J. Soils and Crops 33 (2) 410-414, December 2024

ISSN 0971-2836 (Print)
ISSN 2582-2756 (Online)

ASSESSMENT OF FUELWOOD AND FODDER CONSUMPTION PATTERNS OF MUNDANI VILLAGE, TEHRI, GARHWAL HIMALAYA

Manisha Pandey[1], S.P Joshi[2] and Sachin Sharma[3]

ABSTRACT

Forest utilisation patterns and extent among rural households vary, affecting forest conservation and poverty reduction-related policies and programmes. The present study aims to analyze the household characteristics that enable villagers in the Mundani village, Tehri District of Garhwal Himalaya, to use forest resources. Extensive household studies were conducted during the year 2022-23. Data on relevant household parameters and forest resource use were collected from 43 randomly selected households including 253 members in different groups and communities. The analysis showed that households use forests for multiple purposes. The most used forest resources were fuelwood for energy, grass and leaf fodder for livestock. The study of results shows that the fuelwood consumption in the winter season was maximum (2.2 ± 0.07 kg capita^{-1} day^{-1}) followed by the rainy season (1.8 ± 0.08) and minimum (1.53 ± 0.07 kg capita^{-1} day^{-1}) reported in the summer season. Fodder such as tree leaves and grasses, from forests was used to feed livestock to 32.42 ± 5.5 kg day^{-1}in green form and 14.51 ± 0.25 kg day^{-1} in dry form. As forest resource utilisation is an essential component of the rural households of Garhwal Himalaya, its extensive use may lead to over-exploitation of resources, therefore forest management and forest development programs emphasising conservation should be formulated in such a way that complements both economic and ecological aspects. Thus, the study also suggests the implementation of sustainable forest resource management schemes which may help maintain and enhance the potential flow of economic benefits sustainably to the surrounding communities.

(Key words: Agroforestry, fuel-wood, fodder, Garhwal Himalaya, livestock)

INTRODUCTION

Human civilization relies on the numerous ecosystem services (ES) provided by forest ecosystems. Forests, as crucial and self-sustaining ecological systems, play a vital role by providing a diverse range of services that are essential for human survival and well-being. Ecosystem services are the result of the interaction and exchange between the living and non-living components of an ecosystem (De Groot *et al.,* 2002). In the Garhwal Himalaya, rural households mainly depend on the forest to meet their energy needs to sustain their livelihood due to remoteness, unemployment, and low agricultural productivity (Singh and Sundriyal, 2009). They have the privilege to collect fuelwood and fodder in limited quantity from forested areas (Rawat *et al*., 2009).

The Millennium Ecosystem Assessment, conducted by the United Nations, classified ecosystem services (ES) into four broad categories. The first category is provisioning services, which encompass the production of food and the provision of water for human consumption and agricultural use. The second category is regulating services, involving the natural processes that help control floods and diseases, contributing to human well-being and safety. Thirdly, cultural services include the spiritual, recreational, and cultural benefits that ecosystems provide to humans. Lastly, supporting services encompass the essential processes such as nutrient cycling, soil formation, and photosynthesis that uphold the conditions necessary for life on Earth (Anonymous, 2003).

Forests play a pivotal role in sustaining human well-being by providing various tangible goods derived directly from forest ecosystems, such as timber, non-timber forest products (NTFPs), and diverse forms of bioenergy. Forests are crucial for the supply of raw materials for construction, paper production, and fuelwood, particularly in rural communities where dependence on forest resources is integral to daily subsistence (Herforth *et al.,* 2020). Forests sustain life for over 70% of terrestrial biodiversity; they regulate water cycles, maintain soil quality, and reduce the risk of natural disasters such as floods and landslides, as well as directly and indirectly support the livelihoods of over 1.6 billion people worldwide (Anonymous, 2005; Eliasch, 2008). Despite being widely recognized, the benefits provided by many natural ecosystems are still poorly understood and quantified (Negi and Agrawal, 2006). Although the ecological, cultural, and economic importance of these ecosystem services are crucial, ecosystems are continually deteriorating worldwide as the value of ecosystems to human welfare is still

1* & 3. Ph.D. Scholars, Dept. of Botany, D.A.V. (P.G) College, Dehradun, (A Central University) 248001 U.K. (*Corresponding Author)

2. Professor, Dept. of Botany, D.A.V. (P.G) College, Dehradun, (A Central University) 248001 U.K.

underestimated, and the ecosystem services are not, or are only partly, captured in conventional market economics.

The region boasts a rich diversity of plant species and presents a promising opportunity for local communities and farmers to harness their economic potential (Pandey *et al.,* 2024). In this paper, we present a study from Mudhani village, Tehri District of Garhwal Himalaya, which deals with fuel and fodder consumption patterns.

MATERIALS AND METHODS

Study site

The study was conducted in Mundani village, in Jaunpur block and Dhanaulti tehsil of the Tehri Garhwal district. The village falls under Mundani gram panchayat, with a geographical area of 372.71 ha.The climate of the study area can be divided into three distinct seasons, namely summer (April-June), rainy (July-September) and winter (November-February). The transition periods between rainy and winter and winter and summer are recognised as autumn (October- November) and spring (February-March), respectively.

Field survey and data collection

A survey was conducted in the village to record the number of families (43) and the number of members (253) in each household. The study was conducted in different seasons in the year of 2022-2023. Interviews were then carried out in 90% of the households using a structured questionnaire. The questionnaire focused on human and livestock populations, literacy levels, types of employment, and consumption of fuelwood and fodder. Additional data were also collected through interviews and discussions with the heads of villages (Gram Pradhans).

Figure 1. Map of the study site (Mundani village)

RESULTS AND DISCUSSION

Demography of Mundani Village

In the Mundani village in the Tehri Garhwal district, there was a total population of 313 people, belonging to 55 families. There were 153 males and 160 females, resulting in a sex ratio of 1046, which was higher than the Uttarakhand state average of 963. In terms of children aged 0-6 years, there were 51 in Mundani village. The child sex ratio in the village was 821, which was lower than the Uttarakhand state average of 890 (Anonymous, 2011)

We surveyed 43 households in a village with a total population of 253, including 124 males and 130 females. The sex ratio was 1048.39 females 1000^{-1} males, indicating a higher number of females in the village. There were 79 children in the village, with 40 males and 39 females, resulting in a child-sex ratio of 975. The literacy rate in the village was 87.34%. Out of the 43 households, 157 individuals were part of the working population, of these workers, 156 were main workers, and 143 were main cultivators. There were no recorded agricultural labourers, but there were a minimal number of marginal workers and cultivators, with only one individual in each category. The non-working segment consisted of 156 people, including 75 non-working males and 81 non-working females. This data highlights the village's demographics, literacy level, and employment patterns, emphasizing a strong reliance on cultivation as the primary occupation. Similar work was done by Sharma *et al.* (2009), who observed total family counts in the range of 30-134 with average family sizes between 5.2 -6.62 members. Human populations in the villages ranged from 156 to 798 individuals. Gender distribution found in between 46.15 - 54.07% male and 45.92 to 53.84% female populations. Literacy rates also varied significantly with overall literacy spanning from 47.30 to 63.82%. Male literacy rates ranged in between 45.90 to 63.82%, while female literacy rates were found in between 48.73 to 60.71%.

Fuel wood consumption

The daily fuel wood consumption by villagers was 66.32 ± 0.7 kg day^{-1} in summer, 80.1 ± 0.9 kg day^{-1} in the rainy season, and 94.7 ± 0.7 kg day^{-1} in the winter. The $capita^{-1}$ fuel wood consumption during summer, rainy, and winter seasons in the Mundani villages averaged 1.53 ± 0.07 kg day^{-1} $capita^{-1}$, 1.86 ± 0.08 kg day^{-1} $capita^{-1}$, and $2.20 \pm$

Table 1. Fodder and fuelwood consumption by households and livestock

Sl.No.	Name of family head	T.F.M.	Fodder use capita^{-1} day^{-1}		Cattles	Fuel wood use capita^{-1} day^{-1}		
			Green (July - Dec)	Dry(Dec- June)		Summer	Rainy	Winter
1	Prem Singh	9	115 kg day^{-1}	59 kg day^{-1}	5Cows, 2 Oxen, 10 Goats	2 kg day^{-1}	2.54 kg day^{-1}	2.9 kg day^{-1}
2	Sambeer Singh	5	32 kg day^{-1}	12 kg day^{-1}	2 Cows, 1 Goat	1.5 kg day^{-1}	1.8 kg day^{-1}	2.1 kg day^{-1}
3	Dhanpal Singh	8	30 kg day^{-1}	10 kg day^{-1}	2 Cows	2 kg day^{-1}	2.4 kg day^{-1}	2.6kg day^{-1}
4	Surat Singh	6	50 kg day^{-1}	20 kg day^{-1}	2 Cows, 10 Goats	1.6 kg day^{-1}	1.9 kg day^{-1}	2.3 kg day^{-1}
5	Inder Singh	9	140 kg day^{-1}	66 kg day^{-1}	2 Buffaloes, 4 Cows, 10 Goats, 2 Oxen	2.12 kg day^{-1}	2.4 kg day^{-1}	2.6 kg day^{-1}
6	Dinesh Singh	5	0	0	0	1.5 kg day^{-1}	1.7 kg day^{-1}	2.1 kg day^{-1}
7	Vijaypal Singh	8	0	0	0	2.1 kg day^{-1}	2.4 kg day^{-1}	2.6 kg day^{-1}
8	Vinod Singh	5	15 kg day^{-1}	7 kg day^{-1}	1 Cow	1.2 kg day^{-1}	1.8 kg day^{-1}	2.1kg day^{-1}
9	Soban Singh	8	60 kg day^{-1}	28 kg day^{-1}	2 Cows, 2 Oxen	1.2 kg day^{-1}	1.9 kg day^{-1}	2.2 kg day^{-1}
10	Sobat Singh	7	120 kg day^{-1}	57 kg day^{-1}	4 Cows, 2 Oxen, 15 Goats	2 kg day^{-1}	2.4 kg day^{-1}	2.5 kg day^{-1}
11	Chinta Devi	8	30 kg day^{-1}	14 kg day^{-1}	2 Cow	2.2 kg day^{-1}	2.45 kg day^{-1}	2.6 kg day^{-1}
12	Basanti Devi	6	30 kg day^{-1}	14 kg day^{-1}	2 Cow	1.7 kg day^{-1}	2.2 kg day^{-1}	2.6 kg day^{-1}
13	Magan Lal	9	55 kg day^{-1}	27 kg day^{-1}	1 Mule, 2 Oxen, 10 Goats	2.1 kg day^{-1}	2.4 kg day^{-1}	2.6 kg day^{-1}
14	Surgeet Singh	4	0	0	0	1 kg day^{-1}	1.4 kg day^{-1}	1.8 kg day^{-1}
15	Jagat Singh	6	45 kg day^{-1}	21 kg day^{-1}	1 Buffalo, 2 Cows	1.6 kg day^{-1}	1.9 kg day^{-1}	2.1 kg day^{-1}
16	Vikarm Singh	5	75 kg day^{-1}	35 kg day^{-1}	4 Cows, 1 Buffalo	1.5 kg day^{-1}	1.9 kg day^{-1}	2.3 kg day^{-1}
17	Lakhi ram	8	45 kg day^{-1}	21 kg day^{-1}	1 Buffalo, 2 Oxen	2 kg day^{-1}	2.4 kg day^{-1}	2.6 kg day^{-1}
18	Balma Devi	6	30 kg day^{-1}	14 kg day^{-1}	2 Cow	1.6 kg day^{-1}	1.9 kg day^{-1}	2.1 kg day^{-1}
19	Sumer Singh	6	15 kg day^{-1}	7 kg day^{-1}	1 Buffalo	1.5 kg day^{-1}	1.8 kg day^{-1}	2.1 kg day^{-1}
20	Jayveer Singh	5	60 kg day^{-1}	28 kg day^{-1}	2 Buffaloes, 2 Oxen	1.5 kg day^{-1}	1.7 kg day^{-1}	1.9 kg day^{-1}
21	Pulma Devi	8	45 kg day^{-1}	21 kg day^{-1}	2 Oxen, 1 buffalo	2.1kg day^{-1}	2.41 kg day^{-1}	2.7 kg day^{-1}
22	Gunanand Singh	7	120 kg day^{-1}	38 kg day^{-1}	30 Goats, 2 Oxen, 2 Buffaloes	2 kg day^{-1}	2.4 kg day^{-1}	2.6 kg day^{-1}
23	Narendra Singh	6	15 kg day^{-1}	7 kg day^{-1}	1 Buffalo	1.7 kg day^{-1}	2.1 kg day^{-1}	2.5 kg day^{-1}
24	Jaypal Singh	4	30 kg day^{-1}	14 kg day^{-1}	2 Buffaloes	1.2 kg day^{-1}	1.6 kg day^{-1}	2.3 kg day^{-1}
25	Bharat Singh	4	0	0	0	1 kg day^{-1}	1.2 kg day^{-1}	1.8 kg day^{-1}
26	Pratap Singh	4	0	0	0	1 kg day^{-1}	1.3 kg day^{-1}	1.8 kg day^{-1}

Contd....

28	Bhagwat Singh	6	0	0	0	1.9 kg day^{-1}	2.1 kg day^{-1}	2.5 kg day^{-1}
29	Hari Om Singh	5	15 kg day^{-1}	7 kg day^{-1}	1 Cow	1.3 kg day^{-1}	1.5 kg day^{-1}	1.9 kg day^{-1}
30	Chamani Devi	5	15 kg day^{-1}	7 kg day^{-1}	1 Buffalo	1.5 kg day^{-1}	1.8 kg day^{-1}	2.1 kg day^{-1}
31	Surat Singh	2	15 kg day^{-1}	7 kg day^{-1}	1 Cow	1 kg day^{-1}	1.5 kg day^{-1}	1.9 kg day^{-1}
32	Virendra Singh	5	0	0	0	1.4 kg day^{-1}	1.6 kg day^{-1}	1.9 kg day^{-1}
33	Hari Bhajan Singh	5	0	0	0	0	0	0
34	Govind Singh	5	0	0	0	1.3 kg day^{-1}	1.7 kg day^{-1}	2.1 kg day^{-1}
35	Balveer Singh	8	55 kg day^{-1}	27 kg day^{-1}	1 Buffalo, 20 Goats	2.1 kg day^{-1}	2.4 kg day^{-1}	2.7 kg day^{-1}
36	Sudama Devi	7	45 kg day^{-1}	21 kg day^{-1}	2 Buffaloes, 1 Cow	2 kg day^{-1}	2.4 kg day^{-1}	2.8 kg day^{-1}
37	Sulochana Devi	8	15 kg day^{-1}	7 kg day^{-1}	1 Cow	2.1 kg day^{-1}	2.3 kg day^{-1}	2.7 kg day^{-1}
38	Manoj Singh	5	30 kg day^{-1}	14 kg day^{-1}	2 Buffaloes	1.9 kg day^{-1}	2.1 kg day^{-1}	2.6 kg day^{-1}
39	Vinod Singh	4	15 kg day^{-1}	7 kg day^{-1}	1 Buffalo	1 kg day^{-1}	1.4 kg day^{-1}	1.8 kg day^{-1}
40	Surendra Singh	4	15 kg day^{-1}	7 kg day^{-1}	1 cow	1 kg day^{-1}	1.3 kg day^{-1}	1.7 kg day^{-1}
41	Rakesh Singh	5	0	0	0	1.1 kg day^{-1}	1.5 kg day^{-1}	1.9 kg day^{-1}
42	Rajesh Singh	5	0	0	0	1.3 kg day^{-1}	1.6 kg day^{-1}	1.9 kg day^{-1}
43	Pramod Singh	4	0	0	0	1 kg day^{-1}	1.4 kg day^{-1}	1.9 kg day^{-1}

Abbreviation: T.F.M. = Total family member

0.07 kg day^{-1}capita^{-1}, respectively. The estimates in our study closely align with those reported by Joshi and Negi (2011) for the Western Himalayan region. They found that in oak and pine forest-dominated villages, the estimated values were 1.57 and 1.75 kg capita^{-1} day^{-1}, respectively. Similarly , Bhatt *et al.* (1994) reported a value of 1.49 kg capita^{-1} day^{-1}, 1.63 to 2.52 kg capita^{-1} day^{-1} by Kumar *et al.* (2009) and 1.53 to 2.91 kg capita^{-1} day^{-1} by Rawat *et al.* (2018) for lower altitude villages of the Western Himalayas. The large quantity of fuel wood was extracted from the nearby forest with the rest being collected from trees growing on private agroforestry land. The village's annual total fuelwood consumption was 880.08 quintals. The rural people in the area preferred specific tree species for fuelwood, including *Grewiaoptiva, Celtisaustralis, Juglansregia, Pyruspashia,* and *Quercus leucotrichophora*, which were retained and maintained as agroforestry tree species. Among these, Oaks (Quercus sp.) were the most preferred multipurpose tree species.

Livestock population and fodder consumption

The maximum 58% of goats were recorded followed by cows (21%), buffaloes and oxen (10%) each and (1%) mule. Increased livestock population, reduced fodder production from farmlands, and changed cropping patterns imply more intensive grazing in forests (Saxena *et al.,* 2005). In the Himalayan region, domestic animals are the main source of drought power for agriculture. They also generate income when sold, they process crop residues and provide essential organic manure which is mixed with forest leaf litter to form compost. The major fodder sources are the crop residues, the leaves of some tree species, ground flora of the forest areas and dried grasses, which are stored on the tree tops in heaps and fed during the lean periods. The forest is the main source of leaf fodder and bedding material for livestock (Sharma *et al*., 2011).

The average daily consumption of fodder in the village was 32.42 ± 5.5 kg in green form and 14.51± 0.25 kg in dry form. This brings the total daily consumption to 1377 ± 5.7 kg in green fodder and 62.24 ± 14.23 kg in dry fodder. The village's total daily fodder requirement was 2001 ± 19.93 kg. Additionally, the annual total fodder consumption in this village was 7303.65 quintals.

The study provides detailed information about the livestock population, fodder usage, and fuel wood consumption in Mudani village. Indigenous agroforestry is an important and ideal practice for fodder production in this region. Efforts should be made to expand agroforestry through government policies and social forestry programs, such as afforestation and reforestation, to meet the fodder needs of the increasing livestock population and reduce pressure on valuable natural forests.

REFERENCES

Anonymous, 2003. Assessment, M. E. Ecosystems and human well-being: a framework for assessment. p.p. 1-245. shttps://www.wri.org/millennium-ecosystem-assessment-framework

Anonymous, 2005. Millennium ecosystem assessment, (M. E. A.) Ecosystems and human well-being. Washington, DC: Island Press. **5** : 563.

Anonymous, 2011. Directorate of Census Operations Uttarakhand, District Census Handbook Tehri Garhwal, 2011: Vol. Xii A (6 B) [English]. Village And Town Wise Primary Census Abstract (PCA) http://www.censusindia.gov.in

Bhatt, B. P., A. K. Negi and N. P. Todaria, 1994. Fuelwood consumption pattern at different altitudes in Garhwal Himalaya. Energy. **19** (4) : 465- 468.

De Groot, R. S., M. A. Wilson and R. M. Boumans, 2002. A typology for the classification, description and valuation of ecosystem functions, goods and services. Ecol. Econ. **41** (3): 393–408.

Eliasch, J. 2008. Climate Change: Financing Global Forests - The Eliasch Review (1st ed. Vol. 1) [English]. The Stationery Office Limited, United Kingdom.

Herforth, A., Y. Bai, A. Venkat, K. Mahrt, A. Ebel and W. A. Masters, 2020. Cost and affordability of healthy diets across and within countries: Background paper for The State of Food Security and Nutrition in the World 2020. FAO Agricultural Development Economics Technical Study No. 9 (9). Food and Agriculture Org.

Joshi, G. and G. C. S. Negi, 2011. Quantification and valuation of forest ecosystem services in the western Himalayan region of India. Int. J. Biodivers. Sci. Ecosyst. Serv. Manag. **7** (1) : 2-11.

Kumar, M., C. M. Sharma and G. S. Rajwar, 2009. Energy budget of traditional hill agroecosystems along altitudinal gradients in Garhwal Himalaya, India. World J. Agric. Res. **5** (6) : 729-736.

Negi, G. C. S. and D. K. Agrawal, 2006. Measuring and valuing ecosystem services: Himalayan Mountain context. Curr. Sci. **91** (5) : 573.

Pandey, M., S. P. Joshi and S. Sharma, 2024. Utilization pattern of medicinal plants in Jaunpur range of mussoorie forest division, Uttarakhand. J. Soils and Crops. **34** (1) : 202–207.

Rawat, S., M. Kumar, R. Pandey and B. Nagar, 2018. Forest resource utilization pattern and heterogeneity in rural household characteristics in Garhwal Himalaya. Indi. For. **144** (2) : 150-158

Rawat, Y. S., S. C. Vishvakarma and N. P. Todaria, 2009. Fuelwood Consumption Pattern of Tribal Communities in Cold Desert of Lahaul Valley, North-Western Himalaya, India. Biomass and Energy. **33** (11): 1547–1557.

Saxena, K. G., R. K. Maikhuri and K. S. Rao, 2005. Changes in agricultural biodiversity: Implications for sustainable livelihood in the Himalaya. J. Mt. Sci. **2** (1) : 23–31.

Sharma, C. M., S. Gairola, M. Kumar, Y. S. Rawat and H. K. Bagwari, 2009. Resource utilization in village ecosystem of temperate zone of Garhwal Himalaya. Ind. J. Agro. **(11)**2 : 94-100.

Sharma, C. M., D. S. Butola, S. Gairola, S. K. Ghildiyal and S. Suyal, 2011. Forest utilization pattern in relation to socio-economic status of people in dudhatoli area of garhwal himalaya. For. Tr. and Livelihood. **20** (4) : 249-263.

Singh, N. and R. C. Sundriyal, 2009. Fuelwood, fodder consumption and deficit pattern in Central Himalayan village. Nat. Sci. **7** (4) : 85–88.

Rec. on 15.06.2024 & Acc. on 05.07.2024