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Fuelwood and Fodder Consumption Pattern in Uttarkashi District, Uttarakhand, India

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Abstract

The present investigation was conducted in six different villages (Bonga, Ganeshpur, Dang, Bandrani, Kyark, and Aleth) of Uttarkashi district which lies between the altitudinal ranges of 1417m to 2266m altitude. The study was proposed to evaluate farmer's fuelwood and fodder consumption pattern. The survey was carried out in 120 households (20 households from each village). The maximum number of households were 278 in Dang village whereas, the minimum number 62 households were 62 in Kyark village. Among the selected villages the maximum population 1480 (747 males and 733 females) was recorded in Dang village whereas the minimum population 325(160 males and 165 females) was in Bandrani village, 325(160 males and 165 females). The average daily fuelwood consumption of the villages varied from 850 kg/day/village to 1267.20 kg/day/village in the summer season whereas, it varied from 1185.18 kg/day/village to 1949.36 kg/day/village in the winter season. The village to village consumption of the fodder varied from 1224.19 kg/day/village to 3005.10 kg/day/village in summer season whereas it varied from 1208.47 kg/day/village to 2969.46 kg/day/village in winter seasons.

Key wards : *Fuel wood, fodder, village, household, consumption.*

Introduction

In most of the developing countries, forests are the main source of fuelwood, timber and fodder for the livestock. In India, for the rural communities' forest are the chief source of fuelwood, fodder and various other product and services (1).There is an insufficient and unreliable supply of clean and inexpensive energy resources in rural India, therefore traditional sources of fuel, such as fuelwood, crop residue, and animal dung cake, continue to be the primary source of cooking fuel. (2). India's consumption of fuelwood is about five times higher than what can be sustainably removed from forest (1). Fuelwood is the primary source of energy for the rural household in the Western Himalaya, where people still rely on fuelwood for cooking and other household tasks (3, 4). In India, around 50 million tons of fuelwood are extracted from forests and adjacent places each year, and fuelwood provides roughly 70% of the country's energy (5). Forest is an essential component of various ecosystem services. Local people depend on forest resources for various products such as fuel wood, construction materials, fodder, medicine and food (6). About 70% of Indian population lives in rural areas, and most of them have either agriculture or forest-based economy. Their dependency on the forest resource is still high due to easy access, simple use, and lack of economically viable options (7, 8). In Uttarakhand Himalayan region, most of the fuelwood and fodder consumption is done by women (9). The local people of Himalaya have natural coexistence with the forests and depend on these of the natural resources county for their livelihood. The presence of trees around field borders and homesteads intended to increase the magnitude of production. Fodder and fuelwood are the two most important livelihood resources for mountainous regions, of the Himalayas (10). In the villages of Garhwal Himalaya, it has been noticed that usually villagers collected fuelwood from adjacent existed traditional agroforestry field and forest (11).

Materials and Methods

Study area : The study was carried out in six villages of Uttarkashi district i.e. Bonga, Ganeshpur, Dang, Bandrani, Kyark and Aleth varying in elevation from 1417 to 2266m above mean sea levelduring 2020-2021.Uttarkashi district is the least urbanized districts in the state having less than one tenth (7.36 percent) of the population in urban areas. The district is located in the hilly areas of the state and agriculture is the main occupation of its inhabitants. Total cropped area is 41,099 hectares and the forest area is 3036 sq. km. The latitudinal range of the study area was 30°41'41.265" N to 30°49'35.353" N whereas the longitudes ranged from 78°18'47.142" to 78°37'52.905" E. The rainfall occurs almost throughout the year and annual rainfall recorded was 1476.7 mm. The mean temperature ranges between 14.8ºC to 36.3ºC.

Fuelwood and fodder consumption pattern : A multistage random sampling technique was applied while conducting the study. The primary data was collected by carrying out the survey in the selected villages of district Uttarkashi, with the help of the Questionnaire that was well prepared keeping in mind all the desired variables. Using

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a weight survey method, the quantities of fuel wood consumption of the sampled households were measured over a period of 24 hours. For the purpose of estimation of fodder consumption each household was surveyed exclusively for stall-feeding of cattle, and the given feed was measured. The secondary data was obtained from the published sources like, Journals, bulletins, and internet etc. which helped in acquiring some additional information about the study sites, and in addition to that it was also quite beneficial in verifying the information which was attained as the primary data. The agricultural land was also surveyed for the availability of agroforestry species, their composition and structure. Group discussion was also conducted with farmers for understanding the problems and prospects with the agro-forestry system in the study area along with the perceptions of local people on the climate change and indigenous agro-forestry.

Fuel wood consumption : Fuelwood requirement of the selected villages of the study area was analyzed with the help of data collected from the villages using questionnaires. The fuelwood requirement was based on the daily consumption rate per capita basis, which was later multiplied by the number of individuals in the villages.

$$\text{Daily per head consumption of Fuelwood} = \frac{\text{Quantity consumed / day / household}}{\text{No. of people in the household}}$$

Total consumption of the village = daily per head consumption No. of persons in the village

Fodder Consumption : The domestic animals depend on forest as well as agriculture residue for their fodder demand. The main type of fodder and sources of fodder are quantified by the survey method using the well prepared questionnaires. The fodder requirement was analyzed based on the daily use of fodder in the villages which was calculated in accordance with the cattle equivalent unit (CEU). Cattle equivalent unit refers to:1 adult cow/bullock/buffalo=1 CEU, 1 young cattle, buffalo and other animal=0.5 CEU, Goat/Sheep=0.2 CEU.

The fodder consumption was calculated for the summer and winter season. The fodder is collected from wasteland, trees in existing agroforestry system, residue from agriculture crop and grasses from agriculture fields.

$$\text{Total consumption of the village} = \frac{\text{Quantity consumed / day / household}}{\text{No. of livestock in the household}}$$

Total consumption of the village = Daily per head consumption No. of livestock in the village

Results and Discussion

Fuelwood consumption : The fuelwood consumption pattern investigation was done among different land holding communities. The average per head fuelwood consumption during summer and winter in the present study varied from 1.58 kg/head/day to 1.85 kg/head/day and 2.15 kg/head/day to 2.80 kg/head/day. The maximum value for the per head fuelwood consumption(1.85 kg/head/day) in summer season was recorded for Ganeshpur followed by Aleth (1.82 kg/head/day) whereas, the minimum per head fuelwood consumption(1.58 kg/head/day) was recorded in Bonga village. In winters Aleth village had the maximum fuelwood consumption (2.80 kg/head/day) followed by Kyark (2.70 kg/head/day) whereas, Bonga had the minimum fuelwood consumption (2.15 kg/head/day). Household to household fuelwood consumption also varied due to various factors such as family size, distance from the adjacent forest, land holdings, etc. Therefore, it can be noted that Aleth village had the maximum 10.73 kg/day/household and 16.52 kg/day/household fuelwood consumption for both summer and winter season respectively. Similarly, Bonga village had the minimum, 8.29 kg/day/household and 11.28 kg/day/household fuelwood consumption in both summer and winter season respectively (Table 2).The average daily fuelwood consumption of the villages varied from 850 kg/day/village to 1267.20 kg/day/village in summer season and 1185.18 kg/day/village to 1949.36 kg/day/village in winter season. The maximum fuelwood consumption (1267.20 kg/day/village) in the summer season was recorded for Kyark village followed by Aleth (1267.08 kg/day/village), Ganeshpur (1181.10 kg/day/village), Dang (998.25 kg/day/village), and Bonga village (870.45 kg/day /village) whereas, Bandrani village had the minimum fuelwood consumption (850 kg/day/village). In winters, Aleth village had the maximum (1949.36 kg/day/village) fuelwood consumption followed by Kyark (1944 kg/day/village) while Bonga village consumption was least(1185.18 kg/day/village) among the six villages. On the basis of above mentioned result it is observed that in winter season the consumption of fuelwood is much higher than summer season. During winter season, temperatures fall under 0ºC, especially during the night. So therefore, fuelwood is required for heating the room and boiling of water.

(3) has shown the relationship between altitude and fuelwood consumption (kg/capita/day) pattern, in which fuelwood consumption varied considerably at different locations of the western region. It ranged from 0.05 (kg/capita/day) to 8.755 (kg/capita/day). However, (12) stated that fuelwood fuelwood consumption in Himalaya varies due to altitudinal variations and climatic conditions.

Table-1 : General Details of the villages.

S. No.	Village Name	Altitude (m asl)	Total No. of Households	Total population	Latitude	Longitude
1.	Bonga	1603	132	670	30°42'58.479 N	78°27'34.432" E
2.	Ganeshpur	1417	240	1220	30°46'4.826" N	78°29'1.388" E
3.	Dang	2060	278	1480	30°43'7.008" N	78°18'47.142"
4.	Bandrani	2266	65	325	30°48'59.199" N	78°37'47.798" E
5.	Kyark	1968	62	350	30°49'35.353" N	78°37'52.905" E
6.	Aleth	2144	180	1070	30°41'41.265" N	78°30'18.097" E

Table-2 : Fuel consumption pattern of different villages in different season.

Villages	Fuel Consumption (kg)					
	kg/day/head		kg/day/household		kg/day/village	
	Summer	Winter	Summer	Winter	Summer	Winter
Bonga	1.58	2.15	8.29	11.28	870.45	1185.18
Ganeshpur	1.85	2.45	10.45	13.84	1181.10	1564.20
Dang	1.65	2.55	9.07	14.02	998.25	1542.75
Bandrani	1.70	2.40	8.50	12.00	850.00	1200.00
Kyark	1.76	2.70	10.56	16.20	1267.20	1944.00
Aleth	1.82	2.80	10.73	16.52	1267.08	1949.36
Mean	1.72	2.50	9.60	13.97	1072.34	1564.24
S.D.	0.10	0.23	1.10	2.12	191.52	337.44

Table-3 : Livestock population of different villages.

	Villages					
Type of Livestock	Bonga	Ganeshpur	Dang	Bandrani	Kyark	Aleth
Cow	122	167	153	44	67	144
Buffalo	12	07	19	07	06	08
Ox	04	12	28	06	14	14
Goat/Sheep	05	05	-	90	80	-
Total	143	191	200	147	167	166

Table-4 : Cattle Equivalent Unit and its average in the selected villages.

Village Name	Total Households	Total Livestock	CEU	Avg. CEU
Bonga	132	143	118	0.89
Ganeshpur	240	191	149	0.62
Dang	278	200	162	0.58
Bandrani	65	147	65.5	1.007
Kyark	62	167	91	1.46
Aleth	180	166	140.5	0.78

Table-5 : Fodder consumption of different villages in different season.

Villages	Fodder Consumption (kg)			
	kg/day/cattle head		kg/day/village	
	Summer	Winter	Summer	Winter
Bonga	16.85	16.15	1988.3	1905.70
Ganeshpur	14.55	12.75	2167.95	1899.75
Dang	18.55	18.33	3005.10	2969.46
Bandrani	18.69	18.45	1224.19	1208.475
Kyark	15.75	15.25	1433.25	1387.75
Aleth	20.80	19.56	2922.40	2748.18
Mean	17.53	16.74	2133.53	2019.88
SD	2.26	2.52	737.68	709.58

(13) reported the consumption of fuelwood in summer season was 164.16 kg/day/village to 389.91 kg/day/village and in winter season it was 277.92 kg/day/village to 662.53 kg/day/village. The average per capita fuelwood consumption varied from 1.14 kg/capita/day to 1.23 kg/capita/day in summer and in winter season from 1.93 kg/capita/day to 2.09

kg/capita/day respectively for Kedarnath forest division in Rudraprayag district of Garhwal Himalayas.

Fodder consumption : For the assessment of the fodder consumption pattern in selected villages the livestock breeds *viz*. buffalo, cow, calf, goat and sheep in different villages were categorized. The maximum livestock population (200) was recorded in Dang village followed by Ganeshpur (191), Kyark (167), Aleth (166), Bandrani (147) and Bonga (143). It was noted that the maximum number of cows (200) were in Ganeshpur village followed by Dang (153), Aleth (144), Bonga (122) and Bandrani (44). The buffaloes were recorded maximum (19) in Dang village followed by Bonga (12) whereas it was minimum (6) in Kyark village. The maximum number of oxen (28) were in Dang whereas the minimum value (04) was recorded for Bonga village. The population of Goat/sheep were present mostly in Bandrani (90) and Kyark (80) (Table-3).

The CEU (Cattle Equivalent Unit) were calculated on the basis of livestock breeds.Further total numbers of CEU were divided by number of household for the calculation of the average CEU in each village. The CEU (Cattle Equivalent Unit) was also highest in Dang village (162) whereas lowest CEU was recorded for Bandrani village (65.5). The value of the average CEU was highest in Kyark village (1.46) followed by Bandrani village (1.007) whereas the lowest value was recorded for Dang village (0.58). (Table-4).

The greatest amount of fodder is available in the form of grasses, hay leaves young stems, etc. The fodder consumption varied from 14.55 kg/day/cattle head to 20.80kg/day/cattle head in summer and from 12.75 kg/day/cattle head to 19.56 kg/day/cattle head inthe winter season. The maximum fodder consumption (20.80 kg/day/cattle head) in summer season was recorded in Aleth village followed by Bandrani village (18.69 kg/day/cattle head) Dang village (18.55 kg/day/cattle head) whereas, the minimum fodder consumption (14.55 kg/day/cattle head) was recorded for Ganeshpur village. The altitudinal variation in the fodder consumption can be established with these findings. The villages at high altitudes are closed to the forest area thus collect more fodder in comparison to villages at mid and low altitudes. The peoples of mid and lower altitude majorly collect fodder from their farmland. The results also shows that the season plays a vital role in the availability of the fodder species. The village to village consumption of the fodder varied from 1224.19 kg/day to 3005.10 kg/day/village. The maximum fodder consumption (3005.10 kg/day/village) was recorded for Dang followed by Aleth village (2922.40 kg/day/village whereas, the minimum value of the fodder consumption (1224.19 kg/day/village) was recorded for Bandrani village for the summer season. In winters, the maximum value for the fodder consumption (2969.46 kg/day/village) was recorded for Dang village followed by Aleth village (2748.18 kg/day/village) whereas, Bandrani for winter season also had the minimum fodder consumption (1208.47 kg/day/village) (Table-5). There were different types of tree species present in the study area but due to the easy availability and great nutritive value of certain tree species like *Grewia optiva, Quercus leucotrichophora, Celtis australis,* etc. were more preferred than the others.

The above study is in line with the (14) a study conducted to understand the fodder consumption pattern at three different altitudes of Kedarnath Wildlife Sanctuary. The average fodder consumption was found to be 43.96 kg/day/household. (15) carried out a study in eight villages of Kewer Gadhera sub-watershed, which revealed that variation in forest biomass consumption variesfrom 12 kg/day/house hold (fodder) in the lower elevation (1150m) to 34 kg/day/ household (fodder) in the higher elevation (1900 m). Another study, (16) showed that the minimum amount of fodder was around 40.20 kg household^{-1} day^{-1} which was collected during winter season in the middle altitude and highest was 92.70 kg which was collected during summer season in middle altitude villages. People of middle and lower altitude collected maximum fodder from their farmland and their farm trees. In rainy and summer season fodder consumption was high and low during winter season. Fodder consumption (per animal per day) is highest 21.72 kg in the higher altitude region followed by 17.06 kg in the middle and 15.46 kg in the lower.

Conclusion

The fuelwood are utilized for different purposes like cooking, water and room heating. Alternatives such as kerosene, LPG, etc. are used by families having better economic conditions. *Quercus leucotrichophora* and *Rhododendron arboretum* due to their high calorific value are used as fuelwood species. Though the fuelwood consumption has decreased to an extent in recent years because of government initiatives like Ujjwala Scheme but still the rural households have higher fuelwood consumption in the study areas mainly due to the lack of accessibility to alternative energy sources, remoteness and poverty. In winter season there is a huge shortage of grasses therefore, tree leaves are fed as green fodder to the livestock. The requirement of dry fodder was supplied from the preserved grasses and agriculture crop residues in the form of hay and silage. The high demands for fuel and fodder put extra pressure on the forest thus creating threat to biodiversity and environment conservation. People also rehabilitate to different places to ensure

availability of fuelwood for themselves and fodder for their livestock. The fodder purchase from the markets also puts extra burden on the people and hence in extreme cases they are left to no choice and have to sell their animals. Therefore, awareness programmes should be conducted in the villages regarding the biodiversity and environment conservation and hence villagers should be encouraged to plant fuel and fodder trees in forests on their farms, community lands in surroundings of the villages so as to minimize the pressure from the existing forest.

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