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Fuelwood Dependence around Protected Areas: A Case of Suhelwa Wildlife Sanctuary, Uttar Pradesh

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ABSTRACT Forests have been very important natural resource for rural livelihood in India providing variety of products and services. In most Indian villages, local people are heavily dependent on forests mainly for fuelwood which is the only dependable energy alternative they have, sometimes it also works as potential cash earning sources for households. This paper examines the nature and extent of fuelwood dependence in the protected area of Suhelwa Wildlife Sanctuary and its buffer area by local people living in nearby villages. In this study, a field survey of 1636 households from 55 villages located within 5 kilometres proximity to forest was conducted for collecting primary data about the basic household's attributes, fuel use pattern, dependency on fuelwood, consumption and collection pattern of fuelwood. Simple descriptive methods are used to analyse the data. The result shows that fuelwood contributes 91.6% of total domestic fuel requirement for cooking in the study area. While comparing various rural energy sources, fuelwood ranked first, followed by dung cakes and crop residues. Similarly the average monthly consumption figures were also high for fuelwood that was 426 kg, 113 kg for animal dung and 69 kg for crop residues while the monthly consumption figure for LPG was found to be 16 kg amongst the LPG users. The mean consumption of fuelwood per capita in the area was 1.8 kg per day while mean consumption per household was 14.2 kg per day. The result shows that fuelwood availability, collection and consumption depend on the family size, distance from forest area, transportation opportunity and economic condition of the household. Nearly 87% of the households fulfil their fuelwood requirement completely from forest while rest procure it from various sources like home gardens, roadside trees, from agricultural farms. After the establishment of the Wildlife Sanctuary local people are facing serious problems in collection of fuelwood from native forests, which has initiated some conflict with the Forest Department.

INTRODUCTION

India has experienced an average annual GDP growth rate of 8.38% in the last five years from 2006 (World Bank 2012). However this impressive growth is accompanied by a complex story of increasing aggregate energy demand and growing need for increasing energy inclusion. If we look at the household expenditure pattern across country, we will find that rural household consumes 277 INR worth of fuel per month while urban household consumes 456 INR per month that accounts for approximately 10% of the overall monthly household expenditure for both rural and urban households (Woodbridge et al. 2011). The major determinants of the energy needs and consumption in rural India are income distribution preferences, private discount rates and micro financing (Ekholm et al. 2010).

The energy use pattern in rural India is changing, with uptake of clean energy, but traditional fuels including fuelwood, crop residue and cow dung still constitute the main source of household cooking energy due to inadequate and unreliable supply of clean energy (Balakrishnan et al. 2004; Das and Srinivasan 2012). 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. Over 7 percent use dung cake and only 9 percent use LPG. However fuelwood is the major source of household's energy for the rural population of India, estimates of current fuelwood consumption vary by a factor of 100 percent for three reasons (Kumar 2000). First, it is difficult to be precise about demand for an item that is mostly collected for subsistence and where substitution occurs. Where fuelwood is easily accessible and the opportunity cost of rural labor is low, fuelwood substitutes for other fuels, leading to higher estimates of needs. Second, it is difficult to assess the direct and indirect impacts

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of causal variables such as product price, prices of substitutes, size and location of user households, price and income elasticity of demand, and likely changes in the causal variable themselves. Third, consumption of fuelwood is highly elastic in supply and varies a great deal with availability.

'Forests' are deemed to be green lung of a nation. Historically, India's rural economy was intimately related to forest resources and they have been part and parcel of our economy, culture and tradition (Bhat 2010). However this relation is now producing a negative impact on the conservation of India's forest resources as the pressure exerted by the human and livestock population is increasing tremendously. The dependency of rural people on forest resources in India ranges from fuelwood for domestic energy requirements to fodder for animals, timber for house construction and agricultural implements and a large number of NTFPs for different uses. Fuelwood collection is one of the most traditional activities which contribute to the forest degradation in the event of people adopting an unsustainable use of forests for these activities (Heltberg et al. 2000; Trossero 2002; Malhotra and Bhattacharya 2010).

Presently, the Protected Area network in India covers an area of 16 million hectare (approx.) encompassing about 4.9% of the geographical area with 102 National Parks, 515 Wildlife Sanctuaries, 48 Conservation Reserves and 4 Community Reserves (Wildlife Institute of India 2012). However, the majority of the Protected Areas in India are located right in the midst of densely populated agricultural landscapes. This coexistence of Protected Areas with high population densities, leads to conflicted people-park relationships (Nagendra 2008).

The people living around the Protected Areas depend upon them for their livelihood in varying degrees. The extraction of forest products like fuelwood and fodder affects wildlife habitat and the ecosystem of the forest. Increasing demand for forest products, driven by demographic and market pressures, often leads to accelerated extraction of forest resources that in turn drives habitat degradation. There is a need for holistic conservation initiatives, to have a clear description of the region in order to understand various socio-economic factors, forest resource production, use and dependence. This sort of an understanding is necessarily region specific and is frequently missing in many conservation initiatives. In order to effectively alter systems, it is first required that they are understood in a specific context (Sumati 2006; Bhattacharya and Joshi 2001).

The Uttar Pradesh Forest Policy (1998) clearly mentions the need to reduce the gap between the demand and supply of forest produce for meeting the needs of fuel, fodder, minor forest produce and timber for rural poor and tribal. The policy puts special emphasis on the plantation of local species in social and agro forestry so as to fulfil the fodder, fuel, small timber, fruits and flowers needs of the local people. It also specifies that for bringing one- third of land area under green cover, all types of degraded and blank areas whether they are forest or non-forestlands should be taken up for extensive plantation with special emphasis on development of fuel and fodder. The policy also specifies that people/ tribals living in and around forests shall be given facility of free collection of *mahua, chiraunji*, honey, wax and fuel used for self use without causing any damage to the forest health in any way. The policy also encourages the use of alternatives of timber for fuel along with stall-feeding to reduce increasing pressure on forest.

Objectives of the Study

This paper is an attempt to document the socio-economic attributes of households' in the villages situated around the Suhelwa Wildlife Sanctuary (SWS) and its buffer zone and their dependency on forest in terms of using fuelwood as energy alternatives based on information gathered from the field study and household survey. The study concentrates on the following objectives -

- Collecting primary information for assessment of forest dependency for fuelwood in the villages situated around Suhelwa Wildlife Sanctuary.
- Analyzing the consumption and collection of fuelwood in the selected villages for estimating the fuelwood requirement in the area.
- Based on the demographic and socioeconomic condition of the villages identifying the alternative options for sustainable fuel wood use.

This information will be useful in designing and implementing appropriate conservation

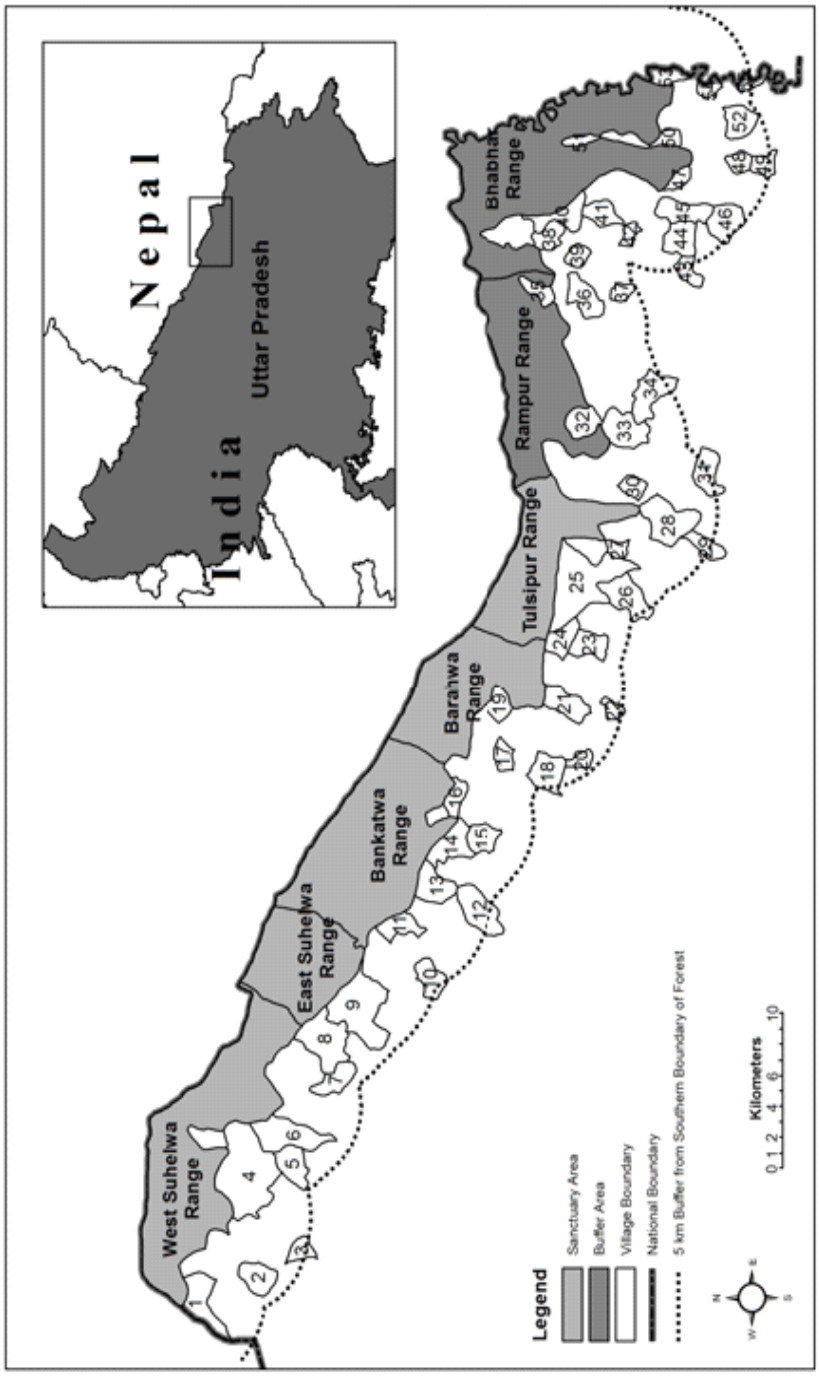

Fig. 1. Study area

strategies in the area by understanding the needs of households, livelihood opportunities, forest dependency and their critical consequences in deforestation and forest degradation process under the particular set of ecological, sociological, economic and political conditions.

MATERIAL AND METHODS

Study Area

Suhelwa Wildlife Sanctuary covers an area of 452.47 sq. km. and lies under the Suhelwa Wildlife Division of Uttar Pradesh Forest Department (Fig. 1). The forest area of the whole division is divided into seven forest ranges. The sanctuary itself comprises of five ranges among which the forest of Tulsipur, Barahwa and Bankatwa range lie under Balrampur district while the forest of East Suhelwa and West Suhelwa lie under Shrawasti district. The forests of two other ranges named as Rampur and Bhabhar range constitutes the buffer zone of the sanctuary also lie under Balrampur district and covers an area of 230.78 sq. km. Geographically these forests are situated between 27°30'1'' N to 27°55'42'' N latitude and 81°55'36''E to 82°48'33'' E longitude with an average width of 6.7 km. The altitude ranges from 120 to 200 m from MSL. The climate is monsoon-type and divisible into three different seasons, viz., rainy (mid June–September), winter (October–February) and summer (March-mid June). The diversified socio-economic structure and connection to the neighbor country Nepal falling all along its Northern boundary is another characteristic of the region. The forest resource is predominantly covered by pure Sal (*Shorea robusta*) forests and Sal mixed forests. Plantations constitute a significant part of the forest landscape, which is reflected in the plantation species such as Teak (*Tectona grandis*) and *Eucalyptus.* The dominant wildlife generally observed in the Sanctuary are deer, wild boar, jackals, and different types of birds. The villages on the southern boundary of the forests form a continuous stretch of rural settlement alongside the sanctuary and its buffer area.

Sampling Procedure and Data Collection

The study was carried out in the villages which are situated within the range of 5 km from the forest boundary of the SWS. Tehsil level administrative atlas maps of Balrampur and Shrawasti districts were used to demarcate the boundary of the forest area. After demarcating the boundary, a five kilometer radius was drawn from the forest boundary to identify the villages located within five kilometer radius. Nearly 147 villages were found to be located within this range. The villages were clustered in three groups according to the range and number of villages it contained. About 40% of the total numbers of villages located within the five kilometer radius were selected randomly from each cluster for the survey. A total of 55 villages were selected for carrying out the survey.

In order to generate primary and area specific information required for the study a questionnaire survey was conducted at the household level. 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. Thirty households from each village were surveyed. A total of 1636 households were surveyed in a total of 55 villages (15% of the total households), during year of Census report 2011. Secondary data was collected from Census of India (primary census abstract, village profile, tehsil level administrative maps) and Forest Department of Suhelwa Wildlife Division (working and management plan).

Data Analysis

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. Simple descriptive methods were used to analyse the data and the results were displayed through tables and charts.

RESULTS AND DISCUSSION

General Characteristics of Respondent Household

To understand the contribution of fuelwood, understanding the socio-economic condition of local people was crucial for the study and which

Table 1 General characteristics of respondent households (n=1636)

Parameter	*Number of respondents*	*Percentage of respondents*	*Mean/ Mode*
Type of Housing			
Kutcha	642	39.2	
Pucca	428	26.2	*Kutcha*
Kutcha /Pucca both	566	34.6	
Total	1636	100.0	
Household Size			
1-5	525	32.1	8
6-10	795	48.6	
11-15	210	12.8	
16-20	67	4.1	
More than 20	39	2.4	
Total	1636	100.0	
Agricultural Landholdings			
No agricultural land	286	17.5	2.23
Less than1 acre	478	29.2	acres
1 to less than 3 acres	543	33.2	
3 to less than 6 acres	200	12.2	
6 to less than 9 acres	64	3.91	
More than 9 acres	65	3.97	
Total	1636	100.0	
Occupation			
Agriculture/Labor			
Agriculture	298	18.2	
Labor	300	18.3	
Agriculture / Labor	978	59.8	
Agriculture / Others	31	1.9	
Others	29	1.8	
Total	1636	100.0	
Household Electrification			Not
electrified			
Electrified	88	5.4	
Not electrified	1548	94.6	
Total	1636	100.0	
Type of Energy Consumption Unit			*Kutcha chulha*
Kutcha chulha	1616	98.8	
LPG	8	0.5	
Kutcha chulha / LPG both	12	0.7	
Total	1636	100.0	

was taken up in the beginning of the study. The general household characteristics of the respondents in the survey are presented in Table 1. The result shows that majority of the households survive on agriculture and allied activities. About 18.2% households were completely dependent upon agriculture while 61.7% were also engaged in labor and other activities along with agriculture. If we compare this 79.9% fraction of households with 62% of rural households across India engaged in agriculture reported by Woodbridge et al. (2011), it clearly reveals the livelihood importance of agriculture in the area.

It was observed that 39.2% of the rural households lived in *kutcha*[1] houses, while only 26.2% of them had complete *pucca*[2] houses. There were total 34.6% households who lived in partially *kutcha* and partially *pucca* houses due to some economical regions.

The mean household size in the area is 8 persons per household which shows a relatively larger size as compared to 6.4 persons for the whole state and 5.3 persons for the whole country (Census of India 2011). About 48.6% of the respondents have a household size that ranged between 6-10 persons. The reason behind their larger families is supported by the fact that large families have an economic impact because of the need for labor for farm activities. The higher the number of household members, the more labor input can be used to advantage in farming and other activities like fuelwood collection.

The agrarian structure of the households shows that the mean size of agricultural landholding in the area is 2.23 acres. However there is significant difference in the agrarian structure of the households. A total of 17.5 % respondents acclaimed that they had no piece of agricultural land of their own. While 29.2 % of households had agricultural land less than 1 acre. Largest proportion of the respondents had agricultural land size ranged between 1 to less than 3 acres. The Table 1 shows the variant distribution of the agricultural landholdings among the households.

Forty- seven out of fifty- five sampled villages were found to be electrified. However only 5.4% of total households were electrified and 94.6% households had no electricity connection to their house.

Out of 1636 households surveyed, 98.8% responded that they cook their food on *kutcha chulha*. Only 1.2% households had LPG stove. However among these LPG stove owner 0.7% also used *kutcha chulha* for cooking. No biogas users were found in the survey that is one area from the study, has got opportunity for future. The reason behind this large proportion of *kutcha chulha* users in the area is the cheapness and easy accessibility of fuelwood and non availability of any cost effective and readily accessible alternative. Therefore, any strategy for the development of the region necessarily will need to focus to change this situation.

Fuel-use Pattern and Dependency upon Fuelwood

The proportion of different types of fuel used by households in a month is presented in the Figure 2. It shows that in the study area fuelwood is meeting more than 91% of the total fuel requirement which reflects very high dependency on fuelwood. In actual volumes, fuelwood ranked first, followed by dung cake and crop residue. The monthly consumption of fuelwood, dung cake and crop residues were observed to be 426 kg, 113 kg and 69 kg respectively while the LPG usage was observed to be the minimum, with a value of 16 kg per month (Fig. 3). All India average of fuelwood consumption in rural areas as per Centre for Development Finance (CDF) (source: www.householdenergy.in) comes to be 121.19 kg per month which shows that the fuelwood consumption in the study area is quite high.

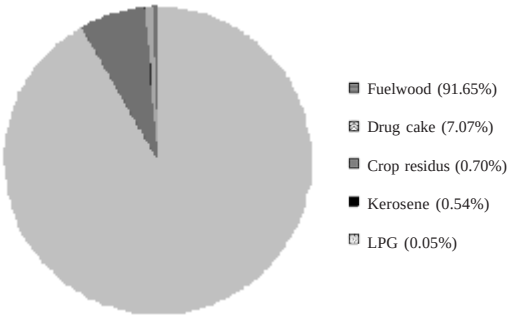

Fig. 2. Proportion of different type of fuels by weight used monthly

Out of the number of households responded for using different type of fuels. About 98.5% of households admitted that they use fuelwood as source of cooking fuel (Table 2) that is quite high as compared to 77% reported by NSSO (2007-08) and recently reported 64% for the whole country (Das and Srinivasan 2012). This proportion also includes the households using other fuel substitutes in addition to fuelwood, the same holds for other fuels. Kerosene was primarily used as lighting material by almost each household in the area (99.5%) which is procured from the nearby ration shop on monthly basis. According to Centre for Development Finance, the proportion of rural households using kerosene is 79.9% in UP state and 89.5% across country. Proportion of households using cow dung and LPG was 28.5% and 1.5% respectively in the study area. Use of LPG as cooking fuel was found to be restricted to only the high income households. The reason behind this behavior is the same as defined by Reddy and Nathan (2012) that the high income households have a greater choice in selecting an energy carrier and to opt for cleaner, comfortable and more efficient modern energy carriers like LPG. In a study conducted in Orissa it was found that 98.2% of the households surveyed use fuelwood for cooking, either as a single energy source or in combination with other traditional and modern fuel type and over 90% of the sampled households use kerosene for lighting (Mishra 2008).

The minimum fuelwood consumption was found to be 90 kg, which was in case where the household size was very small and other fuel alternative such as dung cakes and crop residues were also used. There were also some cases where the measured fuelwood consumption by households was very high ranging from 800 kg to 2550 kg, as some data collected in initial phase of the survey includes the amount consumed in winter season that is, for cooking and space heating both. Table 3 shows the descriptive statistics of different type of fuels used by the households.

Table 2: Type of fuels and percentage of households using them

Fuel type	*Number of households*	*Percentage of households*
Fuelwood	1612	98.5
Dung cake	467	28.5
LPG	24	1.5
Agricultural residue	37	2.3
Kerosene	1628	99.5

Table 3: Descriptive statistics of different type of fuels used by households

Fuel type	*Mean consumption (Kg/HH/month)*	*Standard deviation*	*Min*	*Max*
Fuelwood	426	278	90	2550*
Dung cake	113	41	30	300
LPG	16	9	4	32
Crop residue	69	22	30	120
Kerosene	4.1 Litre	1.5	2	8

* The amount shows consumption in winter season

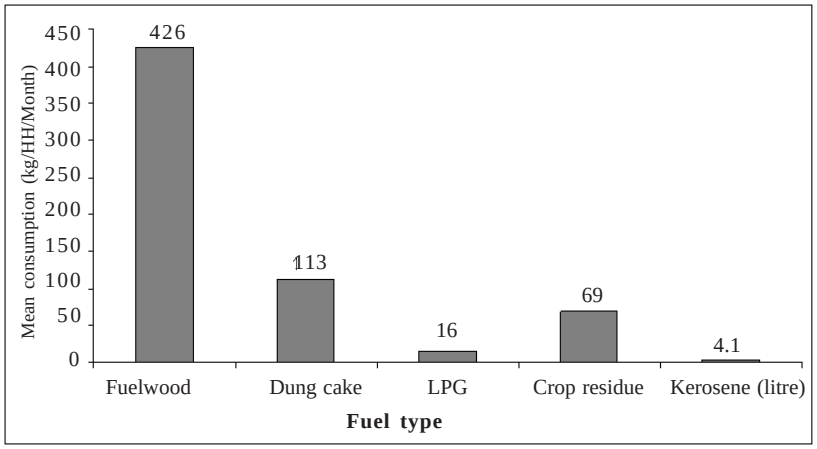

Fig. 3. Mean consumption of different type of fuels

Consumption and Collection Pattern of Fuelwood

It was estimated that the daily consumption of fuelwood is 1.8 kg per capita while at household level it is 14.2 kg. The household level consumption is quite similar to the consumption level in low altitude areas of Uttarakhand, that is, 13 kg per day (Sati and Song 2012). Dhyani et al. (2011) reported it to be 35 kg per 2-3 days in Kedarnath Wildlife Sanctuary, Uttarakhand. In the study of Bhattacharya and Joshi (2001), in the Eastern Himalayan area of North Bengal, the per household fuelwood consumption in average five-member household was found to be 11-13 kg/day. Another study in rural areas of Garhwal Himalayas presented the per capita fuelwood consumption for cooking ranging from 1.13 to 1.82 kg per day depending upon the altitudinal difference of the region (Kumar and Sharma 2009). As for the frequency of visits to the forest for fuelwood collection, the findings of the analysis show that proportion of respondents visiting the forest was highest for 10 to 20 days in a month (60 %) while 15 % of the respondents admitted that they go to forest for more than 20 days in a month (Table 4). However this frequency of forest visits varies seasonally. The reason for this increment in winter consumption is the heating requirement of households in addition to the cooking purpose. However in rainy days most of the villagers don't go for fuelwood collection. This is the reason for comparatively more forest visits in summers, as the villagers need to store fuelwood for the next season. The number of visits also varies according to the farming activities. As the family members totally involve in the labor requirement in the farming activity, they prefer major fuelwood collection before their active farming activity, so that they save quality time require for agricultural activity.

Table 4: Percentage distributions of respondents according to the number of days they go to forest for fuelwood collection

	<10 Days in a month	*10-20 Days in a month*	*>20 Days in a month*	*Total*
%Respondents	23.6	60.7	15.7	100

Fuelwood collected per trip by the households was found to be average 35 kg. However the proportion of households was highest for 30 to 60 kg (53.8%). There were nearly 8% of the respondents who collected fuelwood more than 60 kg in a single trip (Table 5). The amount of fuelwood collected per trip depends upon the

Table 5: Percentage distribution of households according to amount of fuelwood collected in a single trip

	<30 kg	*30-60 kg*	*60-90 kg*	*>90 kg*	*Total*
%Respondents	38.2	53.8	6	2	100

age and number of family members going for collection.

Sources of Fuelwood

Normally in rural areas local people try to meet fuelwood demand from all available sources like agriculture field, forest, pasture land, roadside plantations and open fallow land etc. The major source of fuelwood was forest in the area. Nearly 87% households fulfill their fuelwood requirement completely from forest which is very high as compared to 50% household dependence in Orissa (Mahapatra and Mitchell 1999). Other sources in the study area are home gardens (4%), agricultural and community wastelands (6%). Only 3% households purchase fuelwood but some of them also collects it from forest. In a fuelwood study in North-West Bengal, around 84% of the rural households were found to collect fuelwood directly from the State forests, 11% from home gardens, 1% from community wastelands and rest from other sources (Bhattacharya and Joshi 2001). This dependency upon forest for fuelwood creates pressure additive to other causes of forest degradation (Fig. 4).

Reasons for Preferring Fuelwood

The survey revealed that there are four major factors that are responsible for fuelwood being favoured in the area:

1. Easy availability of fuelwood from the nearby forest
2. Almost free commodity
3. Lack of other alternative energy options
4. Resistance towards adopting new energy options/remain with traditional energy options

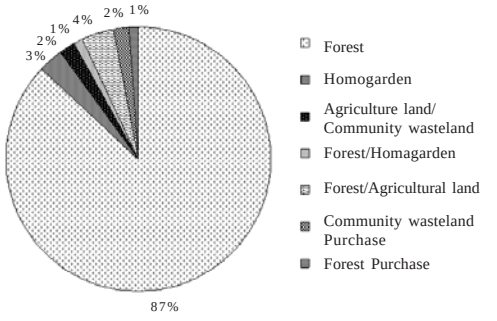

Fig. 4. Percentage distribution of households by the sources of fuelwood

The proportion of households responded in favor of these reasons are given in Table 6 which supports the statement that when there is access to forest stock, people prefers to use forest fuelwood. Even in case of increasing forest scarcity and higher collection time the collection does not stop (Heltberg et al. 2000).

Table 6: Reasons for preferring fuelwood (percentage of respondents)

Reasons for preferring fuelwood	*% Respondents*
Easy availability of fuelwood from the nearby forest	64.8
Almost free commodity	20.5
Lack of alternative energy options	12.0
Resistance towards adopting new energy options/remain with traditional energy options	2.7
Total	100

CONCLUSION

There has been always conflict between protected area management and the local people dependent upon the forest resources of protected areas and it is an unresolved issue in the protection of forest biodiversity. Since fuelwood plays a significant role in these conflicts and the problem is location specific, local or village level studies seems to be most ideal in this context. This paper has examined the fuelwood dependency of local people on the forest resources of Suhelwa Wildlife Sanctuary, India. The analysis shows that the villagers depend heavily on forest for their fuelwood requirement. This is so because the rural households are resource constrained and availability of other cheaper alternatives to fuelwood is poor. This situation creates an additional pressure on the forest of the sanctuary. The local people are allowed to collect twigs and branches from the forest floor and also some extent to extract dry branches of fuelwood and carry on head loads for domestic consumption by permission of the Forest Department. But as they collect in excess in a destructive way and also cut the green and major branches of the trees, whenever seen by forest staffs such activities are abandoned by them. This creates conflicts in the villagers' mind.

RECOMMENDATIONS

Rural development policies and intervention of private institution in forest areas that address the developmental issues and provide cheaper and clean alternatives to fuelwood will reduce the forest dependency of local people and thus the pressure on the forest resource enhancing the success of maintaining and protecting the forest biodiversity.

Social forestry programmes should be extended to reserved and protected forest lands by changing the nature of species from teak, eucalyptus and pine to usufruct and fuelwood species with more twigs and branching such as *Prosopis* and *Acacia*. These should be supplemented with shrubs and bushes to yield fuelwood and fodder, which could satisfy the needs of the poor. Plantation outside forests such as in community wastelands, marginal farmlands, and other vacant lands should be done to increase the production of fuelwood, fodder and small timber in rural areas.

Participation of local people in management of the protected area should be promoted by developing participatory management plan of the sanctuary and addressing such demand and supply. The existing joint forest management programmes should be revived and their efforts directed towards tackling the fuelwood problem in the area. Joint management of existing forests, planting of fuelwood trees on non-forest areas and promotion of other fuels/energy sources appear to be alternative options for protecting the forests and meeting the household and commercial energy needs.

There is also a need to look at current schemes of the Central and state government as well as aided projects like Japanese International Cooperation Agency (JICA) in Uttar Pradesh, which have specific mention on rural energy requirement and particularly how the state is going to address these schemes.

Technological initiatives including the fuel-efficient improved *chulhas*, solar energy, biogas should be promoted in the area. The government of India has launched Integrated Rural Energy Programmes (IREP) since 1987. These programs should be more emphasized in fuelwood-forest hot spot areas such as protected areas.

Distribution of better improved *chulhas* under REDD^{+} (Reducing Emissions from Deforestation and Forest Degradation Plus) project from MoEF may be started under REDD readiness program of India in the sanctuary areas.

There are some institutional and financial constraints which need to be understood and removed for proper implementation of these programs by state governments. There is need for more studies based on fuelwood consumption and production with statistically sound principles in protected areas. Model based approach can be more beneficial to understand the factors influencing the fuelwood and forest relationship.

NOTES

1. The walls and/or roof of which are made of material such as un-burnt bricks, bamboos, mud, grass, reeds, thatch, loosely packed stones, etc. are treated as kutcha house.
2. A pucca house is one, which has walls and roof made of the following material. Wall material: Burnt bricks, stones (packed with lime or cement), cement concrete, timber, ekra etc. Roof Material: Tiles, GCI (Galvanised Corrugated Iron) sheets, asbestos cement sheet, RBC, (Reinforced Brick Concrete), RCC (Reinforced Cement Concrete) and timber etc. (Ministry of Statistics and Programme Implementation)

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