.

Chauhan, R.S., Chauhan, J.S., Rawat A.S. and Rawat, D.S. (2016) Effects of salinity on germination behaviour of two paddy landraces grown in Chakrata, Dehradun, Uttarakhand, India. *Agropedology* 26(2): 164–171.

Chettri, N., Sharma, E., Deb, D.C. and Sundriyal, R.C. (2002) Effect of firewood extraction on tree structure, regeneration and woody biomass productivity in a trekking corridor of the Sikkim Himalaya. *Mt. Res. Dev.* 22(2): 150–158.

Chettri, S.K., Sharma, G., Gaira, K.S., Pandey, A., Joshi, R., Chettri, N. and Pradhan, B.K. (2021) Forest resource use pattern in fringe villages of Barsey Rhododendron Sanctuary and Singalila National Park of Khangchendzonga Landscape, India. *Int. J. For. Res.* 2021: 8856988 (1–11).

Dhyani, S., Maikhuri, R.K. and Dhyani, D. (2011) Energy budget of fodder harvesting pattern along the altitudinal gradient in Garhwal Himalaya, India. *Biomass and Bioenerg.* 35(5): 1823–1832.

Gupta, R.K., Pathania, M.S. and Gupta, T. (1997) A study on fuel consumption pattern in Himachal Pradesh: a case study. *Range Manag. Agrofor*. 18(2): 181–188.

Jain, S.K. and Mudgal, V. (1999) *A Handbook of Ethnobotany*. Bishen Singh Mahendra Pal Singh, Dehradun, India.

Kala, C.P. (2007) Local preferences of ethnobotanical species in the Indian Himalaya: Implications for environmental conservation. *Curr. Sci.* 93(12): 1828–1834.

Kataki, R. and Konwer, D. (2002) Fuelwood characteristics of indigenous tree species of north-east India. *Biomass and Bioenerg.* 22(6): 433–437.

Kumar, P. (2005) Natural resource policy: Some related issues. In: Dewan, M.L. and Bahadur, J. (eds.), *Uttaranchal Vision and Action Programme*. Concept Publishing Company, New Delhi, India. pp. 147–183.

Maikhuri, R.K., Rao, K.S. and Semwal, R.L. (2011) Changing scenario of Himalayan agroecosystem, Loss of agrobiodiversity, an indicator of environmental change in central Himalaya, India. *Environmentalist* 21: 23–39.

Malik, Z.A., Bhat, J.A. and Bhatt, A.B. (2014) Forest resource use pattern in Kedarnath Wildlife Sanctuary and its fringe areas (a case study from western Himalaya, India). *Energy Policy* 67: 138–145.

Nautiyal, M., Tiwari, P., Tiwari, J.K. and Rawat, D.S. (2018) Fodder diversity, availability and utilization pattern in Garhwal Himalaya, Uttarakhand. *Plant Arch*. 18(1): 279–289.

Negi, V.S., Maikhuri, R.K., Rawat, L.S. and Bahuguna, A., (2009) Traditional agriculture in transition: A case of Har-ki Doon Valley (Govind pashu vihar sanctuary and national park) in Central Himalaya. *Int. J. Sustain. Dev.* 16(5): 313–321.

Pandey, U. and Singh, J.S. (1984) Energy-flow relationships between agrosystem and forest ecosystems in Central Himalaya. *Environ. Conserv.*11: 45–53.

Parveen, M., Tiwari, J.K., Nautiyal, M., Tiwari, P. and Rawat, D.S. (2018) Effects of anthropogenic disturbances on community structure and regeneration status of tree species in reserved and panchayat forests of Pauri Garhwal, Western Himalaya, India. *NeBIO* 9(1): 150–157.

Patnaik, R. (1986) Tribals and forest. In: Desh, B. and Garg, R.K. (eds*), Social Forestry and Tribal Development*. Indian Environmental Society, New Delhi. pp. 105–117.

Purohit, K. and Samant, S.S. (1995) *Fodder trees and Shrubs of Central Himalaya*. Gyanodaya Prakashan, Naintal, Uttarakhand, India.

Rawat, D.S. Tiwari, P., Das, S.K. and Tiwari, J.K. (2020) Tree species composition and diversity in montane forests of Garhwal Himalaya in relation to environmental and soil properties. *J. Mt. Sci.* 17(12): 3097–3111.

Rawat, D.S., Tiwari, J.K., Uniyal, P.L. and Tiwari, P. (2018) Assessment of fodder species in Western Ramganga Valley, Uttarakhand, India. *Int. J. Trop. Agric.* 36(1): 23–36.

Samant, S.S. (1998) Diversity, distribution and conservation of fodder resource of west Himalaya, India. Proceedings: *Third Temperate Pasture and Fodder Network (TAPAFON)*, Pokhra, Nepal. pp 9–13.

Sharma, C.M., Butola, D.S., Gairola, S., Ghildiyal, S.K. and Suyal, S. (2011) Forest utilization pattern in relation to socio-economic status of People in Dudhatoli area of Garhwal Himalaya. *For. Trees Livelihoods* 20(4): 249–263.

Sharma, C.M., Gairola, S., Ghildiyal, S.K. and Suyal, S. (2009) Forest resource use patterns in relation to socioeconomic status. *Mt. Res. Dev.* 29(4): 308–319. https://doi.org/10.1659/mrd.00018

Singh, G., Rawat, G.S. and Verma, D. (2010) Comparative study of fuelwood consumption by villagers and seasonal "dhaba owners" in the tourist affected regions of Garhwal Himalaya, India. *Energy Policy* 38(4): 1895–1899.

Singh, H., Malik, Z.A. and Baluni, P. (2017) Forest resource use pattern in relation to socioeconomic status (A case study from two altitudinal zones of western Himalaya, India). *Indian For*. 143(4): 334–343.

Sundriyal, R.C. and Sharma, E. (1996) Anthropogenic pressure on tree structure and biomass in the temperate forest of Mamlay Watershed in Sikkim. *For. Ecol. Manag.* 81(1-3): 113–134.