Socio-economic Fuelwood Survey in Bundelkhand Region of Central India

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Abstract—*Using interviews and questionnaires for key respondents in the local community, the study identified the villager's dependence on their forest for fuelwood and supported with socioeconomic stability of villagers in Bundelkhand region of India. The survey revealed that 70% of local people were heavily dependent on forests mainly for fuelwood due to easy availability and cost free. Out of 120 households surveyed, 93.5% respondent use fuelwood for cooking and 4% respondent uses cow dung as primary and subsidiary source for cooking. Only 2.5% households had LPG stove. In a holistic perspective, the comparative analysis of fuelwood survey indicates that Prosopis juliflora is most commonly preferred due to its easy availability in forest and community lands. This extensive study concluded that plantation of locally available multipurpose tree species can be promoted in the regions like wasteland, community and private land. Moreover, the promotion of fuelwood tree planting to use biomass as one of the source of energy in the semi arid Bundelkhand, not only improved the livelihood condition but will also bring better ecological health in this area.*

Keywords: *Fuelwood survey, consumption, utilization, dependency and forest area*

1. INTRODUCTION

Energy is critical, directly or indirectly, in the entire process of evolution, growth and survival of all living beings and it plays a vital role in the socio-economic development and human welfare of a country. Biomass fuels are the most prominent source of primary energy in India and mainly collected from forest. Fuel is by far the largest use of wood in India, dominating all other uses, as is the cause in most developing countries. The estimated annual consumption of fuelwood far exceeds estimates of the countries forest. In India, out of the total land area of 329 million ha, only 78.29 million ha are classified as forests. This represents only 23.81 percent of the total geographic area as against the recommended forest coverage of 33 percent. Total growing stock of India' forests and trees outside forest are estimated at 6047.15 m cum. The annual estimated production of wood and fuel wood from forests is estimated to be as 3.175 m cum and 1.23 m tones [7]. The total fuel-wood consumption estimated in household sector is 248 million m^3 and about 13 million m^3 additional fuel-wood is consumed in hotels and restaurants, cottage industries and cremation of dead human bodies. This makes the total annual consumption of fuel-wood to be 261 million m3 which comes from different sources. The production of fuel-wood from forests has been estimated to be 52 million m^3 and remaining 209 million m^3 from farmland, community land, homestead, roadside, canal side and other wastelands [6].

According to the Household Consumer Expenditure Survey conducted by NSSO in the year 2007-08, in rural India, over 77 percent households depend on fuelwood and wood chips for cooking. India's round wood production in 2006 was estimated to be about 240 million m^3, of which 75% is the estimated share of fuelwood and 15-20 million m^3 industrial round wood, including poles and small lumber for rural households [15]. Acute shortage of fuel wood and the resultant higher price leads to the burning of more than 80 to 100 million tones of dry cow-dung cakes annually, representing 400 to 500 million tones of wet dung, which could increase our agricultural production substantially. Average per capita consumption was 424 kg and 144 kg respectively. Fuelwood collection ("head loading") from forests is traditionally uncontrolled and unmonitored. About 75% of all forest production is said to be fuelwood, mostly collected from natural forests.

Fuelwood demand is major concern of most of the policies because it's directly related to deforestation of countries forest area. Coming to Bundelkhand, region of Uttar Pradesh and Madhya Pradesh has mainly forest dependent livelihood due to erratic monsoon and low developed agriculture. Poverty, rapid population growth, economic stagnation, unemployment, and environmental degradation are found to coexist and thus seem to be reinforcing each other. Unscientific management of the land has resulted in severe soil erosion due to overexploitation of tree resources which resulted gullies and ravines. The dry deciduous forests of the region are in a highly degraded state. As per, special Project study of Bundelkhand in 2012 reported that the consumption of fuelwood is around 1.22 kg per person/day. Also the population of Bundelkhand is 82.32 lakh, if the total consumption of fuel wood is extrapolated with total population there is 36.64 lakh MT requirement of fuelwood.

Wood Collection to meet the growing demand of fuel-wood and excessive grazing is putting enormous pressure on the forest resources of Bundelkhand. Around 600,000 people make their living through sale of fuel-wood head-load. By considering the huge pressure on forest, there is need to take serious concern to formulate sustainable farming system with important tree species which can provide year around fuelwood supply to farmers. In light of the paucity of information related to fuelwood consumption, we sought to identify the fuelwood tree species preferred by and commonly used by local communities in Bundelkhand. Against this backdrop, this study is formulated based on preferential ranking by farmers with respect to tree choice and utilization pattern that is in existence to help state government machinery and policy makers for making decision of protection of forest and creating fuelwood availability through agroforestry plantations.

2. MATERIAL AND METHODOLOGY

2.1 Background of Study

Most of the tree species are grown in village land, community land and reserved and protected forest area of Bundelkhand. The species are utilized based on their availability not on fuelwood characteristics, due to these women and children are facing the great threat got lung disease problem, because of smoke, poisonous gas and smell. Keeping in view, present study is designed to evaluate people preferential species for scientific proof with the support of socioeconomic parameters.

2.2 Study Site

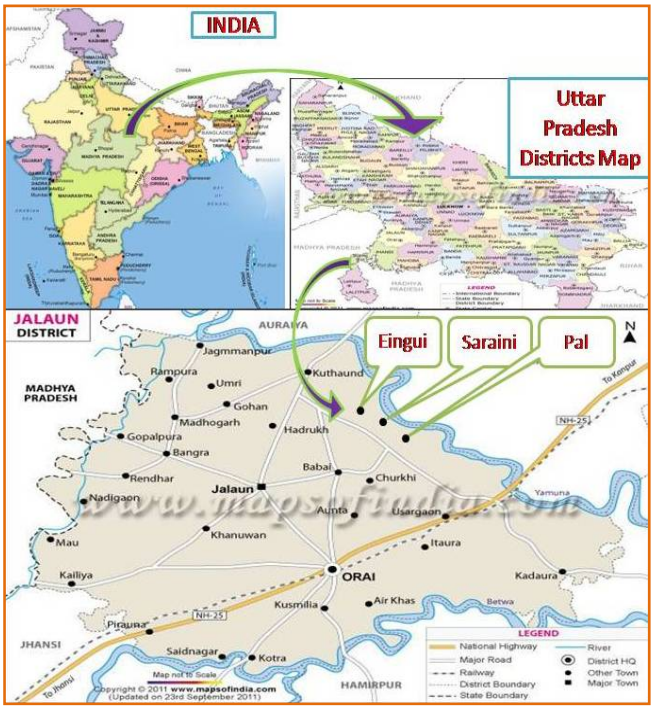

Fig. 1: Study site of Jaluan district of Bundelkhand region

The study site was located in the villages of Saraini, Eingui and Pal, Mahewa Block, Jalaun district, Bundelkhand Region of Uttar Pradesh, India (Fig 1). Agro-climatic zone of Uttar Pradesh is located in S.W. corner of U. P. extended between 24º11' N to 26º27' N latitudes and 78º17' E to 81º34' E longitudes with an average altitude ranging 250-300m above MSL. These villages are located on 30 kilometres from the City of Orai [19].

2.3 Socio-economic survey

The study was conducted during January-February (2014) to collect socioeconomic information from the villages of Saraini, Eingui, and Pal of Orai district of Bundelkhand (U.P). Local language questionnaire was prepared to collect qualitative and quantitative data to gain a better understanding of fuelwood collection within villages. Data was gathered through structured household interviews with both open and closed ended questions as well as direct and participant observations. Quantitative data was gathered through transect walks of fuelwood collection areas to identify major type of fuelwood collection and species.

The sample included 40 randomly selected households in three selected village. If a household selected was unavailable to participate, the next household on the list was interviewed. The fuelwood interview questionnaire was prepared after discussion with scientist of Central Agroforestry Research Institute, Jhansi and Bundelkhand University, Jhansi. The respondent was selected based on their land holding, dependence on agriculture and fuelwood consumption. To understand the contribution of fuelwood, understanding the socio-economic condition of local people was crucial for the study and which was taken up in the beginning of the study. The transect walk, 4-5 person group accompanied around the village area to gather information of type of collection, transportation mode and species choice. Fuelwood collection walks were arranged ahead of time, with the interviewer meeting at the household at a designated time. This was repeated time after time until the walk was completed. On the walk, general observations were made about dynamics of the group (example: who went, did they talk, what did they talk about), thought provoking questions were asked (example: Why are we going here and not there), and age, gender, and relationship to the household were noted. The data collected helped to determine the dependence of villagers on fuelwood and other fuels and the collection pattern of fuelwood from forests. Data on general socio-economic variable was also collected using the same questionnaire.

The questionnaire and matrix ranking used to identify species for preferred fuelwood based on farmer's preference for fuelwood species. Matrix ranking tool of Participatory Rural Appraisal (PRA) technique was used for people's preferential ranking on fuelwood species. Based on these two methods, farmers assigned score to species used for fuelwood.

2.4 Statistical analysis

The data gathered from field was analysed and tabulated. Estimates of mean, variance and standard error were worked out by referring [16]. The significance test was carried out by referring to the standard 'F' table of [20]. Primary data was collected from field survey to calculate the various quantifiable parameters for the entire study area such as number of households visiting forests for fuelwood, quantity of fuelwood collected, consumption of fuelwood on daily basis, etc. The analysis was also done separately for each village to generate village-specific information.

3. RESULTS AND DISCUSSION

The most important purpose for carrying out a survey is to prepare for action; that is, to collect information needed to improve the rural energy situation, so as to facilitate the development process. Within such a framework, surveys may need to be undertaken for a spectrum of purposes, ranging from the estimation of the magnitude of fuel use, and/or the spatial variation in this use, to the planning of natural resource. These type of survey were carried out by [2], [3], [9].

3.1 General characteristics of respondent household

Household size ranged from 1 to 26 persons and average household member size was found to be 8.16 members. Family size and education status play an important role in planning and proper utilization of fuelwood. According to house holding category, nearly 57.50% belong to the 5-10 household categories, while 20% were in the very large category. The 0-5 category comprised 22.50% (Table 1). In India, the majority of the population lives in the rural areas where fuelwood, crop residues and animal wastes provide most of the energy requirement [5]. These results are on par with [5] and [9]. As per the results, dependency of villagers on agriculture was 80 percent and average land holding was 3.46 acre. The 48.33% proportion of the villagers was holding more than two acre land and 39.17% proportion by 1 to 2 acre land. The results of landholding of respondents were more than other study area in India. [9] have reported that the average land holding size was 2.23 in Uttar Pradesh with 29 per cent occupies less than one acre, 33.2% in 1 to 3 acre land. Similar finding was observed by [8] in Jharkhand where average size of land holding per household was found to be 1.89 ha.

Total literacy and ill-literacy rate of respondent in surveyed villages was 74.17% and 25.83%, respectively. Family size and education status play an important role in planning and proper utilization of fuelwood. Total 108 males respondent were responded to this survey followed by female respondents (12). The low number of female respondent in this category is due to traditional and ritual reason, also surveyed villages headed by male. Rural fuel wood collection by gender is

Table 1: General characteristics of respondent households (N=120)

Sr. No.	Parameter	Number of respondent	Percentage of Respondent
1.	Number of samples		
	Saraini	40	33.33
	Eingui	40	33.33
	Pal	40	33.33
	Total	120	100.0
2.	Household size		
	0 to 5	27	22.50
	5 to 10	69	57.50
	Above 10	24	20.00
	Total	120	100.0
3.	Agricultural landholdings	12	10.00
	<1 acres	47	39.17
	1 to 2 acres	58	48.33
	2> acres	3	2.50
	Landless	120	100.0
	Total		
4.	Occupation		
	Farming/Agriculture	79	65.83
	Farm labour	33	27.50
	Other	8	6.67
	Total	120	100.0
5.	Consumption pattern of energy	112	93.5
	Fuelwood	5	4.0
	Cow dung	3	2.5
	LPG	120	100.0
	Total		
6.	Source of Fuelwood		
	Private land	9	7.50
	Forest area	83	69.17
	JFM site	28	23.33
	Total	120	100.0

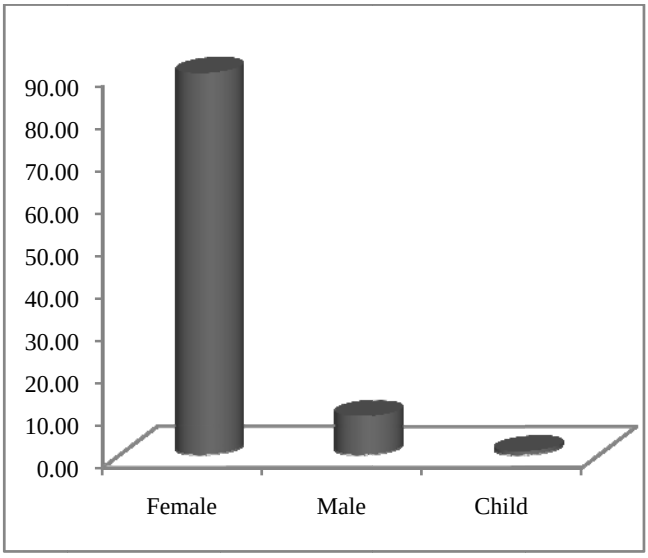

Fig. 2: Gender in fuelwood collection

determined by the purpose of which it is used. Generally, women and children are mainly involved in fuel wood collection for domestic use while men collect wood for sale. In this present study, ninety per cent of females were engaged in fuelwood collection followed by males (9.16%) and children's (0.83). Whereas a larger portion of fuel wood is collected for domestic use by women (Fig 2), it is ironical that most of decisions on wood fuel harvesting are made by men [13]. It is therefore critically important to actively involve women in the decision-making processes and in the management of woodlands and forests [10].

3.2 Fuelwood collection, consumption, dependence and frequency

The use of fuelwood as a primary source of energy for domestic and commercial use is a cause of severe deforestation. The major source of fuelwood is forest and farmland. In the present study, 69.17 % households fulfill their fuelwood requirement completely from forest. Other sources in the study area are JFM sites (23.33%), private agricultural land (7.5%). Among the total respondent, no one was purchasing fuelwood due to its abundance in forest as well as JFM area (Table 1). The results are on par with [2] and [11, 12]. [18] Reported the dependence of fuelwood collection was more than 50 percent in rural India.

The result reveals that 93.5% responded that they cook their food using fuelwood and 5% respondent uses cow dung as primary and subsidiary source for cooking (Table 1). Only 1.5% households had L.P.G. stove. The different biomass energy sources, fuelwood accounts for around 78 percent of the total energy demand, while animal dung and crop residue account for 12 percent and 9 percent, respectively [21]. Also the results of The Household Consumer Expenditure Survey conducted by NSSO in the year 2007-08 in rural India reported that 77% of households in the country depend on fuelwood for cooking, while only 9% on L.P.G. Similarly, 98.8% households cook their food on fuelwood, while only 1.2% had L.P.G. [9].

The finding of survey for period of firewood collection recorded that January-February and November-December were best months to collect fuelwood. The higher percentage of people collects their fuelwood (67.5%) twice a week (Fig 3). Five mode of transport of fuelwood were identified by the respondents in survey. Such as Cycle, tractor, Bullock-carts and bike were comprised of 8.3%, 1.6%, 5.8% and 3.3%, respectively, 80% of respondents use head loads as means of transport. It was the largest category and type of transport of fuelwood among villages (Fig 4). Eighty percent of the respondents said, they collect fuelwood as head loads (Fig 4). These results are concomitant with [14] where he reported that more than 22% respondent collect fuelwood twice a week and 71% transport fuelwood as head load.

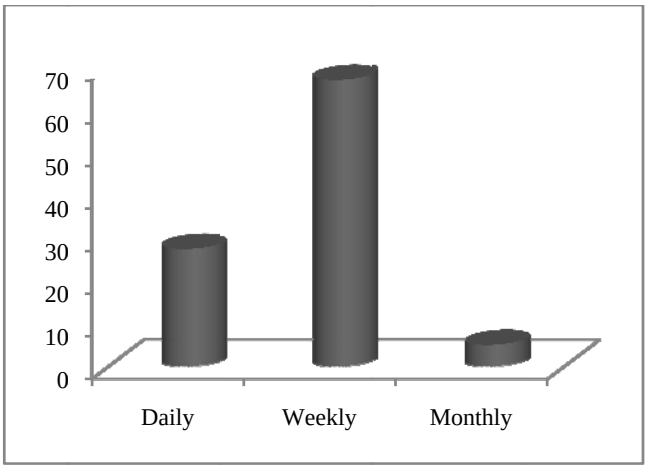

Fig. 3: Frequency of fuelwood collection

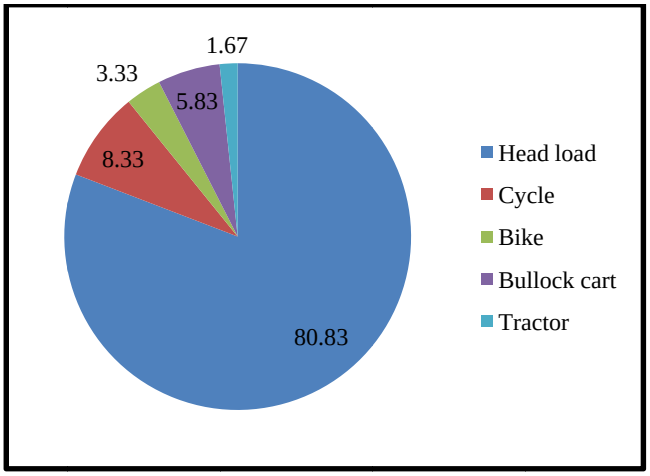

Fig. 4: Different types of fuelwood transportation (%)

3.3 Consumption pattern of fuel energy

Most of the fuelwood in the region is gathered free of charge from the surrounding environment, and thus, the majority of the households collected wood. Out of 120 households surveyed, 93.5% respondent use fuelwood for cooking and 4% respondent uses cow dung as primary and subsidiary source for cooking. Only 2.5% households had L.P.G. stove. No biogas users were found in the survey that has got opportunity for future. Fuel wood in the study area was mainly used for cooking and warming (heating) water during winter (Table 1).

3.4 Preferred fuelwood species and Matrix ranking

Table 2 indicates matrix ranking of preferential fuelwood tree species by farmers of Bundelkhand region. A total of 10 tree species were cited as being known as fuelwood by residents of Saraini, Eingui and Pal villages of Jalaun district of Bundelkhand region. The species were *Acacia senegal*, *Azadirachta indica*, *Acacia leucophloea*, *Acacia nilotica*,

Eucalyptus tereticornis, *Dalbergia sissoo*, *Anogeissus pendula*, *Acacia catechu*, *Leucaena leucocephala* and *Prosopis juliflora* selected based on matrix ranking. The main reasons responsible for fuelwood being preferred by the villagers are due to its easy availability from nearby forest, free commodity, low socio-economic status and lack of alternative source of energy. On completion of the survey including discussions with villagers and personal observations, a total of 10 species were identified as the preferred fuelwood. Most of the fuelwood users indicated that they prefer above mention species based on burning quality, smokeless, heating intensity and slow in burning were outlined for the choice of the species (Fig 5). In the study, Seventy six per cent of respondent preferred *Prosopis juliflora* followed by *Acacia nilotica* (55.83%), *Acacia catechu* (20%) and *Azadirachta indica* (15.83%) due to their qualities and abundant availability. These findings are parallel with [14] where he reported that *Acacia karoo* was preferred by villagers due to its heat intensity (56%), local availability (17%) and lost less (16%).

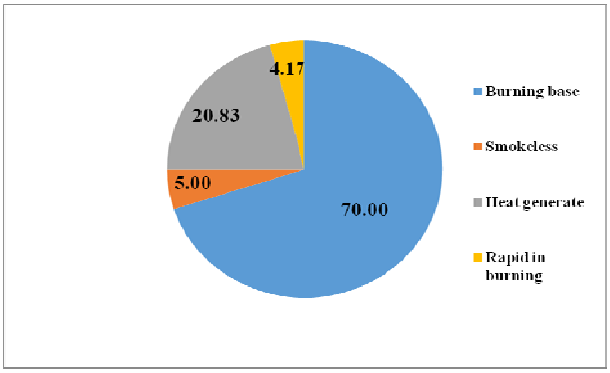

Fig 5: Basis of selection of fuelwood tree species (%)

The principal criteria employed by residents to determine their preferred species was that species possess good fuel characteristics like burn well with good and gradual flame, produces less smoke and also had enough wood hardness and durability of timber [5]. The species were selected based on PRA tools and preferred ranking or frequency reported by [3, 4, 17, 1].

Table 2: Matrix ranking of preferential fuelwood tree species by farmers of Bundelkhand

Species	Preferential frequency	A	B	C	D	E	Total	Rank
Acacia catechu	20.00	5	3	2	3	2	15	3
Acacia senegal	12.50	4	2	2	2	3	13	7
Prosopis juliflora	76.67	4	5	4	4	3	20	1
Acacia leucophloea	12.50	4	2	2	3	2	13	6
Anogeissus pendula	5.83	3	2	1	2	2	10	8
Acacia nilotica	55.83	5	3	3	3	3	17	2
Dalbergia sissoo	9.17	3	1	2	2	1	9	9
Eucalyptus tereticornis	2.50	1	2	0	1	0	4	10
Leucaena leucocephala	13.33	3	5	2	2	2	14	5
Azadirachta indica	15.83	4	3	2	2	3	14	4

(A- Burning base; B- Availability; C- Smoke less; D- Slow burning, E- No Sparking)

4. CONCLUSION

The fuelwood survey revealed that people prefer to use forest fuelwood due to easy availability, free commodity and lack of awareness for alternative energy options. Nearly 70% of the household fulfil their fuelwood requirement completely from forest, of which 90% of females were engaged in fuelwood wood collection for domestic use and the mode of transport is by head loads. Based on preferential ranking, the key informant ranked the following fuelwood species viz. *Prosopis juliflora*, *Acacia nilotica*, *Acacia catechu* and *Acacia senegal*. Based on matrix ranking and survey, *Acacia catechu*, *Acacia senegal*, *Anogeissus pendula* and *Prosopis juliflora* could be desirable fuelwood species. These kinds of studies can be conducted in future combining local preference of fuelwood species with scientific assessment on a large scale will help in identifying the constraints in the particular area. Moreover, many studies have reported the impact of smoke on health of women in villages, so some alternative energy options such as improve Chulas, briquettes, biogas and gasifires should be promoted.

5. ACKNOWLEDGEMENT

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