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Research Article

Forest dependent livelihood in relation to socio-economic status of the people in Chopta-Mandal forest of Garhwal Himalayas, Uttarakhand

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ABSTRACT

The present paper revealed the socio-economic conditions of the villagers with forest resources situated in the close vicinity of Kedarnath wild life sanctuary in Chamoli and Rudraprayag district of Garhwal Himalayas, Uttarakhand. The average family size in study area was found about 5.2 persons per household, the literacy rate in the villages is above 70%, but still due to lack of employment opportunities people invariably depend on forests for their livelihood. In all the study villages more than 75% of fodder and fuelwood were extracted from the forest. Agriculture is more than 90% rainfed which is the main occupation in the study area. Employment as a labourer was the second-largest source of income followed by dairy production. Other sources of income were poultry, goat rearing, government jobs, government pensions, and extraction of minor forest products like wild edible and medicinal plants. In the Mandal valley, approximately 86% of the total fodder was being extracted from the forest. On an average it is accounted about 5.6 animals per households. Almost 75% of the people in study area depend on spring for water consumption. In all the study villages, 100% of the families use wood as the chief source of fuel for cooking and heating, approximately 91% of fuel wood is collected from the forest, and the rest is collected from private lands. A significant or positive correlation was observed between the increase age of the informants with the increase in number of wild edible plants reported. However, no significant correlation was observed between the educational level of informants and the number of species reported by each informant. Local people and forest are intricately linked with each other and their dependency on surrounding forests leading to degradation of forest thus affecting the biodiversity of the region. Lack of employment opportunities is the major cause of dependency of rural people on forest and forcing people to migrate to cities in search of jobs.

Key words: Socio-economic, Dependency**,** Livelihood, Fuel-wood, Wild edible, Biodiversity

INTRODUCTION

Mountains are the home to 20% of the world's population which covers 24% of the world's land area, they possess 50% of the world's biodiversity hotspots. Mountains provide about 60–80% of the world's fresh water (Xu J. *et al*., 2019).

The Indian Himalayan region occupies a special place in the mountain ecosystems of the world as they are the provider of life and harbor a rich variety of flora, fauna, human communities and cultural diversity (Singh, 2006). Himalayan natural resources provide sustainable livelihood to 115 million mountain people and also serve for a much larger population inhabiting the adjoining Indo-Gangetic plains (Rao *et al*., 2003). The Uttarakhand State of India is located between 28° 30'- 31° 30' N latitudes and 77°-81° E longitudes, which covers an area of 55,491 Km^2, of which 90 % (about 50,000 Km^2) lies in the Central Himalayan region (Nag, 2001). Dispersed small settlements and terrace farming on the hill slopes for raising crops, with numerous multipurpose tree species growing particularly on the boundaries of rain fed terraces are typical features in the temperate area of Garhwal Himalaya (Sharma *et al*., 1999). Agriculture is the main occupation of about 80% people of western and central Himalaya. Animal husbandry and marginal agriculture are the major source of their economy (Meena *et al*. 2007).

Numerous people in Garhwal Himalayas resides in remote or almost isolated areas and most of them are completely dependent on nature for their needs like food, cloth, medicine or articles for religious rites (Aase *et al*. 2013 and Grover *et al*. 2015). A number of households in Garhwal villages are economically dependent on income from off-farm employment and there are extremely high number of households that are engaged in agricultural work. Th-e expansion of employment opportunities and the subsequent improvement of the household economy have mainly been attributed to the higher educational levels of villagers (Okahashi 2016 and Okahashi *et al*. 2018).

Indian Himalayas are very rich in biological and cultural diversity, generating the services which supports the livelihood of the native people over multiple scales but sometimes suffer in significant poverty and vulnerabilities (Everard *et al.*, 2019). In past three decade a significant change can be seen in mountain livelihoods as the people are no longer entirely dependent on their land. Most of the people in study area increasingly rely on farming, wage labour and tourism services for their livelihood (Gioli *et al*., 2019, Soe *et al*., 2019).

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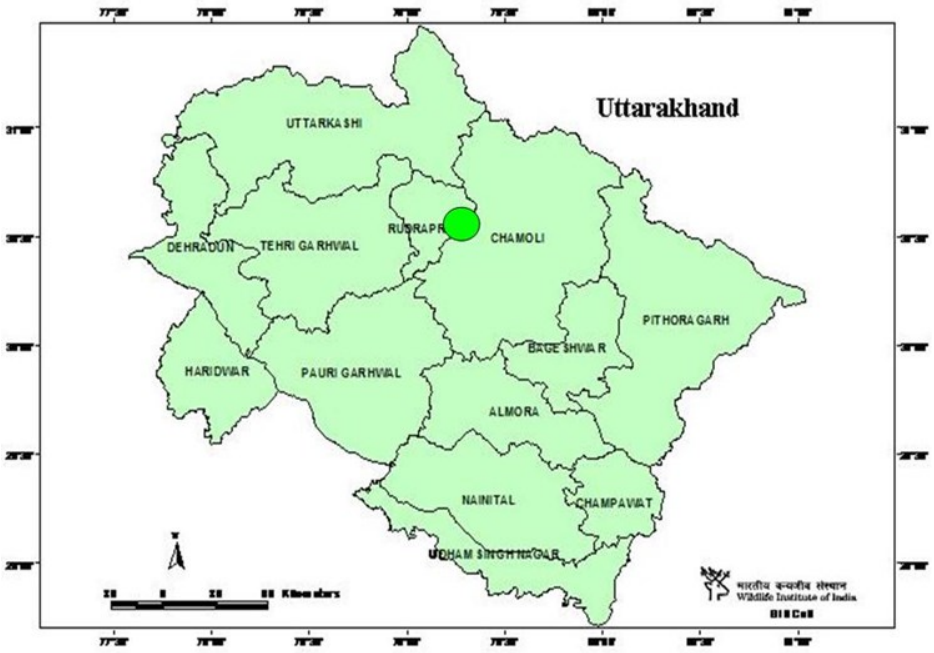

Figure 1. Location map of Study Area

An extensive survey has been conducted on ethnobotanical uses of wild plants in Chopta-Mandal forest of Garhwal Himalayas in Uttarakhand (Agarwal and Chandra, 2019).

MATERIALS AND METHODS

Study Area

Kedarnath Wildlife Sanctuary (KWLS; 30^0 25'-30^0 45' N latitude, 78^0 55'-79^0 22' E longitude) is the one of the floristically rich and largest Protected Areas (PAs) in Uttarakhand covering an area of 975 km^2. An intensive study area of around 400 km^2 (figure1) was selected along the Southern fringe of Kedarnath WLS. Nearly 70% of the intensive study area lies in Mandal valley with in Alaknanda catchment. Upper part of the study area is marked by famous Hindu shrine Tungnath (3550m). The climate in the study areas can be divided into three distinct seasons, namely summer (April–June), rainy (July–September), and winter (November–February). The rainfall pattern in the region is largely governed by the monsoon rains (July–September), which account for about 60–80% of the total annual rainfall. The vegetation in the study areas is both natural and man-made (Agarwal 2019).

Methodology

The study areas lie in the temperate zone of Garhwal Himalaya in Uttarakhand State in India (Figure 1). The study was carried out in 11 villages (Table 1), 6 in the Mandal area (Mandal) between 1500 m and 1550 m in the Chamoli district, and 5 in the Chopta area, between 1600 m and 1750 m in the Rudraprayag district, based on personal interviews among local people. The informers included responsible old persons, attempts were made to include females in interviews and middle aged people who were fully aware about their forest wealth. A total of about 215 households have been taken from the study area. Sample households and interviewed individuals were selected randomly from the entire population on the basis of their possessiveness of traditional knowledge and studied through pre-reconnaissance survey. Structured and pretested questionnaires were used to interview approximately 20% of the total households in each village. Questionnaires were based on the requirements of the study and on information extracted from general discussions 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 discussions with gram pradhans (heads of village legislative councils). The head of each sample household was interviewed. The data collected for the study included general information about each household, such as literacy level, family size, landholding, number of animals per family, sources of income, occupation, sources of energy, extraction of wild edible plants, and so on.

RESULTS

Socioeconomic survey has been carried in 11 villages of the study area. Primary data was collected using the PRA techniques (questionnaire, interviews and observation) (table 1) and 215 households from the study area. Most of the interviewed people were family heads. Majority of respondents (61%, N =132) interviewed were females (table 2). Many (55%) of the respondents were married. A big number of the respondents (34%) were aged between 31 and 40 years.

Education: The average family size in study area was found about 5.2 persons per household. The literacy rate was above 70% in study area (table 7 and figure 5); most of the people were above grade 10. Few people were uneducated, and most (23.3%) of those were older. More than 90% of the agricultural fields in the Mandal area were rain fed (table 5 and figure 3).

Approximately 71% houses in the study area are cemented or pakka and the rest were a traditional type made of slate (pathals), wood and straw (table 4 and figure 2). 80% people in the study area have in-house toilet facility while only 20% have in open toilet facility (table 6 and figure 4).

Table 1. Demographics of villages of study area

Study area and village	**Mandal area**					
Variable	Mandal	Siroli	koteswar	Bairagana	Khalla	Bandwara
Total number of household	100	90	46	35	80	35
Number of household sampled	30	27	20	15	23	15
Total population	550	410	214	180	493	180
Average family size	5.5	4.5	4.6	5.14	6.16	5.14
Number of males	254	227	91	93	238	79
Number of females	296	183	123	87	255	101
Total agricultural land	28.99	28.19	25.141	18.24	39.75	44.1
Average land holding per family (ha)	0.29	0.31	0.54	0.53	0.49	1.25
Annual income per family (Indian Rupees)	42,921	36,477	40, 321	32, 489	50,275	38, 926
Study area and village	**Chopta area**					
Variable	Makku	Hudu	Daira	Kanda	Jagpura	
Total number of household	206	63	82	31	45	
Number of household sampled	40	23	30	12	15	
Total population	964	321	435	183	238	
Average family size	4.67	5.09	5.30	5.90	5.23	
Number of males	435	124	232	86	113	
Number of females	529	197	203	97	125	
Total agricultural land	51.23	32.14	42.78	24.19	27.74	
Average land holding per family	0.24	0.51	0.52	0.78	0.61	
Annual income per family (Indian Rupees)	61,695	42, 998	51,250	41,298	39.826	

Table 2. Gender distribution in study area

		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	Male	83	38.7	38.7	38.7
	Female	132	61.3	61.3	100.0
	Total	215	100.0	100.0	

Table 3. Electricity facility in study area

		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	Yes	209	97.2	97.2	97.2
	No	6	2.8	2.8	100.0
	Total	215	100.0	100.0	

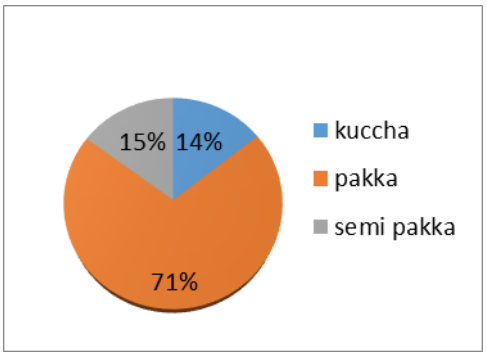

Figure 2. House type in Study Area

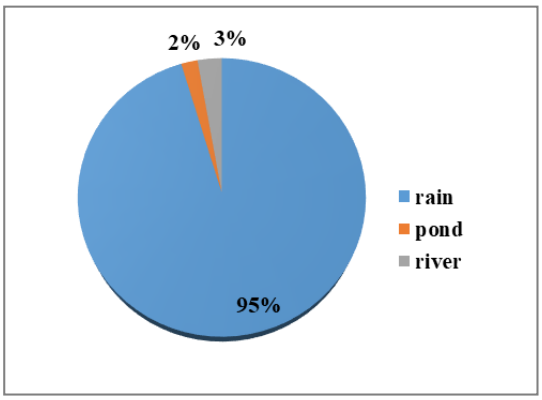

Figure 3. Methods of irrigation in study area

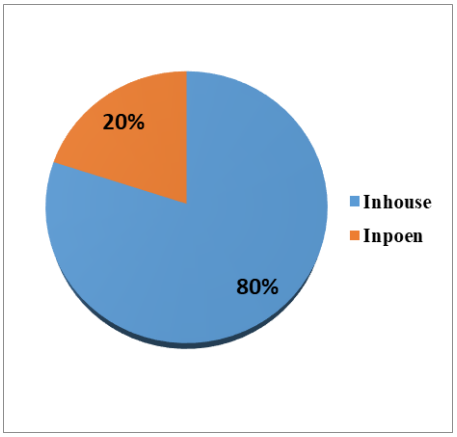

Figure 4. Toilet facility in Study Area

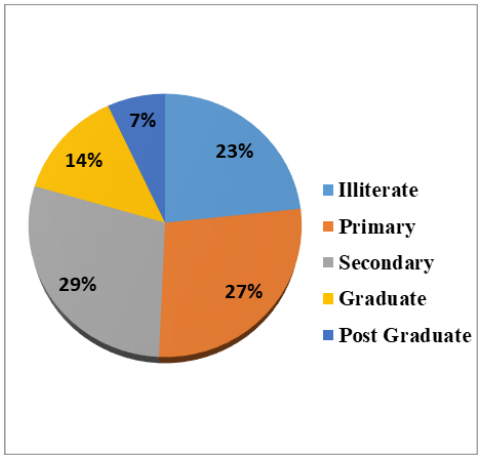

Figure 5. Qualification in study area

Table 4. House type in study area

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Kuccha	31	14.4	14.4	14.4
	Pakka	152	70.7	70.7	85.1
	Semi - Pakka	32	14.9	14.9	100.0
	Total	215	100.0	100.0	

Table 5. Methods of irrigation used in study area

	Frequency	Percent	Valid Percent	Cumulative Percent
Rain	205	95.3	95.3	95.3
Pond	4	1.9	1.9	97.2
River	6	2.8	2.8	100.0
Total	215	100.0	100.0	

Table 6. Toilet facility in study area

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Inhouse	172	80.0	80.0	80.0
	Inopen	43	20.0	20.0	100.0
	Total	215	100.0	100.0	

Table 7. Qualification in study area

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Illiterate	50	23.3	23.3	23.3
	Primary	59	27.4	27.4	50.7
	Secondary	62	28.8	28.8	79.5
	Graduate	29	13.5	13.5	93.0
	Post graduate	15	7.0	7.0	100.0
	Total	215	100.0	100.0	

Sources of Income: The mean annual income in Indian national rupees is about Rs 40, 277 per household in study area (table 1), which is higher than the below poverty line limit defined by the government of India for rural areas (Rs 12,000; US$ 252). The main occupation in study area 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. Few wild edible plants form forest, vegetables and fruits from agricultural land were sold on the open market to earn cash income (table 8 and figure 6). Employment as a labourer was the second-largest source of income for the villagers (table 9 and figure 7). People worked in Gramin Rozgar Yojna and other welfare schemes run by the government, and they sometimes worked as labourers in the private construction sector. Dairy production was the third-largest source of employment in Mandal. Other sources of income were poultry, goat rearing, government jobs, government pensions, and extraction of minor forest products.

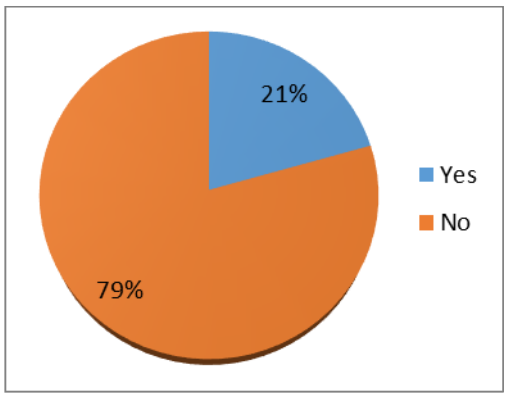

Figure 6. % of household sold wild edible in markets

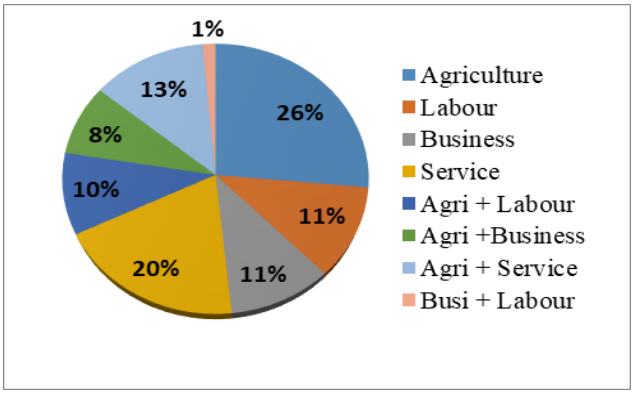

Figure 7. Occupation in study area

Livestock and fodder consumption: Common livestock domesticated by people in the study region are cattle, buffalo, sheep, goat, horses, ponies, and poultry (table 10). These animals are often sold to earn income, whereas large animals are rarely sold and hence are kept as a source of wealth. The major fodder resources are crop residues, leaves from trees, ground flora in forested areas, and dried grasses, which are stored on treetops in heaps and used as feed during lean periods when little fodder is available. The forest is the major source of leaf fodder and bedding material for livestock in the area. Women in the study area spent about 1.5 to 3.5 hours daily to collect fodder from forested areas, which was the major portion of their everyday activity. In the Mandal valley, approximately 80% of the total fodder was being extracted from the forest. The number of animals varied according to economic and social conditions in the villages. As dairy farming was one of the major occupations in the Mandal area. On an average it is accounted about 5.6 animals per households. Almost 75% of the people in study area depend on spring for water consumption (table 11 and figure 9).

Table 8. % of household sold wild edible in market

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	44	20.5	20.5	38.6
	No	171	79.5	79.5	100.0
	Total	215	100.0	100.0	

Table 9. Occupation in study area

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agriculture	57	26.5	26.5	26.5
	Service	24	11.2	11.2	37.7
	Business	23	10.7	10.7	48.4
	labour	42	19.5	19.5	67.9
	Agriculture + Labour	21	9.8	9.8	77.7
	Agriculture + Business	18	8.4	8.4	86.0
	Agriculture + Service	27	12.6	12.6	98.6
	Business + Labour	3	1.4	1.4	100.0
	Total	215	100.0	100.0	

Table 10. Descriptive Statistics of livestock in study area

	N	Minimum	Maximum	Mean	Std. Deviation
Cow	215	0	22	2.09	2.208
Buffalo	212	0	6	0.93	1.046
Goat	215	0	4	0.20	.534
Sheep	214	0	15	0.27	1.155
Valid N (listwise)	211				

Table 11. Potable water supply in study area

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Tap water	51	23.7	23.7	23.7
	River	2	0.9	0.9	24.7
	Spring	162	75.3	75.3	100.0
	Total	215	100.0	100.0	

Pattern of energy consumption: In all the study villages, 100% of the families use wood as the chief source of fuel for cooking and heating. As all the villages are situated in the temperate zone, where it is usually cold, villagers extract wood for heating and cooking throughout the year. In the Mandal valley, approximately 91% of fuel wood is collected from the forest, and the rest is collected from private lands (table 12 and figure 8). Stacks 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. In the study villages, LPG is occasionally used for cooking and mainly for preparing tea or quick food. Other sources of energy used in the area include kerosene oil, which is used mainly for lamps. Other fuel types, such as crop residues and dung cakes, were not used in any of the villages studied. Dung cakes were not used as fuel for 2 reasons: (1) fertilizers are very rarely used in the agricultural fields, and because dung is the main source of manure, it is therefore required in large quantities; and (2) fuel wood is easily available at no cost and is simple to use compared with dung cakes. Whereas crop residues are either used as fodder or bedding material for livestock, a sod and dung combination constitutes the compost manure for agricultural field.

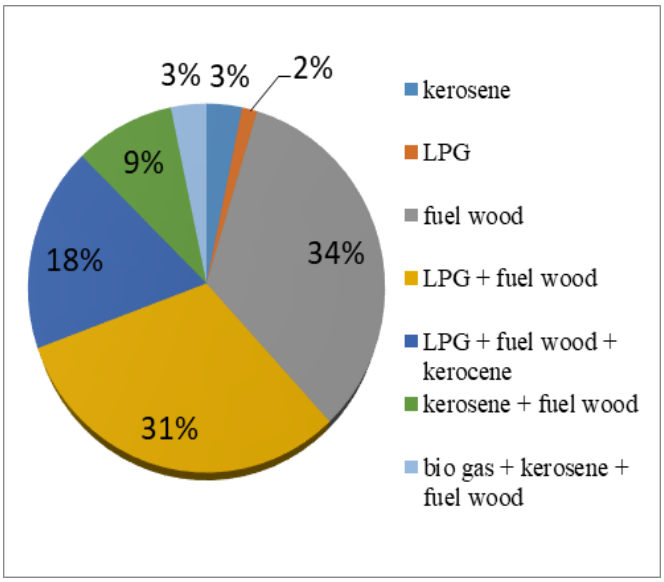

Figure 8. Cooking Energy in Study Area

Table 12. Cooking energy used in study area

		Frequency	Percent	Valid Per-cent	Cumulative Per-cent
Valid	Kerosene	7	3.3	3.3	3.3
	LPG	3	1.4	1.4	4.7
	Fuel wood	72	33.5	33.5	38.1
	LPG + Fuel wood	67	31.2	31.2	69.3
	LPG + Fuel wood + kerosene	39	18.1	18.1	87.4
	Kerosene + Fuel wood	20	9.3	9.3	96.7
	Bio gas + kerosene + Fuel wood	7	3.3	3.3	100.0
	Total	215	100.0	100.0	

Table 13. Statistical test of significance

		Age	Known
Age	Pearson Correlation	1	.473**
	Sig. (2-tailed)		.000
	N	215	215
Known	Pearson Correlation	.473**	1
	Sig. (2-tailed)	.000	
	N	215	215

**. Correlation is significant at the 0.01 level (2-tailed).

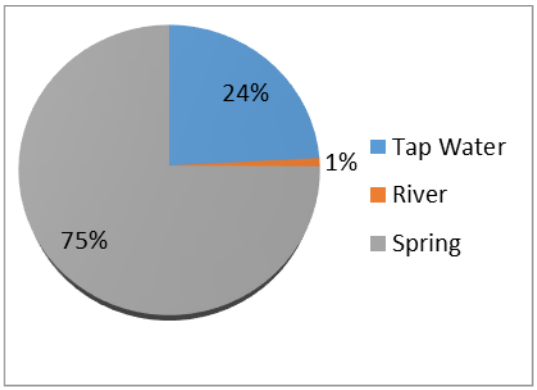

Figure 9. Potable water supply in Study Area

Indigenous knowledge and diversity of wild edible species: Several studies revealed that traditional knowledge of wild plants normally increases with age. However, in this study, analyses of simple correlation (Pearson) coefficient test (r=0.473) calculated using SPSS shows that older people mentioned more number of wild edible species than younger people in the study area (table 13). A significant or positive correlation was observed between the increase age of the informants with the increase in number of wild edible plants reported. However, no significant correlation was observed between the educational level of informants and the number of species reported by each informant.

DISCUSSION

Mountain communities are fully dependent on natural resources, livestock, and traditional agriculture; mountain agriculture is a socioeconomic symbiosis of crop, livestock, production, and manpower (Korner *et al*. 2005). In this type of system, besides human activities, livestock play a crucial role in strengthening the economy. Livestock are considered a capital asset. In addition, livestock provide gainful employment to a large section of the population throughout the year (Sati & Singh 2010). Although the literacy rate was very high, most people were unemployed because of a lack of employment opportunities. The villagers therefore still relied for their sustenance on rain fed agricultural land and forests. The average cultivated land of study area was less than 0.6 ha (table 1); therefore production was supplemented from the adjacent forest ecosystem (Scott *et al*. 2018; Tse-ring *et al*. 2010; Tiwari & Joshi 2014; Chapagain *et al*. 2016). Fuel wood is the most common and primary energy source among rural populations in developing countries and one of the significant cause of forest degradation (Malik *et al*. 2014 and Hussain *et al*. 2017), and is used for cooking and also to heat rooms and water during the winter season. Other forms of commercial energy are beyond the reach of ordinary people because of poor socioeconomic conditions, 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). Hence, fuel wood plays a major role in the progression of forest degradation. In the study area approximately 80% of the fodder is extracted from nearby forests thus increased resource dependency of native people on surrounding forests affecting the ecological status of many wild species.

Most of the people of the Garhwal region are multi-dimensionally impoverished in terms of economic development and growth (Tiwari and Joshi 2016). Instead of high literacy rate in Garhwal Himalayas most

of the population involve in traditional forest-centred livelihood practices. About 85% farming is rainfed and mostly managed in a traditional way (Yadav *et al*. 2017). However old customs, traditional practices and innovative skills helped local communities to adapt to an effective mountain system (Wu *et al*. 2014; Macchi *et al.* 2015; Negi *et al*. 2017). Due to the migration of youth male population in search of livelihood and employment result in the inadequacy of farm labour and abandoned of large proportion of agricultural land and houses (Joshi 2018).

CONCLUSION

Dependency of local people on forest is mainly due to lack of employment opportunities and low income which causing degradation of forests and is forcing people to migrate to cities in search of jobs. As agricultural and livestock productivity is sustained by inputs derived from forests, continued depletion of forest reserves in the long run will result in poor returns from agriculture and dairy farming. Domestic sector in hilly areas is mainly dependent on fuelwood and fodder. Fodder and fuelwood plantations should be established on terraced land under an agro-silvicultural system and on community land.

To reduce the pressure on the forests an effective method of eco-restoration incorporating involvement by local people is needed. A proper understanding of the socioeconomic necessities of the population is essential. Attempts should be made to establish a local framework for generating a sustainable forest economy. One of the major challenges in Garhwal Himalayas is to brought a balance between sustainable livelihoods with productive ecosystems. Climate change, human population growth, urbanization and globalization trends likely to intensify the pressure on natural resources, to which this system of governance will need to adapt.

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