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Fuelwood Consumption in Agroforestry Systems in Jammu District

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ABSTRACT

Study focuses on assessing the impacts of fuelwood consumption on the livelihood of households in the Jammu District. The field survey data were employed for the study. The primary sources involved the use of questionnaire, while the secondary sources involved the use of documented information from books, reports and internet. The study revealed that 70% of the people within the study area are involved in agricultural activities, whereas more than 65% population are depending on the extraction of forest resources for their livelihood. Forests also help to control erosion and enhance aesthetic beautification and temperature regulation in the rural areas of the study region. The study reveals that seasonal variations affect availability of fuelwood as well as quantity of fuelwood used during the cold and warm days. Fuelwood collection is an important and time-consuming activity, whether done at daily or weekly intervals for the majority of rural areas. The use of LPG significantly influenced the domestic fuelwood consumption. The overall fuelwood consumption in agroforestry in the study area i.e., 40.8% followed by LPG (29.5%), Crop residue (14.1%), Dung cake (10.4%) and Kerosene oil (5.2%). Fuel wood consumption per household was estimated in 7.5 kg/day in summer and 10.7 kg/day in winter.

Key words: Fuelwood, Agriculture, Consumption, Households, Livelihood, Agroforestry

Agroforestry system include both traditional and modern land use system in which trees are managed together with crops or animal production systems in agricultural settings. Forests and trees have played an important role in human life since time immemorial [1]. It has dynamic functions, such as the ability of the tree component to produce fruit, fuelwood and fodder, and service functions, chief among which is that of soil conservation. The high potential of agroforestry as a means of achieving sustainable land use especially in the tropics has been investigated and promoted since the early 1980. It is now suitably increasingly translated into practice, throughout the design of appropriate agroforestry systems and their inclusion in process of land use planning [2]. The energy generated from fuelwood is the main component of the domestic rural energy systems of the world, mainly in the developing countries. Fuelwood and dung cake are the primary energy sources for cooking and space heating used by 70% rural households in developing countries [3]. Fuelwood is prominently, a renewable source of energy whose decentralized nature is particularly suited to the scattered nature of rural habitation and usually makes it possible to obtain the fuel at a very low cost. The reliability of 40% proportion of people world-wide as on fuelwood energy for cooking and space heating has given rise to serious concerns that harvesting of fuelwood could be depleting the forest resources [4]. Frequent expansion of human population on the earth, increasing demand for food and living space led to the increase of energy demands as well. In communities where fuelwood is used for residential cooking, it is replaced by other technologies reluctantly, driven by cost differentials [5]. The consumption of biomass as fuel has been identified as one of the most important causes of forest decline in many developing countries. The fuelwood accounts for 54% of all global wood harvest per annum, leading to a significant loss of forest biomass [6]. A heavy and growing reliance on forest and other plant species as a source of fuel had become unsustainable. The heavy dependence of rural households on fuelwood and the anticipated depletion of available stocks presents a real threat to economic welfare and growth [7]. The rural people have to devote an increasing proportion of limited time and money for obtaining the supply of fuelwood they need [8]. Cooking energy constitutes half of the India's total domestic energy consumption. The energy needs of the Indian rural people is still met from non-commercial fuels (fuelwood, animal waste and crop residues) as the majority of the population

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cannot afford commercial fuels and their availability is erratic [9]. The average annual household consumption of fuelwood in India is 836 kg/year for an average household of 5.5 persons [10]. Most of the fuelwood has been reported to be derived from state forests. Because of the increase in population, the area under agriculture has been expanded and forests have shrunk during last two decades [11]. The area is not economically much developed. Local communities depend on farming and livestock rearing with supplementation from harvest of timber and medicinal plants. Livestock rearing requires fodder. In the summer season, livestock graze upper lands. The lush green pastures are thus subject to intensive overgrazing and are converted to barren lands at the end of the season. Observations were reported [12] for the alpine meadows of Jammu & Kashmir, where overgrazing results in great loss to vegetation cover and wide occurrence of unpalatable weedy species of Sambucus, Stipa, and Viburnum. Similarly, [13] thorn forest areas of Punjab are under decline due to overgrazing, felling, wind erosion, desertification, salinity and water logging. The fodder situation in and around Ayubia National Park in the moist temperate forest of Nathiagali have also been found to be under stress [14].

In spite of rapid growth in the commercial energy sector, the demand for fuelwood has in India due to its easy availability and low cost. As in other parts of India, bio-fuels are a source of domestic energy for majority of households in Jammu and Kashmir. Jammu is one of the districts of Jammu division, where people have massive dependence on fuelwood. Out of various bio-fuels, fuelwood is considered as major source of domestic energy in the study area. Though many empirical studies have been conducted but how different factors (type of area-rained/irrigated, socio-economic and biophysical) affect fuelwood consumption, are almost lacking. Further there is a need to investigate the sources of fuelwood and the species preferred. Forest and wildlife are essential for ecological balance of an area. Forests are important components of our environment and economy. Besides economy, forests check air pollution and soil erosion; they save the hill slopes from the landslides and in deserts trees reduce wind erosion by checking wind velocity. Most of the rural population is largely dependent upon the demarcated forest for meeting their timber requirement, for agricultural implements, house building and repair, fuel wood as well as for the grass grazing and leaf fodder for their cattle population. People need fuel for heating and cooking. The forests are under heavy pressure since the bulk of the population of the area use these plants for their fuel requirements. During long winter season there is a huge shortage of wood to be used as fuel. The state government in its forest policy of 2011 emphasizes on conservation of forest resources for ecosystem goods and services, meeting needs of the people for forest produce, and poverty alleviation through forestry-related activities.

MATERIALS AND METHODS

The study area is located between 32° 30' and 33° 7' North latitude and between 74° 20' and 75°10’ East longitude. It is bounded by Rajouri in the west, Reasi and Udhampur in north and north east, Samba in the East and has international border with Pakistan in the south and southwest Jammu. The rural part is constituted of 780 villages spread over an area of 2042.7 Km^2. The district has recorded a population of 1,529,958. Among all the districts of the State, Jammu ranks first in terms of population. Administratively it is divided into four tehsils, namely; Jammu, Akhnoor, R. S. Pura (Ranbir Singh Pura) and Bishnah, for development purposes, these tehsils have been further divided into eight-community development blocks like as, Akhnoor, Bhalwal, Bishnah, Dansal, Khour, Marh, R. S. Pura and Satwari and 296 Panchayats (Census 2011). Except for kandi area, the land is irrigated and fertile. The annual mean maximum range of temperature is 29ºC and 35ºC and the annual mean minimum temperature should be between 19ºC and 22ºC. Highest summer temperature reaches upto 48ºC. Annual rainfall ranges from 1000 to 1300 mm.

The study area was divided into four zones according to physiographic divisions. Zone-I which ranges between 200-350mts comprises of Alluvial plains, zone-II 350 450mts comprises of Rolling plains, zone-III spreading from 450-550mts covers the Piedmont plains and zone-IV ranging upto 115mts amsl comprises of Shiwaliks. From the below table reflects the number of households sample collected in the study area.

Zone	Altitude (Mts)	Total area (%age)	No. of H/H selected	No. of blocks	No. of locations selected
Zone-I	200-350	46.9%	132	8	12
Zone -II	350-450	13.7%	38	6	8
Zone-III	450-550	21.26%	60	5	6
Zone-IV	550-1150	18.05%	50	5	4

The selection of villages was done through Google earth keeping in mind the agroforestry being practiced by the villagers in whom 281 households were surveyed. While making the selection of the households it was assured that they require fuelwood for their daily need. During field visits numbers of locations were identified, where in agroforestry practices could be followed by the suggested combinations. As the study was divided in four zones, depending on the area of each zone numbers of locations were suggested. In zone-I, 12 locations were identified with the help of Google earth, and then visited locations with the help of GPS, where the ground realities were recorded.

RESULTS AND DISCUSSION

To analyze the fuelwood collection/consumption in the study has been conducted by understanding the pattern and quantity collected/consumed. The people living in and around forests are usually visiting the forest for different purposes. It depends upon the necessities of the household. People gather fuelwood, fodder and timber for agricultural equipment, etc. from the forests. The preferences of the people to visit forest also depend upon the distance of the forest i.e., those living close to the forest visit regularly than those living away from the forest. The increase in altitude also affects the visit. Some people trip the forest for the whole year and some seasonally. The details of forest visit at different time and season for collection of forest resources are given in (Table 1).

Table 1 Household visiting forest (in percentage)

Household visiting forests	Zone -I	Zone -II	Zone -III	Zone -IV
	10	18	22	50
Morning	85	64	32	10
Evening	10	26	43	53
Any time	5	10	25	38
Winters	50	38	32	27
Summer	36	27	26	23
Whole Year	14	35	42	50

Data depicted in (Table 1) revealed the percentage of households visiting forest in the study area which varies from zone-I to zone-IV. The collection of fuelwood in Zone-I is 10%, Zone-II 18%, Zone-III 22% and Zone-IV is 50%. In zone-I, people mostly prefer to visit forest in the morning, but the preference changes during the season, 50% households visit during winters, 36% in summer and remaining 14% of households make their visit for the whole year. In zone-II, 64% households visit in the morning, 26% in evening and remaining 10% have no specific time. As far as season of preference is concerned visit of 38% households is in winters, 27% in summer and 35% households during the whole year, similarly in Zone-III 32% households make their visit in the morning, 43% in evening and remaining 25% have no specific time. As far as season of preference is concerned 32% households visit in winters, 26% households in summer and 42% households make their visit during the whole year and in zone-IV, 10% households make their visit in the morning, 53% in evening and remaining 38% have no specific time. As far as season of preference is concerned 27% households in winters, 23% households in summer and 50% households make their visit during the whole year in zone-IV.

Table 2 Source of energy

Source	Percentage	Quantity used kg/year
Fuelwood	40.8	3845.5
LPG	29.5	3121.2
Crop residue	14.1	2979.5
Dung cake	10.4	2472.6
Kerosene	5.2	1281.4

The forest was found to be the major primary source of fuelwood.40.8% of the households collected fuelwood from the forest. The amount of fuelwood was consumed 3845.5 kg/year. Since forest and own-farm were two major primary source of the fuelwood, LPG, dung cake and crop residue respectively were major alternative domestic fuels in the study area. The use of LPG is 29.5% significantly influenced the domestic fuelwood consumption. LPG has been consumption increased from last ten years. Dung cake is an important bio-fuel used in rural areas for domestic energy purpose. The data shows that effect of cow dung on domestic fuelwood consumption is 10.4%. The use of dung cake as an alternative fuel was expected to decrease fuelwood utilization. There was a significant influence of crop residue on domestic fuelwood consumption. Quite surprisingly, the fuelwood consumption was increased with crop residue consumption. Very low use of Kerosene oil i.e., 5.2% for cooking and lightening purposes. LPG, dung cake and crop residue respectively were major alternative domestic fuels in the study area. LPG is primarily used for cooking in the study area. The total amount of LPG consumed in the year 2014 was about 3121.2 kg/year followed by crop residue 2979.5 kg/year, dung cake 2472.6 kg/year and kerosene oil 1281.4 kg/year. The major source of biomass energy in study area is fuelwood, agricultural waste and animal dung [15].

The (Table 3) reflects that 68% of the household depend on LPG in zone-I followed by fuelwood 12%, crop residue 11%, dung cake 8% and kerosene is 1%, similarly in zone-II, LPG consumed 41% followed by crop residue 24%, fuelwood 23%, dung cake 11% and kerosene is 1%. In zone-III 47% fuelwood was consumed, whereas usage of LPG is 15% and the crop residue was more than LPG consumption. In zone-IV 66% of the fuelwood was consumed which is highest in all the zones. There is a huge change in fuelwood and LPG as compare to zone-I and zone-IV. It's clear from the figure 4.3 that in zone-I the forest is very less, and in zone-IV the forest distribution is good [16].

Table 3 Households using different sources of Energy

Source	Percentage			
	Zone-I	Zone-II	Zone-III	Zone-IV
Fuelwood	12	23	47	66
LPG	68	41	15	10
Crop residue	11	24	29	15
Dung cake	8	11	7	6
Kerosene	1	1	2	3

Table 4 Households collecting/consuming fuel wood

Zone	Percentage	Quantity (in/kg/day/hh)
Zone-I	75%	5.8
Zone-II	88%	9.5
Zone-III	92%	11.6
Zone-IV	98%	14.9
Average	88.2%	10.4

Data in (Table 4) shows that households in zone IV use maximum amount of fuelwood as compared to zone-III, zone-II and zone-I, due to the low temperature, 88.2% of the households use fuelwood at an average rate of 10.4 kg/day/hh in the study area. In zone-I the percentage of households collecting/consuming fuelwood is 75% with an average of 5.8 kg/day/hh. In Zone-II, 88% percentage of households and average rate of quantity collected/consumed per day is 9.5 kg/day/hh respectively. 92% of the households and quantity collected/consumed per day 11.6 kg/day/hh fuelwood in Zone-III, whereas zone-IV has the highest percentage of fuelwood as well as quantity collected/consumed per day 14.9 kg/day/hh [17].

The income wise percentage of households collecting/consuming fuelwood in different zones indicates that as the income of the household's increases, the percentage of household collecting/consuming fuelwood as well as the quantity of fuelwood use per day decreases in each zone. It also clears from the (Table 5) that in zone-I percentage of households collecting/consuming fuelwood in each income group is maximum. In Zone-I, 80% of the households having income less than Rs. 10,000 collect/consume fuelwood with an average rate of 11.3 kg/day/hh, 79% of the household with income between Rs. 10,000 to Rs. 25,000 collect/consume fuelwood at an average quantity of 9.5 kg/day/hh, 76% of the households fall under the income group between Rs. 25,000 to Rs. 50,000 use 4.8 kg/day/hh, while 70% of the households having income more than Rs. 50,000 use 2.3 kg/day/hh. Similarly in case of Zone-II, 75% of the households having income less than Rs. 10,000 collect/consume fuelwood with an average rate of 15.4 kg/day/hh 73% of the household with income between Rs. 10,000 to Rs. 25,000 collect/consume fuelwood at an average quantity of 13.6 kg/day/hh, 70% of the households fall under the income group between Rs. 25,000 to Rs. 50,000 use 7.9 kg/day/hh, while 65% of the households having income more than Rs. 50,000 use 4.6 kg/day/hh. In Zone-III, 72% of the households having income less than Rs. 10,000 use fuelwood with an average rate of 16.9 kg/day/hh, 69% of the household with income between Rs. 10,000 to Rs. 25,000 collect/consume fuelwood at an average quantity of 14.8 kg/day/hh, 68% of the households fall under the income group between Rs. 25,000 to Rs. 50,000 collect/consume 10.5 kg/day/hh, while 63% of the households having income more than Rs. 50,000 collect/consume 7.9 kg/day/hh. In Zone-IV, 70% of the households having income less than Rs. 10,000 collect/consume fuelwood with an average rate of 18.3 kg/day/hh, 66% of the household with income between Rs. 10,000 to Rs. 25,000 collect/consume fuelwood at an average quantity of 16.9 kg/day/hh, 60% of the households fall under the income group between Rs. 25,000 to Rs. 50,000 use 13.2 kg/day/hh, while 59% of the households having income more than Rs. 50,000 collect/consume 9.5 kg/day/hh [18].

Table 5 Income wise collection/consumption of fuelwood (kg/day/hh)

Income (Rs. / month)	Zone-I		Zone-II		Zone-III		Zone-IV	
	Percentage	Quantity used	Percentage	Quantity used	Percentage	Quantity used	Percentage	Quantity used
<10000	80	11.3	75	15.4	72	16.9	70	18.3
10000-25000	79	9.5	73	13.6	69	14.8	66	16.9
25000-50000	76	4.8	70	7.9	68	10.5	60	13.2
>50000	70	2.3	65	4.6	63	7.9	59	9.5

Data depicted in (Table 6) revealed that the effect of distance of house from nearest forest for fuelwood consumption was found to be significant. It reveals that the percentage and the quantity used by households in terms of road connectivity. 38% of the household on the road side were consuming 9.6 kg/day/hh of fuelwood daily, which is minimum in Zone-I and maximum quantity i.e. (67%) quantity was collected/consumed 16.5 kg/day/hh in Zone-IV. The road distance within a range from 1 km to 3 kms, 42% households consumed 10.7 kg/day/hh quantity of fuelwood whereas 76% collected/ consumed 17.6 kg/day/hh in Zone-IV. From 3 km to 5 kms, 50% of the households used 11.9 kg/day/hh minimum in Zone-I and 81% of the households collected/consumed 20.5 kg/day/hh maximum in Zone-IV. As the distance from the road side increased the percentage and quantity also increased. Beyond 5 kms in zone-I, 54% of the household collected/consumed 15.0 kg/day/hh that used minimum, whereas Zone-IV has 84% of the households collecting/consuming 22.1 kg/day/hh, which was maximum in all zones [19]. The people residing along the road side are engaged in secondary and tertiary activities and also depend on alternative source of energy (LPG, kerosene, Crop residues and cow dung). On the other hand, the households away from the road side show their dependence on fuelwood because most of the people of these areas have easy availability of fuelwood from their own fields. The data showing effect of distance of households from the nearest metalled road on fuelwood consumption. There was a significant influence of distance of house from nearest metalled road on fuelwood consumption. Children and women are mostly collected the fuelwood from the forest areas.

Table 6 Fuelwood consumption (kg/day/hh) as per road connectivity

Road connectivity	Zone-1		Zone-2		Zone-3		Zone-4	
	Percentage	Quantity used	Percentage	Quantity used	Percentage	Quantity used	Percentage	Quantity used
On road side	38	9.6	45	11.9	53	12.4	67	16.5
1km to 3 kms	42	10.7	51	13.7	59	14.9	76	17.6
3km to 5 kms	50	11.9	53	14.3	65	16.3	81	20.5
> 5 kms	54	15.0	59	16.6	69	19.1	84	22.1

The (Table 7) reveals that the average source of fuel wood from zone-I to zone-IV from state forest is 50.5% in the study area, whereas 35% of the population uses fuelwood from their own fields and the remaining 14.5% purchase fuelwood from the market. In Zone-I 16% of the population depend upon forest for fuel wood, 58% of the population fulfill their need of fuelwood from their own field and 26% of the population dependent on market. Similarly in zone-II, 47% of the population depends upon forest for fuelwood, 38% of the population depends upon their own field and 15% of the people purchased from market. Zone-III, 65% of the population depends upon forest, 26% on their own field and about 9% of the population depends on market and zone-IV 74% of the population depends upon forest, 18% on their own field and about 8% of the population has to purchase fuelwood from the market [20].

Table 7 Source of fuelwood (in percentage)

Zone	State forest	Own farm	Market
Zone-I	16	58	26
Zone-II	47	38	15
Zone-III	65	26	9
Zone-IV	74	18	8
Average	50.5	35	14.5

CONCLUSION

The study reveals that seasonal variations affect availability of fuelwood as well as quantity of fuelwood used during the cold and warm days. Fuelwood collection is an important and time-consuming activity, whether done at daily or weekly intervals for the majority of rural areas. The use of LPG significantly influenced the domestic fuelwood consumption. The overall fuelwood consumption is higher in the study area i.e., 40.8%, followed by LPG (29.5%), Crop residue (14.1%), Dung cake (10.4%) and Kerosene oil (5.2%). In zone-I LPG consumption were highest (68%) followed by fuelwood and crop residue, but higher the altitude higher is the fuelwood consumption. Female and children mainly collect the fuel wood from the adjoining forest. Dry wood was also collected in addition to cutting the live branches of trees. The dry season is best for the gathering of firewood. They also store large collections of the gathered fuelwood near their settlements for the winter and monsoon season when the need is greater. There was a significant influence of distance of house from nearest metalled road on fuelwood collection/consumption. The domestic fuelwood consumption in the area under study was 50.4 kg/day/hh in households along the road in zone-I, as we go beyond 5 kms from the road the collection/consumption gets higher i.e., 72.8 kg/day/hh. As per income, the collection/consumption of the fuelwood in <Rs. 10,000 income group people collected/consumed higher, i.e., 11.3 kg/day/hh compared to income group >Rs. 50,000 who collected/consumed only 2.3 kg/day/hh in zone-I. In zone-IV the collection/ consumption was higher i.e., 18.3 kg/day/hh in zone-I income group <Rs. 10,000, which were reduced in the higher income group i.e., 9.5 kg//day/hh.

LITERATURE CITED

1. Rao DP, Gautam NC, Karale RL, Sahai B. 1991. IRS-1A application for land use/ land cover mapping in India. *Current Science* 61(3/4): 153-161.
2. Young A. 1989. *Agroforestry for Soil Conservation*. CAB International, Wallingford. pp 246.
3. Parikh JK. 1980. *Energy Systems and Development: Constraints, Demand and Supply of Energy for Developing Regions*. Oxford University Press, Delhi. India. pp 13-16.
4. Anonymous. 2010. Annual report. Food and Agriculture Organization. Rome, Italy.
5. Huxley AP. 1983. Plant research and agroforestry proceedings of a consultative meeting held in Nairobi (April 8-15) 1981. International Council for Research in Agroforestry Publication.
6. Wahab M, Ahmad M, Khan N. 2008. Phytosociolgy and dynamics of some pine forests of Afghanistan. *Pakistan Journal of Botany* 40(3): 1071-1079.
7. Marenya PP, Barett CB. 2007. Household-level determinants of adoption of improved natural resources management practices among smallholder farmers in western Kenya. *Food Policy* 32: 515-536.
8. Sood KK. 2003. Factors affecting tree growing in traditional agroforestry systems in western Himalaya India. *Ph. D. Thesis*, University of Aberdeen, Aberdeen, U.K. pp 376.
9. Pohekar SD, Kumar D, Ramachandran M. 2005. Dissemination of cooking energy alternatives in India. *Renewable and Sustainable Energy Reviews* 9(40): 379-393.
10. Jensen JR. 2005. *Introductory Digital Image Processing: A Remote Sensing Perspective*. 3rd Edition, 526. Upper Saddle River, NJ: Prentice Hall.
11. Anonymous. 2010. Annual Report. Food and Agriculture Organization. Rome, Italy.
12. Rawat YS, Vishvakarma SCR, Todaria NP. 2009. Fuelwood consumption pattern of tribal communities in cold desert of the Lahaul valley, north-Western Himalaya, India. *Biomass and Bioenergy* 33(11): 1547-1557.
13. Koul PN, Fotedar AN. 1961. Management of the Forests of J&K State. *The Indian Forester* No. 11.
14. Jensen M. 1995 wood fuel productivity of agroforestry systems in Asia. A review of current knowledge. Regional Wood Development Programme in Asia. FAO, Bangkok. pp 40.
15. Mortan J. 2007. Fuelwood consumption and woody biomass accumulation in mail, West Africa. *Ethnobotany Research and Application* 5: 37-44.
16. Current D, Scherr SJ. 1995. Farmer costs and benefits from agroforestry and farm forestry projects in Central America and the Caribbean: Implications for policy. *Agroforestry Systems* 30: 87-103.
17. Ndayambaje JD, Mohren GMJ. 2011. Fuelwood demand and supply in Rwanda and the role of agroforestry. *Agroforest Syst* 83: 303-320.
18. Turker MF, Kaygusuz K. 2001. Investigation of variables effects on fuelwood consumption as an energy source in forest villages of Turkey. *Energy Convers. Management* 42(10): 1215-1227.
19. Pote J, Shackleton C, Cocks M, Lubke R. 2006. Fuelwood harvesting and selection in Valley Thicket, South Africa. *Jr. Arid Environment* 67: 270-287.
20. Mead DJ. 2005. Forests for energy and the role of planted trees. *Crit. Rev. Plant Sci.* 24: 407-421.