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RESEARCH ARTICLE

FOREST CONSUMPTION PATTERN IN RELATION TO SOCIO-ECONOMIC ARRANGEMENT OF PEOPLE IN WESTERN RAMGANGA WATERSHED IN CENTRAL HIMALAYA, INDIA, UTTARAKHAND

Himanshu Pandeya and Anil Kumar Yadava

Department of Forestry and Environmental Sciences, Soban Singh Jeena Campus, Kumaun University, Almora, Uttarakhand, India

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ABSTRACT

Forest resources have historically played a significant role in the economy of the Uttarakhand since ancient times. This case study explored forest resource use pattern to understand villager's dependency on forests in subtropical and temperate region, the study was carried out in two villages, one is the Farika Village at Masi-Chaukhutia, which lies at latitude 29^0 50^0 N and 79^0 16^0 E, between 1500-1650 m in Almora district, and another one is the Ramara village at Ghaniyal area, which lies 30^0 02^0 N and 79^0 14^0 E, between 2000-2100 m in the Chamoli district of Uttarakhand. The average family size varied between 7.9 people per households in Ramara and 7.3 people per households in Farika village and similarly sex ratio ranged between 933 and 1036, respectively. Although the literacy rate in both villages above 65%, due to lack of employment opportunities people still invariably depend on forests for their livelihood. Agriculture is the fundamental occupation of those villages, simultaneously employment as labourers and NTFP collection were the main occupation of people in the study area. In those villages more than 75% of fodder and fuel-wood were extracted from the forest. Average fodder and fuel-wood consumed/household/day/kg were 30.02 to 38.31 and 13.26 to 23.34, respectively. A total of twelve and sixteen forest tree species were recorded to be used for variety of purposes by the villagers of both villages. Three major important trees species Chir (*Pinus roxburghii*) in lower elevation, oak (*Quercus leucotrichophora*) in mid altitude and Kharsu (*Quercus semecarpifolia*) in higher altitude consumed largely for fuel wood, fodder and cutting of grass for stall feeding in this area. Local people collect 3 to 5 kg lichens (Jhoola grass) a day and sold 100 to 130 per kg on local market. The pressure exerted by human and bovine population, coupled with unsustainable management policies, and has resulted in the destruction of forest cover and ecological degradation.

INTRODUCTION

Forest resources have historically played a significant role in the economy of the Uttarakhand since ancient times. Uttarakhand lies in the Northern part of India between the latitudes 28^0 43'- 31^0 27'N and longitudes 77 ^{0} 34'- 81^0 02'E having a maximum dimension of east - west 310 km and 255 km north - south covering an area of 53,484 km^2 with the elevation ranging from 210 to 7817 masl. The state is rich in forests and has a long history of scientific forest management, and an excellent protected area network.

The State has village level institutions adept at managing chunks of forests called Van Panchayats. Presently 12089 Van Panchayats (Garhwal mandal 6278 and Kumaun mandal 5811) are entrusted with the management of 5500 sq. km. of forests. Traditionally the forestry and biodiversity sector has been conservation oriented with a special thrust on participation of local communities. The forests of Himalaya have a permeative influence on the ecosystems, environment and the lives of people of the area. The state can sustain forestry and agriculture for the survival of the people, live in this rural and hilly area (Bisht, 2006).

Million of forest dwellers across the world depends from forest for their livelihood (Patnaik 1986), but their need varies place to place. Forest diversity is the main source of livelihood of the people living in Uttarakhand, Central Himalaya and provides resources such as fuel wood, fodder, fibres, food, green manure, medicine, agricultural tool, and construction timber which are critical to the household economy. On the

Corresponding author:* **Himanshu Pandeya
Department of Forestry and Environmental Sciences, Soban Singh Jeena Campus, Kumaun University, Almora, Uttarakhand, India

basis of phyto- diversity there are three major important trees species Chir (*Pinus roxburghii*) in lower elevation, oak (*Quercus leucotrichophora*) in mid altitude and Kharsu (*Quercus semecarpifolia*) in higher altitude consumed largely for fuel wood, fodder and cutting of grass for stall feeding in this study area.

The increasing population trends over the last few decades and consequent over dependence on plant products has led to the vast exploration of natural flora of this region. Agricultural practice continue to be the main occupation of people of the Himalaya as about 70% population gets direct and indirect employment from agriculture (2011).

The rich and varied biodiversity of the state attracted the naturalists, wild lifers and taxonomists and conservationists since time immemorial and has been explored extensively. The present case study that deals with the relation between the socio-economic status of people and Non timber forest product use patterns. It explores the pattern of energy consumption, the relationship between income and forest use, and the causes of stress on forest for various products. It concludes with suggestions regarding possible action to prevent further forest degradation.

MATERIALS AND METHODS

The study areas lie in the western Ramganga watershed of Kumaun Central Himalaya in Uttarakhand State in India. The study was carried out in two villages, one in the Masi-Chaukhutia area (Farika village), which lies at latitude 29^0 $50^{'}$ N and longitude 79^0 $16^{'}$ E between 1500 m and 1650 m in Almora district, and one in the Ghyniyal area (Ramara village), which lies at latitude 30^0 $02^{'}$ N and 79^0 $14^{'}$ E between 2000 m and 2100 m in the Chamoli district. Climate and cropping patterns in these study areas are shown in table 1.

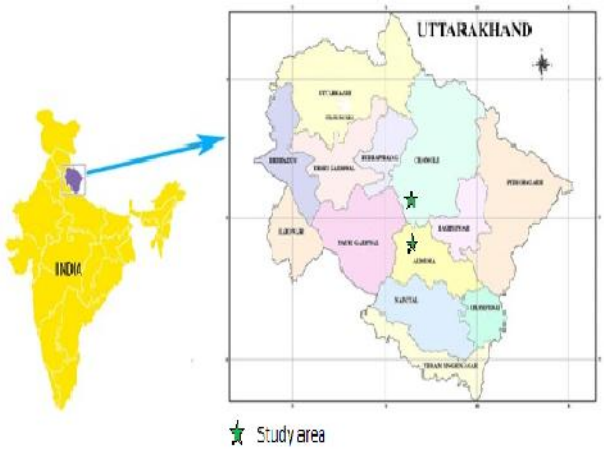


Table 1 General Climatic and agriculture details for the study areas

Study area	Climate data (2011-2013) Mean annual maximum Temperature*	Mean annual minimum Temperature*	Mean annual rainfall*
Ramara	15.23±3.34^{0}C	4.58± 1.85^{0}C	765±148 mm
Farika	21.12± 4.96^{0}C	5.87 ±1.49^{0}C	450±120 mm

*Source: Uttarakhand Forest Department

Cropping Pattern

Ravi (Winter season crops)	Kharif (Rainy season crops)	Common Leguminous crops
Wheat (*Triticum aestivum*)	Finger millet (*Eleusine coracana*)	Pea (*Pisum sativum*)
Mustard (*Brassica campestris*)	Soyabean (*Glycine max*)	Horse gram (*Dolichos uniflorus*)
Barley (*Hordeum vulgare*)	Hog millet (*Panicum miliaceum*	Kidney bean (*Phaseolus lunetus*)
Lentil (*Lens esculenta*)	Amaranth (*Amaranthus paniculatus*	Black gram (*Vigna munga*)
Jau (*Hordeum vulgare*)	Barnyard millet (*Echinocloa frumentacea*)	Gahat (*Macrotyloma uniflorum*)
	Paddy rice (Oryza sativa)	

The climate in study areas can be divided into three distinct seasons, namely summer season (April to June), rainy season (July to September) and winter season (November to February). The rainfall pattern in the region is largely governed by monsoon rains (July-September), which account for about 60-80% of the total annual rainfall. The vegetation in the study areas is natural. Farika village is situated at the base of natural *Pinus roxburghii* dominant forest, whereas Ramara is situated in *Quercus leucotrichophora* mixed forests. Leaf litter from the forest is used as bedding material in the cattle shed. The litter mixed with cattle excreta is used as manure in the crop fields. Cattle feed is met partly from crop by products and tree fodder from the private farms and partly from grazing and lopping of fodder trees in the community and government forests. Summer camping sites the villagers of both the villages migrate to the Dudhatoli forest area for grazing of animals where temporary Kharaks constructed earlier.

A door to door survey was conducted in two villagers of the study area to gather information on socio-economic status. Structured and pre tested questionnaires were used to personal interview. These questionnaires were based on the requirement of the study and on information extracted from general discussion with villagers to gather information from each social caste, economic level, gender and age.

We also used different ways of collecting precise, quantitative data on income and income sources, questionnaires, personal observation, and discussion with gram pradhan (Head of village legislative council). The head of each sample household was interviewed. The data collected for study included general information about each household, such as literacy level, family size, landholding, number of animal per family, sources of income, occupation, source of energy, extraction of non-timber forest products, and so on (Table 2).

To estimate the amount of fuel wood and fodder consumption per day per households, in both the villages 20% of the households per village (12 and 18 HH) were survey and their consumption pattern were noted seven consecutive days in three different season: summer, rainy and winter. The families surveyed were chosen to include equal representation from all economic classes and family sizes. To understand pressure on individual forest tree species, we asked about villagers preferences for various purpose such as fuel wood, fodder, agricultural implements, household articles, and other uses; a maximum of 10 points was given for each (Sharma *et al.*, 2009).

RESULTS AND DISCUSSION

Socio-economic observations

The average family size varied between 7.9 person per households in Ramara and 7.3 per household in Farika (Table 1.2). The sex ratio (females/thousand males) ranged between 933 in Ramara and 1036 in Farika village. This difference can be attributed to lack of employment, which has led to migration of the male population from Ramara area to other areas in search of jobs.

The literacy rate was above 65% in two villages; most of people were educated between grades 5 and 10 in Ramara village area and above grade 10 in the Farika village. In both the villages 33% and 25% people were uneducated in Ramara and Farika, respectively, and the majority of those were older. In two studied villages males exhibit a higher literacy level than female.

Female children only get primary education in the schools situated nearby villages, whereas male children have option to study in the cities. Although the literacy rate was high, most people were unemployed because of lack of employment opportunities.

Women work hard through the day, starting with the family works, nurturing children and livestock, going out for fuel wood, fodder, and drinking water. The villagers therefore still relied for their sustenance on rainfed agricultural land and forests.

The average cultivated land at both sites was less than 0.5 ha; therefore, production was supplemented from the adjacent forest ecosystem. More than 70% of the agricultural fields in the Ramara area and about 60% in the Farika area were rainfed. Approximately 85% houses in two villages were made of traditional type of slates (Pathals), wood and straw and rest made of cement. Usually, villagers have been using traditional stoves (Chullas) for cooking which is generally situated at the corner of the kitchen.

Sources of income

The main occupation in those villages was agriculture, which was practiced at a small scale on terraced farms and was not sufficient to feed an entire family for the year. Vegetables such as Radish, Mustard leaf, Bean, Potato, Pea, Spinach and fruits from agricultural land were sold on the open market to earn money.

Table 2 Socio- economic profile of the study villages, in western Ramganga watershed

Village		**Ramara**		**Farika**	
Altitute(m asl)		2100		1500	
District		Chamoli		Almora	
No.of households		37		90	
Sampled house		12		18	
Total Population		292		676	
Average household size		7.9		7.5	
			Percentage		Percentage
Education level	Illiterate	97	33.21	171	25.29
	Primary	89	30.47	214	31.65
	Middle	41	14.04	106	15.68
	Matric	35	11.98	88	13.01
	Higher Secondary	17	5.82	59	8.73
	Graduate	13	4.45	38	5.621
Age	Up to 25 year	83	28.42	197	29.14
	26 to 50 year	144	49.31	293	43.34
	50 onward	65	22.26	186	27.51
Income Level	Below Poverty Line (i.e. below Rs 25000)	5	27.02	12	13.33
	Rs 25,000 -35,000	8	21.62	11	12.22
	Rs 35,000 -50,000	12	32.43	26	28.88
	Rs 50,000 & above	13	35.14	41	45.55
Employment Pattern	Government Job	9	24.32	22	24.44
	Private Jobs	6	16.21	19	21.11
	Business	3	13.51	8	8.88
	Agriculture	15	40.54	29	32.22
	Landless Labour	4	15.06	12	13.33
Livestock	Total livestock population	285	-	494	-
	Average number of animal/household	7.7	-	5.48	-
	Livestock owning families	34	-	78	-
	Average fodder consumed/household/day(kg)	38.31	-	30.027	-
	Fodder extracted from the forest	85.4	-	72.2	-
	Distance travelled for fodder collection(Km)	1.5 to 2.5	-	2 to 3	-
Energy consumption	Average fuelwood consumed/household/day(Kg)	23.34	-	13.26	-
	Fuelwood extracted from forest	96.4	-	74.6	-
	Distance travelled for fuel wood collection (Km)	1 to 2	-	1.5 to 3	-
	Average LPG consumed/household/year(L)	2.4	-	53.26	-
	Average Kerosin consumed/household/month (L)	4.5	-	6.6	-

Table 3 Preference of the tree species used in Ramara village of western Ramganga watershed.

Rank	Species	Comman name	Preference									Availability
			Fo	Fw	Ag. I.	HA	T	Fr	M	BL	WH	RE	
1	*Quercus leucotrichophora* A.Camus	Banj	A	A	A	B	N.A.	N.A.	N.A.	A	A	N.A.	+++
2	*Quercus floribunda* Lindl.exRehder	Tilonj	A	A	A	D	N.A.	N.A.	N.A.	A	N.A.	N.A.	+++
3	*Quercus glauca* Thunb	Haring	B	D	D	D	N.A.	N.A.	N.A.	A	N.A.	N.A.	++
4	*Rhododendron arboreum* Sm.	Buras	D	B	N.A.	N.A.	N.A.	N.A.	B	B	N.A.	N.A.	++
4	Myrica esculenta Buch-Ham ex D.Don	Kafal	N.A.	D	N.A.	N.A.	N.A.	A	C	D	N.A.	N.A.	++
5	*Alnus nepalensis* (D.Don) Spach	Utees	B	D	N.A.	D	N.A.	N.A.	N.A.	D	N.A.	N.A.	++
5	*Lyonia ovalifolia (Wall.) Drude*	Anyar	N.A.	C	N.A.	N.A.	N.A.	N.A.	N.A.	C	N.A.	N.A.	++
6	*Pinus roxburghii* Sarg.	Chir	N.A.	D	D	A	A	N.A.	N.A.	B	N.A.	A	++
7	*Cedrus deodara* (Roxb.)G.Don	Devdar	N.A.	D	N.A.	C	A	N.A.	N.A.	N.A.	N.A.	A	++
8	*Juglans regia L.*	Akhroot	N.A.	D	D	N.A.	N.A.	B	N.A.	N.A.	N.A.	N.A.	+
9	*Pyrus pashia* Buch.Ham. Ex D.Don	Mehal	N.A.	D	D	N.A.	N.A.	B	N.A.	N.A.	N.A.	N.A.	++
9	*Ilex dipyrena*wall.	Kanel	N.A.	D	N.A.	C	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	+
10	*Daphniphyllum himalense* (Benth.) Mull. Arg.	Ratnalee	N.A.	D	N.A.	D	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	+
11	*Symplocos paniculata* (Thinb.) Miq	Lodh	D	D	N.A.	N.A.	N.A.	N.A.	N.A.	D	N.A.	N.A.	+
11	*Persea duthei* (King ex Hook. F.) Kostermans	Kaul	D	C	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	+
12	*Carpinus viminea* Lindl.	Chamkharik	D	C	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	+

Abbreviations:-R- Ranking (Based in the combined points given for performance for uses), Preference :-A highest used , B-Mostly used, C-Intermediate used, D -Lowest used

N.A.-Not applicable; Fo-Fodder, Fw -Fuel wood, Ag. I-Agricultural implements, HA-Household uses, Fr-Fruit, BL-Bedding material for livestock, WH-Wooden hutments, RE-Resin

Availability: +++ (Easily available), ++ (Moderately available), + (Lowest available).

Table 4 Preference of the tree species used in Farika village of western Ramganga watershed.

Rank	Species	Comman name	Preference									Availability
			Fo	Fw	Ag. I.	HA	T	Fr	M	BL	WH	RE	
1	*Pinus roxburghii* Sarg.	Chir	N.A.	A	N.A.	A	A	N.A.	N.A.	B	N.A.	A	+++
2	*Toona ciliata* M. Roem.	Toon	N.A.	D	C	A	A	N.A.	N.A.	N.A.	A	N.A.	+++
3	*Quercus leucotrichophora* A.Camus	Banj	A	A	A	B	N.A.	N.A.	N.A.	A	A	N.A.	+++
4	Myrica esculenta Buch-Ham ex D.Don	Kafal	N.A.	C	N.A.	N.A.	N.A.	A	C	D	N.A.	N.A.	++
4	*Alnus nepalensis* (D.Don) Spach	Utees	A	B	N.A.	D	N.A.	N.A.	N.A.	D	N.A.	N.A.	++
5	Grewia optiva J.R.Drumm. Ex Burret	Bhimal	A	B	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	++
6	*Ficus roxburghi Wall.*	Timala	A	D	N.A.	N.A.	N.A.	C	N.A.	N.A.	N.A.	N.A.	++
7	*Pyrus pashia* Buch.Ham. ExD.Don	Mehal	N.A.	B	D	N.A.	N.A.	B	N.A.	N.A.	N.A.	N.A.	++
7	*Mangifera indica Linn.*	Aam	N.A.	N.A.	N.A.	B	B	A	B	N.A.	N.A.	N.A.	++
8	*Bauhinia varigata Linn.*	Kachnar	A	C	N.A.	C	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	++
9	*Emblica officinalis Geartn.*	Awala	N.A.	N.A.	N.A.	N.A.	N.A.	A	A	N.A.	N.A.	N.A.	+
9	*Rhododendron arboreum* Sm.	Buras	N.A.	B	N.A.	N.A.	N.A.	N.A.	B	B	N.A.	N.A.	+

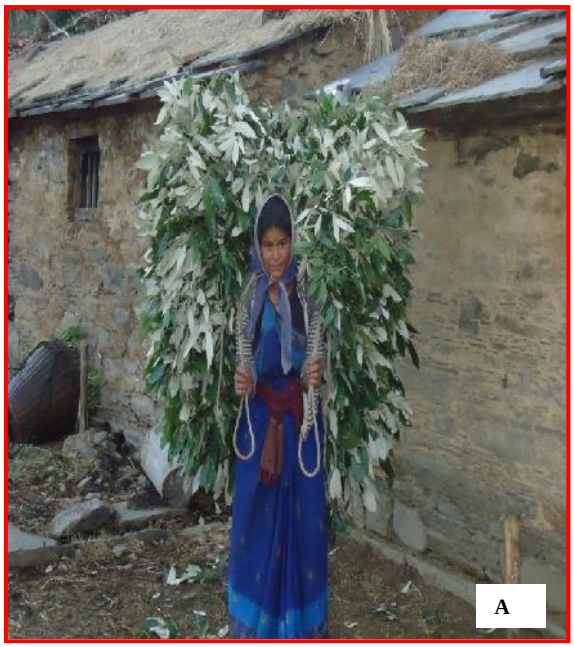
Abbreviations:-R- Ranking (Based in the combined points given for performance for uses), Preference :-A highest used , B-Mostly used, C-Intermediate used, D -Lowest used

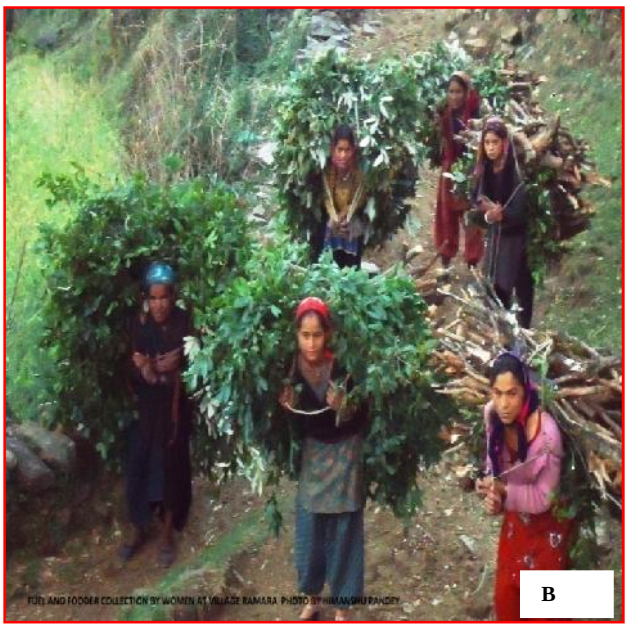
N.A.-Not applicable; Fo- Fodder, Fw-Fuel wood, Ag. I-Agricultural implements, HA-Household uses, Fr- Fruit, BL-Bedding material for livestock, WH-Wooden hutments, RE-Resin

Availability: +++ (Easily available), ++ (Moderately available), + (Lowest available).

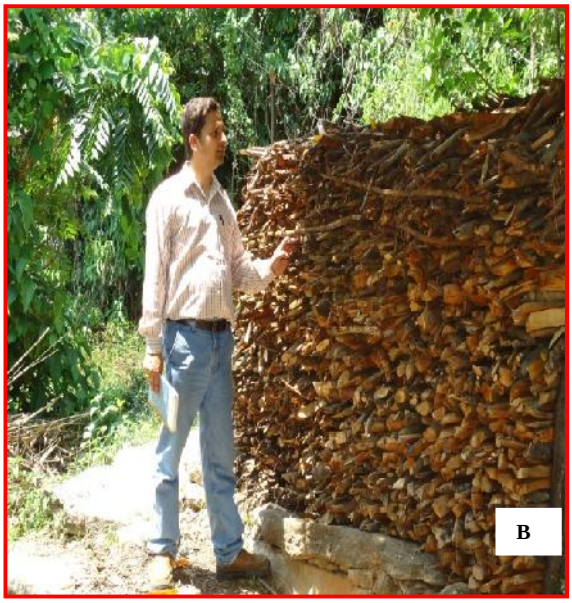
The rural economy has been greatly improved by largely *Cannabis sativa* and *Camellia sinensis* cultivation. Dairy production was the second largest sources of employment in Ramara village. Transmittal income sent by people who had migrated to other places also accounted for large portion of income in the Ramara (48.6%), whereas in the Farika it was just 54.44%.

This is because most of the villagers of Ramara (65%) and Farika (30%) area are nomadic shepherds and migrate to Dudhatoli (higher altitudes) during the summer and rainy season. They earn most of their income while residing outside their conventional kharaks. Dairy products were sold to personal agencies that collect them and sell in town. Employment as a labour was the third-largest source of income for the villagers. People worked in MNERAGA, Hariyali and other welfare schemes run by government and they sometimes worked as labourers in the private construction sector. Other sources of income were goat rearing, government pension, and extraction of non timber forest products. Most of peoples dependency on agriculture and forest resources for income from which they earn general money.

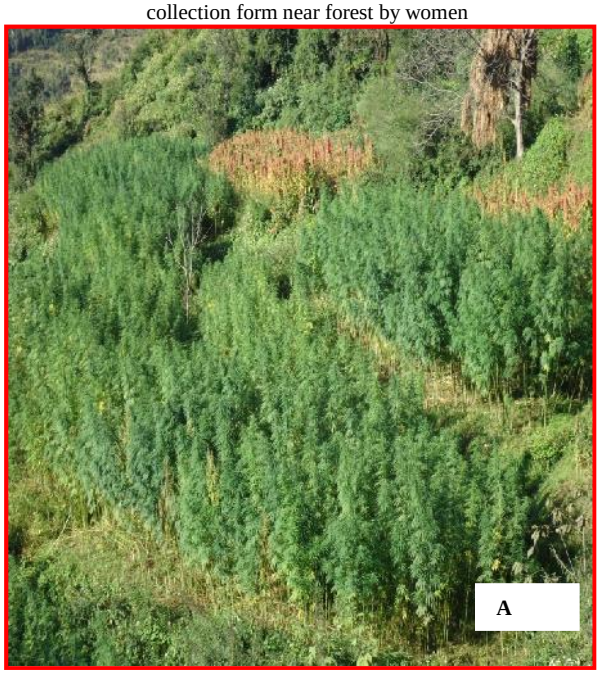


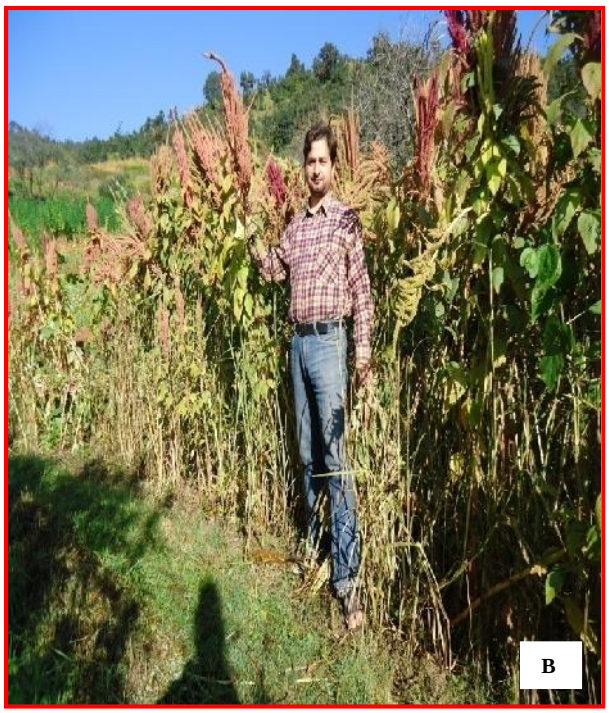


A to C Fodder collections from near forest by women



A and B Lots of fuel wood stacked for the winter season C: Fuel wood collection form near forest by women





A: Cultivation of *Cannabis sativa* **B:** Cultivation of *Amaranthus paniculatus* **C:** Traditional agriculture cultivation pattern at Ramara village and dry grass hanged on tree for winter season.

A. Collection of lichens (Jhoola grass) from forest **B.** Collection of bedding material for livestock **C.** Routine hard work by women in village Ramara.

Livestock and fodder consumption

Animal husbandry is an integral part of farming system. In the Central Himalaya region, agriculture is by and large based on livestock. Increase and changes in composition in livestock population are a common trend (Mishra 1997). Livestock is one of the most important economic resources of the local people. Every household invariably keeps a few cows and many more sheep and goats. These animals are usually kept for wool, meat and manure. Sheep's wool is used by the villager for making, shawls, sweaters**,** and blankets, while goat hair is used for making blankets only.

The dung of these animals is of course, good manure for the fields. Hilly agriculture is socio economic symbiosis of crop, livestock, production, and manpower. Livestock are considered a capital asset. In addition, livestock provide gainful employment to a large section the population throughout to a large section of the population throughout the year. Common

livestock domesticated by people in the study region are cattle, buffalo, sheep, goat, horses and poultry.

Among Hindus, only the meat of goats and chickens is eaten, and these animals are often sold earn income, whereas large animals rarely sold and hence are kept as a source of wealth. The major fodder resources are leaves from trees, ground vegetation in forest areas, crop residues, and dried grasses, which are stored on tree tops in heap and used as feed during winter season. The seasons also play a major role in the availability of fodder. Generally winter season, most of the trees remain leafless and grass were not available, at the time the fodder was obtain from the agroforestry trees like *Grewia optiva*, *Bauhinia variegata* etc. Similarly the storage grasses and agriculture residue mainly of *Eleusine coracana* (finger millet) and *Echinochloa frumentacea* (barnyard millet) is also to feed during lean period of Farika village. The forest is the major sources of leaf fodder and bedding material for livestock in the study area.

Most of the families in the study areas owned livestock. Fodder consumed per house hold per day was 38.31 and 30.00 kg in Ramara and Farika, respectively (Table 1.2). This difference in fodder consumption per household between the Ramara and Farika areas is due to higher number of livestock in the Ramara areas. Mostly women spent about 2 to 3.5 hours daily to collect fodder from forest areas, which was their main work of everyday. In the Ramara areas, approximately 85% of the fodder was being extracted from the forest and 72% of the Farika village. All the animals graze in forestland, even up to an elevation 2100 m, which evils the ground vegetation and delay regeneration of dominant species in the area.

The number of animals varied according to economic and social conditions of the villages. As dairy farming was one of the major occupations in the Ramara village, it accounted for a higher number of animals per households (7.7) compared with the Farika (5.48) village (Table 1.2).

Pattern of fuel wood consumption

In the study area in Central Himalaya region fuel wood is one of the most important natural resource that villagers extract from for their daily use. Each household require fuel wood for cooking, space heating, lighting, heat rooms and water during winter season. However, the families with better economic condition were also using kerosene oil, LPG and bio-gas. Other forms of commercial energy are beyond the reach of ordinary people because of poor socio-economic condition, lack of communication, high prices, and limited supply in inaccessible mountain areas (Chettri *et al.*, 2002). It has been reported that 54% of the total global wood harvest is for fuel (Nautiyal and Kaechele 2008). Therefore, fuel wood plays a major role in the succession of forest degradation.

In Ramara village, 100% of the families use wood as the chief source of fuel for cooking and heating. Village is situated in the temperate zone, where it is usually cold, villager extract wood for heating and cooking throughout the year. Collection of fuel wood from forests and private lands requires at least 2 to 3 hours of work every day in the study areas. The villagers travel 1-2 km in the Ramara area to 1.5–3 km in the Farika area every day to collect fuel wood from the forest. In the Ramara area, approximately 95% of fuel wood is collected from the forest, and the rest is collected from personal lands; for the Farika area, 75% of the fuel wood is collected from the forest (Table 1.2). Reasons for less forest wood collection in Farika area could be linked to the greater distance of the forest from the village.

Average fuel wood consumption per household per day was recorded as 23.34 and 13.26 kg for Ramara, and Farika villages, respectively. Lots of fuel wood were collected during summer and stored for the winter season, when snowfall is high and accessibility to the forests at higher altitudes is minimal. The abandoned lopping and falling of trees for fuel wood, leaf fodder, burning of ground vegetation, livestock grazing and harvesting of ground vegetation for forage are some of the factors responsible for formation of grassland. Average liquefied petroleum gas (LPG) consumed per household per year was 2.4 kg and 53.26 kg in Ramara, and Farika villages, respectively. In the study villages, LPG is hardly used for cooking and usually for preparing tea or quick food. Other sources of energy used in the area include kerosene oil, which is used mostly for lamps.

Demands on Forest

The Ramara forest is extremely dense and diverse compared with the Farika forest. We recorded 16 tree species in the Ramara forest and 12 tree species in the Farika forest. Villagers in both study areas use natural and agroforestry tree species to fulfil their various requirements. In the Ramara area, the villagers favoured 16 tree species (12 tree species in Farika) for a variety of purposes. As these species were easily available, pressure on them was enormous (Table 1.3 and 1.4).

Extraction of mosses and lichens

Lichens, a mutualistic association of a dominant fungus (mycobiont) and green (phycobiont) and or blue green algae (Cyanobiont). Lichens, group of lower plants growing in bark, wood, rocks, soil, and other fixtures in the environment, are represented by thousands of species from arctic to tropical regions. Many of these plants are used commercially as spices, dyes, foods, medicines, animal feed, architect models, wreath and floral decorations, perfumes, and as test organisms for atmospheric pollution (Anonymous 1962, Ding 1988, and Sochting 1999). Due to their economic value easy accessibility ready availability, mosses and lichens (locally called Makku or Jhulla Ghas) are collected on oak tree from April to September is the most commonly collected non timber forest product in the Dudhatoli forest area. Kumar and Upreti (2008) and Kumar (2009) lichen exploitation is a common practice among the villagers and the rivals in moist temperate regions of the Western Himalaya to collect the lichens together with tree twigs as oak and other trees bears plentiful growth of lichens. Lichens in India are collected from the temperature regions of Himalayas and used indigenously for preparation of perfumes, dyes, and condiments (Kumar and Upreti, 2008).

Approximately 750 tons of lichens are collected from Uttarakhand Mountains and another 800 tons are exported every year (Shah, 1997). Lichens are sold at 100-130/kg on local market. After grading and trading, its value becomes double or triple.

Estimates indicate that a professional person can collect between 6 and 12 kg of lichens a day from a lichen-rich forest and local villagers collect 3-5 kg. As climbing on large trees to collect lichens and mosses is very tough and time consuming, collectors prefer to either cut branches of trees or even fell old trees, leading to large amount in the forest. Cutting of species in large proportions would reduce its chance to dominate in the canopy formation and thus affected associated species. This significantly influenced the floral composition and subsequently the structure and functioning of entire forest ecosystem.

Grazing

Ramara and Farika villager's livestock animals are generally maintained as free grazers. Only a few calves and milking animals are kept at home and stall fed. Villagers take their animals to higher altitude (Dudhatoli forest area) during the summer season (generally from April to October) and bring them back to the lower altitude during winter. Increasing in livestock population and reduction in fodder production from farmland along with changing cropping pattern implies more intensive grazing in forest (Saxena *et al.*, 2005).

Large herds of cattle were seen grazing freely in the Dudhatoli forest area, which may reduce or even prevent the regeneration of the tree cover in case of livestock overstocking and uncontrolled grazing. Goat and sheep rearing Gujjars and Bhotiya, who migrates with their herds every year, halt in various places in the Dudhatoli and stay for some days. In the forth site, Kodiyabagarh at 3000 masl., is one such traditional kharaks, where the animals are kept for free grazing in the forest for few days. Grazing of animal in the higher regions has mounted added pressure on the forests due to which the regeneration of palatable species has become difficult at certain tract. Grazing and trampling prevent the regeneration of woody species, and the understory is transformed from tussock grassland into short, pasture like grassland.

Manufacture of seasonal wooden Kharaks

Phyto-sociological observations reveal that *Abies pindrow* and *Quercus semecarpifolia* are dominant species in Dudhatoli forest area (Pandeya and Yadava, 2015). The seasonal movement of villagers to higher reaches of forest during summer months (April-May) is also causing harm to dominant tree species because planks of these species are used for making short-term wooden kharaks inside the forest by the inhabitants and wandering shepherds. In facts these kharaks are used only during summer and rainy season. The villagers repair these kharaks every year by replacing old planks and logs with new-fangled. There were about 19 kharaks in the area located at 3000 masl in Kodiybagarh alone and many more spread at other places in the area.

CONCLUSION

Harvesting of forest resources to meet livelihood needs can impact forest regeneration, structure and diversity (Fashing *et al*., 2004; Olupot, 2009), but there is scope for considerable variation with location, human activities and histories. Forest biodiversity is the chief resource of livelihood of the people of Uttarakhand. Agriculture is the main occupation around which all human activities are centred and is mainly managed at the cost of the surrounding natural resources. Local peoples are the principle actors in management of diversity.

Decision making by local people in choice of component for their field is influenced by environmental, socio-economic, and cultural factors as well as political climate (Morin *et al*., 1998). The forests present around the crop fields are highly degraded due to continuous anthropogenic disturbances. Thus, the biodiversity of these forests is under great anthropogenic pressure. *Pinus roxburghii* forest is present around the crop field in lower altitude and has the highest anthropogenic disturbances. *Quercus leucotrichophora* forest in mid altitude and higher elevation and has least anthropogenic disturbance. Oak forest has been subjected to maximum change through reduction in density after heavy biotic influence. Trees are lopped for fuel wood, fodder for the domestic animals, timber for house construction and industrial raw material. Various products like removal of forest floor biomass and minor forest products are exploited from the forest. These disturbances influence the climatic conditions and nutrition condition.

Socio-economic point of view, forest fuel wood is the only renewable energy sources easily available to human being. But while forest biomass is a resource, the availability of forest fuel wood is limited over short time period by both the amount of land in forest and the rate of forest growth. Therefore an increased use of biomass for fodder, fuel wood, and timber woody will likely impact all other user of the forest resources. Extreme use of forest biomass as a form of major and minor forest products has resulted in environmental degradation. Fuel wood is required for cooking food and warming rooms in winter season. Higher and mid altitude region suffer cold climates. Therefore, the fuel wood needs in these regions are high, particularly during the winter, when the highlands receive snowfall. Inaccessibility of the settlement does not provide a base for consuming other means of such as LPG. Therefore, the dependency on the forest for fuel wood consumption is high and thus cause for deforestation.

In valley region or lower altitude the proper management of biogas plants may reduce fuel requirement. Due to sustainable management of forestation and plantation should conserve pastureland. It may reduce soil erosion and protect biodiversity of flora and fauna. For the best conservation of forest, the use of land surrounding villagers can most helpful by growing grasses and plantation of fodder trees. Introduction of forestry practices for maximum production of fuel wood, fodder, fruits, timber and fibre etc must be encouraged. The participation of community is very important, people ensuring to develop a suitable methodology to conserve grass land and stop deforestation for that the whole forest area can be divided in to

using sector and non using after a time span of one year or two years the non using area can be opened for use the villagers according to their requirement and the using area of the forest can be closed. This rotation will provide conservation of biodiversity of that forest area as well as protection of fauna habitats also and reduce soil erosion also. The Government also should provide biogas, LPG and Kerosene reduce burden on forest especially fuel wood consumption.

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