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ECONOMIC SUSTAINABILITY FROM FUEL WOOD AND PATTERN OF RURAL ENERGY CONSUMPTION IN MADHYA PRADESH

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This study deals with the economic sustainability from fuel wood and the pattern of rural energy consumption in Madhya Pradesh. This study is based on the survey conducted in the two tribal dominant districts Jhabua and Mandla. These two districts were selected for the study because of the forest cover and status of water availability. Mandla district was selected because of good forest cover and Jhabua district as low forest cover. 10 villages were surveyed in both districts, covering 100 households. The objective of the study is to study the factors influencing the rural energy consumption. Secondly, to assess the collection and extraction of wood from the forest and consumption pattern of the fuel wood. Thirdly, to assess the economic sustainability of fuel wood in the rural area. Fourthly, to assess the impact of seasonal variation on consumption of fuel wood; and to find out the rate of extraction and depletion of forest cover and fuel wood trade trend in the study area. lastly, this paper attempts Identification and tackling down the issues hindering in the sustainability of fuel wood as rural energy base. At last, it is suggested in the paper that how identified issue pertaining to economic sustainability could be tackled down and recommends that how the extraction of fuel wood or wood bio-mass is affecting the depleting forest cover and its impact on natural resources. Further, this study recommends the alternative low cost fuel for the rural area to conserve the natural resource.

Keywords: *Sustainability, fuel-wood trade, rural energy, production, consumption.*

INTRODUCTION

In most rural areas, wood is the chief domestic fuel and is important for a large range of industries. The rural energy problem in the third world is concerned essentially with the maintenance and improvement of the energy whilst finding the extra energy needed for development. The supply has to be adequate not only in quantity but also in the several different forms required. Most research on the question of rural energy has

concentrated on drier lands where fuel wood supply problems have been identified and associated with desertification (Digernes 1977 & 1978), Earl (1975) has even argued that economic process is governed by energy laws.

In the third world the overwhelming majority of poor people live in the rural areas, the high rate of population growth, rising price of alternative fuels and difficulties of supply, together with major problems of developing and applying new energy technologies suggest rather that wood consumption will increase. Their preference for local fuels, whatever their inconvenience in use, is a reflection not just of the greater accessibility and after greater reliability of local fuel supply, but of their poverty. Rural fuel production, distribution and sale have become in large part an industry of poor, providing many those, whose living from agriculture is meagre or inadequate with a valuable supplementary income.

Fuel wood is derived mainly from forest and the key to its production lies in forest policy and management Earl describes Fuel wood as "forest energy" and refers to the "forest capital stock" and "forest productivity". A section of his book on "forest energy and economic development" is devoted to so-called natural forest types and uses a map of forest types to make an estimate of the renewal and removal of energy stored in the Worlds forest resource (Earl, 1975). The FAO report on food and agriculture for 1976 also refers to the cutting of wood from the worlds " Forests" and use of half of it as fuel wood (FAO,1977a).

Moss & Morgan (1991) find out the difficulties involved in supply because of a diminishing resources and how the costs of alternative fuels are rising in relation to its demand and also suggest the strategy required for the problem arise. Whereas (Islam *et al.,* 1984) in their edited version, focused about the problems of social and economic development of the less developed countries that the attention must be accorded to the rural areas, regarding the availability of fuels for cooking and heating can be improved. Such improvements, however, will require the injection of increased quantities of energy into the rural system.

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How can these increased demands for energy best be met? Will rural areas, like the urban ones, become increasingly dependent upon fossil fuels, which for the most part must be obtained from distant sources? or is sufficient energy available through the intelligent development and management of indigenous energy sources to fill gap? and further develops a new set of priorities for energy and rural development research and an integrated set of methods for strengthening rural people's participation in energy programme development. (Agrawal, 1980) focuses towards the wealth of information regarding the complexities of fuel consumption patterns, fuel supply potentials and their implications for rural futures (Bajracharya, 1984), in his study Action research in Nepal suggests the diffusion of technologies in Rural areas and assess the role of innovation. Besides (Morse al 1984) finds out the indicators for analysing rural energy needs and potential, viz need indicator, value indicator, diagnostic indicator and also estimated cooking fuel requirements and efficiencies, such as Fuel/food weight ratio (Agrawal 1981, Siwatibau 1978) in their reports find out the indicative fuel to food ratios.

Munslow, Katerere (1988) focuses on a new approach to the problem of wood fuel energy and development both within and outside of SADCC region and find out the best way to ensure future wood fuel supplies and simultaneously to prevent environmental degradation and improve the management of woody bio-mass within existing production systems based upon the innovations and responses already occurring among small holder farmer where as (Bajracharya, 1985) in his paper highlights about the balance by incorporating the perspectives not only of central Planners but also of the underprivileged rural population. Moreover he emphasis how rural energy planning paves the way of development in Asia and discusses the relationship between forest energy resources and human subsistence and development and how the fuelwood management can be utilised so as to obtain the future development. (Leach & Mearns, 1988) attempts in their book "literature of hope rather than of despair by presenting challenges and it approaches them from the narrower perspective of energy and the so-called wood fuel" crisis of Africa and other parts of the Third World.

Sharma (1992) compiled the various data on cost structure for the development of man-made forestry/fuelwood plantations. An exercise has been made to calculate the cost of per sapling raised at the nurseries. The cost-benefit ratios have been worked out for the fuelwood species under different climatic regions of India, and emphasis has been given on some of the alternative suggestions to deal with the problems of fuelwood scarcity and raising the plantations on wasteland tracts in the country.

Alam *et al*., (1984) examines some of the important questions relating to urban fuelwood use in one particular setting of Hyderabad city and also focuses on the methodology used in the study, and how the wood fuel substitution is taking place by other alternate fuel like LPG, Kerosene oil, Electric Heater etc. (Bhattacharya, 1998) in his interim report suggests how the villagers are struggling for their survival strategies in the Baikunthpur Forest Range of Siliguri Division of North Bengal and further discusses about the trade of wood fuel in Siliguri Market.

Although enough work has been done on rural energy, yet a detailed comprehensive analysis is required to understand the factors which influences the rural energy consumption, such as economic, social, and Technical factors, but also agricultural and environmental conditions, which must all be taken into consideration, when supply and demand analysis is required.

OBJECTIVES OF THE STUDY

- To study the factors influencing the rural energy consumption.
- To assess the collection and extraction of wood from the forest and consumption pattern of the fuel wood.
- To assess the economic sustainability of fuel wood in the rural area.
- To assess the impact of seasonal variation on consumption of fuel wood.
- To find out the rate of extraction and depletion of forest cover and fuel wood trade trend in the study area.
- Identification and tackling down the issues hindering in the sustainability of fuel wood as rural energy base.

METHODOLOGY

Two Tribal dominant districts Jhabua and Mandla were selected for the study. 10 JFMCs and Forest villages were covered from the districts. Primary data was collected through interviewing 100 households with structured questionnaire. Secondary data was collected from the district H.Q and From the MP Forest department, population census etc.

ANALYSIS OF RESEARCH FINDINGS

Economic Sustainability from Fuel Wood

The forest energy resources include all woody plants that provide fuel. Eight categories may be defined : fuel forests, timber forests, shelter forests, Sparse woods, Shrub areas, economic forests (Excluding timber) Homestead gardens and orchards. Three parts of the tree can be used as fuel ; the branches, top of the trunk, and bark of the main trunk. The quantity of fuel wood obtained from each tree depends on its variety. In general, broadleaf trees have more branches and therefore yield more fuel wood than coniferous trees. bark is 10% of the trunk in weight . The top part of the main trunk is 5% of the entire weight above ground when a standing forest is cut, a number of young plants, and equivalent to 30% of the accumulated total are left behind. Waste material from timber processing amounts to 50% when all these are properly accumulated, up to 60% of the total tree can be used as fuel.

Fuelwood consists mainly of carbon and oxygen, with a variable proportion of moisture. Most species will burn, but vary in their qualities such as calorific value, tendency to spark, tendency to smoke and effectiveness as different forms of processed fuel or in different kinds of stove. Species also vary in the ease with which they may be cut and handled and in the efficiency with which they may be converted into charcoal or wood chips or used to produce methyl alcohol, gas or electricity. There are therefore preferred fuelwood species, particularly in the commercial supply to the towns. (Moss and Morgan, 1981)

The Calorific Values of Various Fuels are as Follows

Fuel	*Calorific Values*
Kerosene	10.4
Oven-dry wood	4.7
Air-dry dung	4.0
Air-dry wood (25-30%) moisture content	3.5

Data quoted in Earl 1975, 22.

The calorific values as quoted by (Earl, 1975) *air-dry wood (25-30%) moisture content* is used in the study area of Jhabua and Mandla district of Madhya Pradesh. The year wise production of Timber and fuelwood in Madhya Pradesh has specific relevance in context of Forest productivity and level of extraction form forest. Table 1 shows the year wise timber and fuelwood production and comparison. It is clear from the table that In the year of 1958-59 the timber production was 926.68 (30.99%) thousand cubic meter while the production of fuelwood was 2063(69.01) thousand cubic meters. The

highest contribution of fuelwood in total production as per cent was recorded 74.65% in 1978-79. While highest contribution of timber in total production as per cent was recorded 49.11% in 1994-95.

Table 1
Year Wise Timber and Fuel wood Production and Comparison

(In thousand CUM)

Year	*LOGS TIMBER (CUM)*	*FUEL WOOD (CUM)*	*TOTAL PRODUCTION (CUM)*	*% TIMBER*	*% FUEL*
1958-59	926.68	2063.73	2990.38	30.99	69.01
1959-60	1132.49	2404.50	3536.99	32.02	67.98
1960-61	1163.47	2923.10	4086.57	28.47	71.53
1961-62	984.05	2360.70	3344.75	29.42	70.58
1962-63	1163.7	3171.40	4335.10	26.84	73.16
1963-64	1678.44	3448.10	5126.54	32.74	67.26
1964-65	1542.95	2478.00	4020.95	38.37	61.63
1965-66	1637.26	3270.10	4907.36	33.36	66.64
1966-67	2296.5	3280.40	556.9	41.18	58.82
1967-68	2616.37	3632.20	6249.57	41.86	58.12
1968-69	2108.21	3382.13	6490.34	32.48	52.11
1969-70	2210.12	2871.41	5081.53	43.49	56.51
1970-71	1502.35	1664.80	3167.15	47.44	52.56
1971-72	1913.18	1475.96	3389.14	56.45	43.55
1972-73	1556.00	2162.00	3718.00	41.85	58.15
1973-74	666.22	1020.27	1686.49	39.50	60.50
1974-75	799.71	1460.74	2260.45	35.38	64.62
1975-76	811.2	1437.00	2248.20	36.08	63.92
1976-77	822.39	1413.37	2235.76	36.78	63.22
1977-78	1085.49	2289.12	3374.61	32.17	67.83
1978-79	1381.44	4067.3	5448.74	25.35	74.65
1979-80	1597.02	3782.93	5379.95	29.68	70.32
1980-81	1690.00	4000.00	5690.00	29.70	70.30
1981-82	1091.75	2260.11	3351.86	32.57	67.43
1982-83	1127.49	1726.78	2854.27	39.50	60.50
1983-84	1129.59	1814.45	2944.04	38.37	61.63
1984-85	944.31	2028.64	2972.95	31.76	68.24
1985-86	970.00	2100.00	3070.00	31.60	68.40
1986-87	823.00	1417.00	2240.00	36.74	63.26
1987-88	681.993	1029.082	1711.075	39.86	60.14
1988-89	662.584	1129.362	1791.896	36.98	63.03
1989-90	730.756	1017.711	1748.467	41.79	58.21
1990-91	685.114	971.683	1656.797	41.35	58.65
1991-92	732.035	990.945	1722.980	42.49	57.51
1992-93	569.179	784.547	1353.925	42.04	57.95
1993-94	513.338	617.749	1131.087	45.38	54.62
1994-95	609.245	631.420	1240.663	49.11	50.89

Ref: MPFD Note: Over the years percentage of timber production has increased, while fuelwood has decreased.

Table 2, furnishes the information of types of fuel used in the rural areas. The maximum percentage of households are using fuel wood in all the selected VFCs/ FPCs in the study area of Jhabua and Mandla districts. Where as, the combination of cow dung as fuel used was only found in Madhya Pradesh . It could be conclude from the table that 100% of the respondents were using wood as fuel before JFM. After JFM the number of households using wood as fuel has reduced by 2% in the study area. Where as other fuels used in the second priority were cow dung cakes , agricultural residue, kerosene oil Bio-gas and other stoves like improved stoves (chullah). The details of the fuel used as fuel in the selected area of Jhabua and Mandla district of Madhya is shown in Table 2.

Table 2
Types of Fuel Used in Rural Areas

	Jhabua			*Mandla*			*Total*		
Types of Fuel used in study area by the households	*Before JFM*	*After JFM*	*Changes*	*Before JFM*	*After JFM*	*Changes*	*Before JFM*	*After JFM*	*Changes*
Fuel wood	50	49	-1	50	49	-1	100	98	-2
Cow dung cakes	10	12	+2	3	4	+1	13	16	+4
Agricultural residue	2	3	+1	2	4	+2	4	7	+3
Kerosene oil	1	3	+2	2	5	+3	3	8	+5
Bio-gas	1	2	+1	1	2	+1	2	4	+2
Improved Stoves (chullah)	-	1	+1	-	1	+1	-	2	+2

Source: Survey.

Table 3 ,reveals the attributes related to collection of wood fuel in the study area of Jhabua and Mandla district of Madhya Pradesh.

Before JFM

(i) The people's were travelling 1.3 and 0.800 Km. to collect wood fuel in Jhabua and Mandla district respectively.

(ii) All households 100% were collecting wood fuel.

(iii) 37 & 40 males; and 145 and 158 females were collecting wood fuel. The tips per week were 3.0 and 3.5 in Jhabua and Mandla district respectively.

(iv) The spent for the collection of wood fuel was 4 and 2.0 hours in Jhabua and Mandla district respectively.

(v) The quantity of wood fuel brought was 18 and 20 kg. in Jhabua and Mandla district respectively.

(vi) The weekly collection of wood fuel was 0.54 & 0.70 quintals in Jhabua and Mandla district respectively.

(vii) The average collection of wood fuel was 28.0 and 36.4 quintals per households in Jhabua and Mandla district respectively.

(viii) The average collection of wood fuel for all households was 1350.0 and 1820.0 quintals in Jhabua and Mandla district respectively.

After JFM

(i) The distance travelled by people has increased to 1.5 and 0.900 Km. to collect wood fuel in Jhabua and Mandla district respectively.

(ii) The total per cent of households collecting wood fuel has reduced by 2 %.

(iii) The number of peoples collecting wood fuel has decreased to 30 & 35 males; and 128 and 132 females related to collection of wood fuel. The trips per week have increased to 3.3 and 4.0 in Jhabua and Mandla district respectively.

(iv) The spent for the collection of wood fuel has increased to 4.5 and 2.5 hours in Jhabua and Mandla district respectively.

(v) The quantity of wood fuel brought by the households has increased to 21 and 23 kg. in Jhabua and Mandla district respectively.

(vi) The weekly collection of wood fuel has increased to be 0.69 & 0.92 quintals in Jhabua and Mandla district respectively.

(vii) The average collection of wood fuel has increased to 33.81 and 45.08 quintals per household in Jhabua and Mandla district respectively.

(viii) The average collection of wood fuel for 98% of household has increased to 1690.0 and 2208.92 quintals in Jhabua and Mandla district respectively

(ix) It could be concluded on the basis of Table that there has been a change in distance travelled by the peoples' in + 0.300 Km. While 2% of the households has been reduced in context of wood fuel collection. The gender participation in collection of wood fuel has decreased to 12 males and 43 females due other activities in the selected VFCs/ FPCs of Jhabua and Mandla district of Madhya Pradesh. The weekly trips made by the peoples has increased in the study area by 0.8 per week. While the yearly trips has increased by 42 trips to collect wood fuel from forest. The time consumed in collection of wood fuel has increased by one hour. The quantity brought by the peoples has increased by 6 kgs. The weekly collection of wood fuel by household has increased by 0.46 kgs. While the average collection of wood fuel has increased by 15.49 quintals in the study area. The average collection of wood fuel in a year by the sample households has increased to 729.42 quintals in the study area. The increase in collection of wood fuel per household also indicates the level of extraction of wood fuel from the forest and if estimated at the market price the annual extraction of wood fuel per household could be assessed in money value.

Table 4, shows the mode of bringing wood fuel in the study area. It is evident from the table that 61% of the household brings wood fuel as head load, followed by cycle 16.5%; Shoulder load 11%; bullock cart 9% and on animal 2.5 respectively in the study area of Jhabua and Mandla district respectively.

Table 5, gives the information about the extracted wood fuel by the household in a year from the forest in Rs, if estimated at the base year price of the local market. It could be concluded from the table that the wood fuel extracted before JFM was Rs 1.350 and 1.82 lakhs in Jhabua and Mandla district of Madhya Pradesh. While the per household earning if estimated was Rs 0.027 and 0.0364 lakh in Jhabua and Mandla district of Madhya Pradesh respectively.

Table 3
Fuel Wood Collection by the Households

	Jhabua			*Mandla*			*Total*		
Attributes	*Before JFM*	*After JFM*	*Changes*	*Before JFM*	*After JFM*	*Changes*	*Before JFM*	*After JFM*	*Changes*
Distance from forest (in Km)Average Distance	1.3	1.5	+.2	.800	.900	+.100	2.1	2.4	+.3
Number of households collecting wood fuel	50	49	-1	50	49	-1	100	98	+2
No. of Family members Going to collect Wood fuel Male	37	30	-7	40	35	-5	77	65	-12
Female	145	128	-17	158	132	-26	303	260	-43
Number of weekly trips	3.0	3.3	+.8	3.5	4	+1	6.5	7.3	+0.8
Number of yearly trips	156	172	+16	182	208	+26	338	380	+42
Average time spent per household in collection (in Hrs)	4.0	4.5	+.5	2	2.5	+.5	6.0	7.0	+1
Quantity of fuel wood brought per trip by household (in Kgs)	18	21	+3	20	23	+ 3	38	44	+6
Weekly collection of Wood fuel by household (in quintals)	0.54	0.69	+0.15	.70	0.92	+0.22	1.24	1.61	+0.46
Average collection of fuel wood per household annually (in Quintals)	27.0	33.81	+6.81	36.4	45.08	+8.68	63.4	78.89	+15.49
Average collection of fuel wood by sample households annually (in Quintals)	1350.0	1690.5	+340.5	1820.0	2208.92	+388.92	3170.0	3899.42	+729.42

Source: Survey

Table 4
Mode of Bringing Wood Fuel in the Study Area

Attributes	*Jhabua*	*Mandla*	*Average %*
Mode bringing fuel wood (in Per cent)			
Head load	60.0	62.0	61
Bullock cart	12.0	6.0	9
Cycle	15.0	18.0	16.5
Shoulder load	10.0	12.0	11
On animals	3.0	2.0	2.5
Total	100	100	100

Source: Survey.

After JFM, the households earning has increased by Rs. 0.3405 and 0.3888 lakh in the study area of Jhabua and Mandla district of Madhya Pradesh. The overall estimation of income has increased by 17.5% .While the per capita income estimated from the removal of wood fuel removal from forest has increased to Rs. 0.0345 and 0.0450 lakh Rs. in Jhabua and Mandla district of Madhya Pradesh. The per capita income has increased overall by 20.2%. The estimation of income from the extraction of wood fuel is free to the people.

Table 5
Estimated Value of Wood Fuel Extracted from Forest at Market Price

(in lakh Rs)

	Jhabua			*Mandla*			*Total*		
Attributes	*Before JFM*	*After JFM*	*Changes*	*Before JFM*	*After JFM*	*Changes*	*Before JFM*	*After JFM*	*Changes*
Market Value of fuel wood extracted from Forest @ Rs 1.00 Kg annually the households (Base year price 1995.	1.35	1.6905	+0.3405	1.82	2.208	+0.388	3.17	3.89	+0.72
Per household earning indirectly from fuel wood collection in lakh Rs. (if valued)	0.027	0.0345	+0.0075	0.0364	0.0450	+0.0086	0.0 634	0.0795	+0.0161

Source: Survey

Fuel Wood Trade in the Study Area

The utilization pattern of forest resources like the removal of wood fuel, indicates the depletion in forest resources against the regenerative capacity (Rathore, 1993) . Some of the study (Saxena, 1997) estimated the value of wood fuel consumed in India worth of 7 billion US dollars ; while the study (Prasad and Bhattacharya, 1998) estimated 60 billion US dollars assuming 250 million tonnes at the rate of Rs 1000 per tonnes.

The study related to wood fuel trade in India (Prasad *et al.* 2001) addresses trade related issues and Government forests are the main source from where the people's

collects wood fuel in the study area of 6 states of India. The huge collection of wood fuel is contributing to forest degradation. Another study (Somashekar and Ravindranath, 2001) assessed the fuel wood consumption and Trade in South India, reveals that the per capita consumption and marketing of wood fuel. Study of production and marketing of fuelwood in *Gadchiroli district of Maharastra* points the status of wood fuel prior to the stopping of clear felling. (Majumdar ,2001). The trade as a first step survival strategy was dealt by (Bhattacharya *et al.*, 2001) in context of forest and displaced people of North Bengal.

Generally, there is no standard system of grading or unit of measurement of fuelwood in the local market of the area. Yet fuelwood trade is not done in the "Cash and Carry" way, without any close relationship between the sellers and the buyers, as characterized by (Ouerghi, 1993). The frequency of selling fuelwood per week is very important indicator to understand the inflow of fuelwood in the periodic market or regular market.

However, the price at which the fuelwood sold by the fuelwood collector s is mainly dependent on the season and time of the year when it is traded. During Monsoons, not only the forest visits for fuelwood collection become difficult, but also it is not possible to procure dry fuelwood and bring it to the market. At present there is only an occasional scarcity of fuelwood that is mainly seasonal., with dry fuelwood during rainy season . The fuelwood prices fluctuates, differ from state to state in different season. The highest price per Kg rises much more sharply in rainy season and in winter season (15-25%) as compared to the price of summer season in the study area.

Generally the villagers, stores a firewood in a summer season and sale it during rainy season. Therefore, highest price is in fact lies in value addition on account of storage and adds value to the collected fuelwood. There are number of factors which increases the value of fuelwood in the market such as storage ,splitting (Processing) debarking, quality of firewood at time of scarcity, distance from forest. However this scenario differs from that what was presented by Cooper(1985 in Hulseboch, 1993).

Table 6, shows the income generated by the people's in the study area of Jhabua and Mandla district of Madhya Pradesh.

Before JFM

(i) 30 and 35 households were selling wood fuel in the study area of Jhabua and Mandla district of Madhya Pradesh.

(ii) On an average 2.8 and 2.9 trips were made to the market to sell wood fuel in Jhabua and Mandla district of Madhya Pradesh. Trips recorded to market was highest in Mandla district as compared to Jhabua district.

(iii) The yearly trips to market were 145 and 150 in Jhabua and Mandla district.

(iv) On an average sample households were selling 6 and 7.2 quintals of wood fuel per trip in Jhabua and Mandla district.

(v) The average distance travelled by the wood fuel seller was 7.2 and 6.8 Km. Respectively in Jhabua and Mandla district.

Table 6
Income Generated from the Sale of Wood Fuel Per Households before and after JFM

	Jhabua			*Mandla*			*Total*		
Attributes	*Before JFM*	*After JFM*	*Changes*	*Before JFM*	*After JFM*	*Changes*	*Before JFM*	*After JFM*	*Changes*
Number of households selling wood fuel.	30	18	-12	35	20	-15	65	38	-27
Number of trips per week to sell wood fuel	2.8	3.0	0.2	2.9	3.2	.3	5.7	6.2	+.5
Yearly trips to sell wood fuel	145	156	+9	150	166	+16	295	322	+27
Wood fuel selling per trip in a week (in quintals)	6.0	4.2	1.8	7.2	5.8	-1.4	13.2	10.0	-3.2
Average distance travelled by the fuel wood seller (in Km)	7.2	7.2	-	6.8	6.8	-	14	14	-
Income earned by selling wood fuel to the households per week @ of Rs 1.50 per kg (in Rs) Base year price 1995.	900	630	-270	1080	870	-210	1980	1500	-480
Annual income from the sale of wood fuel (in Lakhs)	1.30	0.9	-0.4	1.62	1.44	-0.18	2.92	2.3	-0.62
Net income from the sale of fuel wood per household per year (in Rs)	4333.0	5000.0	+667	4628.0	7200.0	+2572	8961.0	12200.0	+3239

Source: Survey, Data is based on the information as stated by the households.

(vi) Average income earned by the wood fuel seller was Rs 900 and 1080 in Jhabua and Mandla district.

(vii) The annual income earned by all households was Rs 1.30 and 1.62 lakhs in Jhabua and Mandla district.

(viii) Average annual income, per household from the sale of wood fuel was Rs 4333.0 and 4628 in Jhabua and Mandla district .

(ix) It was reported by the fuel wood seller that 45% of the total earning from the sale of wood fuel comes to their hand in the month of rainy season (because of high prices of wood fuel as compared to other season.) while other 55% of income earned from two other seasons.

After JFM

(i) The number of households selling wood fuel has decreased to 18 and 20 in the study area of Jhabua and Mandla district.

(ii) On an average trips made to the market has increased to 3.0 and 3.2 to sell wood fuel in Jhabua and Mandla district. Trips recorded to market has been recorded highest in Mandla district as compared to Jhabua district.

(iii) The yearly trips to market has increased to 156 and 166 in Jhabua and Mandla district.

(iv) On an average sample households selling wood fuel has decreased to 4.2 and 5.8 quintals per trip in Jhabua and Mandla district.

(v) No change has been recorded in the distance travelled by the wood fuel seller in Kilometres in Jhabua and Mandla district.

(vi) Average income earned by the wood fuel seller has reduced by Rs 270 and 210 in Jhabua and Mandla district.

(vii) The annual income earned by all households has also decreased by Rs 0.4 and 0.18 lakhs in Jhabua and Mandla district.

(viii) Average annual income, per household from the sale of wood fuel has increased to Rs. 5000.0 and 7200 in Jhabua and Mandla district.

(ix) The sale of wood fuel has increased by 3% more in rainy season as compared to other seasons in the study area.

It could be concluded on the basis of table that the per cent of households selling wood fuel has reduced by 41% in the study area. The trips so far made by the wood fuel seller per week after JFM has increased by 7.6%. due to increase in weekly trips the yearly trips made by the wood fuel seller has increased by 8.3%. The quantity sold by wood fuel has decreased by 24 %. No change has been recorded in the distance travelled by the wood fuel seller in kilo meters. The overall decline in the income has registered after JFM by 21.2%. While the income of per households has increased by 26% because of increase in number of yearly trips and reduction in the per cent of households selling wood fuel. The 3% increase in income from the sale of wood fuel as reported by wood

fuel sell in the study area has been recorded in rainy season. The decline in the number of households selling wood fuel also indicates about the increase in the alternatives of income generation provided to the households by Forest department after JFM.

FUEL WOOD CONSUMPTION

Table 7, shows the fuel wood consumption in the study area of Jhabua and Mandla district of Madhya Pradesh.

The following are the important issues hindering sustainability of rural energy resources and wood fuel collection , consumption, and trading in the study area of Jhabua and Mandla district of Madhya Pradesh.

- Types of the fuels used by the villagers.
- Other alternatives of fuel based on low cost.
- Maintaining supply of fuelwood and other fuels used in the study area.
- Proportionate consumption of other fuel and requirements.
- Issues related to distance travelled in Km to collect wood fuel, availability of species to be used as fuel, time factor in collection and mode of bringing.
- Gender participation in collection of wood fuel.
- Carrying capacity of the fuel wood collector to bring wood fuel as head load and shoulder load.
- Variation in prices in three seasons, Winter , summer and rainy.
- Distance travelled by the wood fuel seller up to the market and non availability of transportation.
- Collection of wood fuel gets affected by rains- such as increase in moisture containment in wood, the link road up to forest disconnected due to rainy water.
- Lack of value addition.
- Problems related to storage of wood fuel, especially in rainy season.
- Existing rules and regulations
- Barter system.
- Quality of wood fuel.
- Receding forest boundaries.
- Issues related to Place, product, price, promotion and policy in fuel wood trade.
- In equity in the income from the sale of wood fuel.

TACKLING DOWN THE ISSUES RELATED TO WOOD FUEL

The following are the important issues hindering sustainability of rural energy resources and wood fuel collection, consumption, and trading in the study area of Jhabua and Mandla district of Madhya Pradesh.

Table 7
Fuel Wood Consumption by the Households

	Jhabua			*Mandla*			*Total*		
Attributes	*Before JFM*	*After JFM*	*Changes*	*Before JFM*	*After JFM*	*Changes*	*Before JFM*	*After JFM*	*Changes*
Average fuel wood consumption per household daily (in Kgs)	6.5	7.5	+1.0	7.5	10	+2.5	14.0	17.5	+3.5
Average fuelwood consumption per household daily during winter season 4 months (in Kgs)	8.5	10.0	+1.5	12.5	14.0	+1.5	21.0	24.0	+3.0
Difference in consumption of wood fuel as compared to other seasons	+2.0	+ 2.5	+0.5	+2.5	+2.2	+0.3	+4.5	+ 4.7	+0.2
Per capita per year collection (in quintals)	4.029	4.72	+0.691	5.83	6.38	+0.55	9.859	11.1	+1.241
Per capita consumption of wood fuel in 8 months in quintals	2.32	2.52	+0.20	2.88	3.51	+0.63	5.2	6.03	+0.83
Per capita consumption of wood fuel in 4 months during winter season (in quintals)	1.51	1.57	+0.06	2.00	2.05	+0.05	3.51	3.62	+ 0.11
Per capita consumption per year (in quintals)	3.83	4.09	+0.26	4.88	5.56	+0.68	8.71	9.65	+0.94
Balance wood fuel as stock with households after consumption (in quintals)	0.199	0.63	0.829	0.95	0.82	1.77	1.149	1.45	+0.301
Per capita per day in 8 months in Kgs	.970	1.05	+0.15	1.20	1.46	+0.26	1.085	1.255	+0.17
Per capita per day for 4 months during winter season in kgs	1.26	1.31	+0.05	2.00	2.05	+0.05	1.63	1.68	+0.05

Source: Survey

- In seeking to transform rural energy production and supply in India, we are concerned both with the immediate issue of ensuring an adequate provision of energy to satisfy basic needs and the long-term issues of improving the quality of life. Even more urgently, in many countries it is imperative to prevent the economic decline associated with reduced energy availability, whereas Brandt Commission report has provided a useful summary of development problems, setting energy issues in perspective so that they may be related to other issues such as food supply, resource development, technology transfer and international finance.
- "The dependence of rural communities on living resources is direct and immediate... unhappily, people on the margin of survival are compelled by their poverty and their consequent vulnerability to inflation to destroy the few resources available to them."
- In the sphere of rural ecology not only is wood removed, but the nutrient cycles are broken, the bringing up of nutrients from depth ceases, and the conservative effect of the tree canopy on water use and erosion is removed. This breakdown of the ecological system has far-reaching consequences for the whole economic base of the rural communities involved. In presenting the general picture of the development of rural energy production and supply, a great variety of supporting evidence has been used, evidence which is clearly derived from very diverse regions. Whilst it is important to consider the broad aspects of energy problem in India as a whole improvement in energy production and greater efficiency in energy consumption and distribution can only be achieved by strategies and actions firmly based on understanding at the local and regional level. Planning has to comprehend much more than generality and theory. It can only be done satisfactorily by undertaking the very difficult task of discovering and understanding all factors in each region and district which affect present energy production and use, and which will affect the innovations proposed.
- There should be , Firstly widespread evidence of the usefulness and applicability of some alternative energy technologies to particular situation in the India and therefore real hope in that direction; and second that technologies for developing renewable resources especially fuelwood, are already available and readily applicable and most important socially acceptable.
- At the National and local level medium term strategies will involve the social economic inducements required to encourage people to say in rural areas and the educational requirements for these rural development programmes. A major dilemma is the competition between food production and renewable energy production for land favourably located with regard to consumers that is on farm. Or near major energy consuming centres. Increased distance between consumer and energy source means not only higher cost but increased energy consumption in transports usually costly imported oil.
- In the study area at local level, however, long -term strategies are extremely important with regard to the development of renewable energy resources, the diffusion in rural areas of new-energy using and conservation technologies.

General rural development policies must include energy, and particularly fuelwood and small timber, as a significant part of their strategy. In the long-term, research and development programmes in appropriate technology will be needed to develop methods of energy production adapted to local environments and social conditions and to provide the cadre of experienced technicians needed to develop and exploit any major breakthrough, or to adopt any technique successfully developed elsewhere.

- The frequency of sale of fuel wood reflects the trade condition in the concerned markets. The frequency of sale depends upon the distance covered by the sellers, mode of bringing to the market, and time taken to, by the mode, to cover distance.
- The seasonality of fuel wood pricing is another important indicator to judge the inflow and outflow from the market from seller's point of view and buyer point of view. This has a direct impact on the demand for and supply of fuel wood traded in the market.
- The pattern of fuel consumption in the rural areas differs from region to region, which in turns governs by the socio- economic and cultural aspects of the society and occupational structure of the villagers also.
- The per capita consumption of agricultural residue cow dung cakes and kerosene oil in the rural areas if, increases will reduce the dependency on fuelwood.

It is recommended that the spatial pattern of rural energy consumption is based on the income elasticity of peoples. Therefore, it is essential that there income should be increased by occupational shifts searching out the other economic activities related to upgradation of their occupation. The per household collection and consumption of wood fuel need to be replaced by other fuel alternatives to have the positive impact on the forest cover with good herb, shrubs and tree density.

References

Agrawal, B. (1980), The Wood fuel Problems and the Diffusion of Rural Innovations. London: Tropical Products Institute.

Agrawal, S.C. (1981), Rural Energy in Two Regions of Uttar Pradesh: First Phase Report .Honolulu: Resource Systems Institute East-West Center.

Bajracharya, Deepak (1984), Organizing for Energy Need Assessment and Innovation : Action Research in Nepal (279-336).

Bajracharya, Deepak (1985), Rural Energy Planning in China and other Developing Countries of Asia FAO (1985)Rural Energy Planning in China and other developing countries of Asia. FAO Pub.

Bhattacharya, P., Bharati Joshi, Parag Dubey, S. P. Singh, and Rishi Kapoor (2001), Forests and Displaced People: Fuelwood Collection and Trade as a First step survival Strategy, *in* Wood fuel Trade in India Food and Agriculture Organization of the United Nations Bangkok, July 2001. pp. 113-132, RWEDP Report No. 57.

Bhattacharya, P (1998), Forest & Displaced People : Woodfuel Collection & Trade as First step Survival Strategy: A Case Study of Baikunthapur Forest Division, North West Bengal, Interim Report submitted to Regional Wood Energy Development Programme in Asia/FAO (GCP/RAS/154/NET)

Digernes, T. H. (1977), Wood for Fuel, Energy Crisis Implying Desertification. The Case of Bara, The Sudan, Unpublished Thesis, University of Bergen.

Digernes, T.H. (1978), Addendum to Thesis: Wood for Fuel. Energy Crisis Implying Desertification. The Case of Bara. The Sudan (Mimeograph) Bergen.

Earl, D.E. (1975), Forest Energy and Economic Development, Oxford

Food and Agriculture Organization (FAO), (1977a), The State of Food and Agriculture 1976, Rome.

Gerald Leach and Robin Mearns (1988), Beyond the Wood Fuel Crisis: People, Land and Trees in Africa.

Hulsebosch, PCJ (1993), Marketing of Fuelwood in Asia. Agricultural University Wagenian/FAO Regional Wood Energy Development Programme in Asia.

Islam, M. Nural., Richard Morse, et al. (1984), Rural Energy to Meet Development Needs. Asian Village Approaches. West view press

Majumdar, N.B. (2001), Production and Marketing of Fuelwood in the Gadchiroli District of Maharastra: A Case Study, *in* Wood Fuel Trade in India Food and Agriculture Organization of the United Nations Bangkok, July 2001. pp 110-112, RWEDP Report No. 57.

Manzoor Alam, J.Dunkerley, Gopi,william, Elizabeth (1984), Fuelwood in Urban Markets, Concept Publishing Company, New Delhi.

Morse, Richard., Agrawal, S.C., al. (1985), Organizing Current Information for Rural Energy and Development Planning (473-518).

Moss, R.P. & W.B. Morgan (1991), Fuelwood and Rural Energy Production and supply in the Humid Tropics . A Repot for the United Nations University with Special Reference to Tropical Africa and South-East Asia.Tycooly International Publishing Ltd. Dublin.

Moss, R.P. & W. B. Morgan (1991), Fuelwood and Rural Energy Production and Supply in the Humid Tropics. A Repot for the United Nations University with Special Reference to Tropical Africa and South-East Asia.Tycooly International Publishing Ltd. Dublin.

Munslow, Barry with Yemi Katerere al. (1988), The Fuelwood Trap: A Study of the SADCC Region Earthscan Publications LTD.

Ouerghi, A (1993), Wood fuel Use in Pakistan: Sustainability of Supply and Socio-economic and Environmental Implications. Pakistan Household Energy Strategy Study (Hess,GOP/UNDP/ ESMAP. Paper Presented at the Regional Expert Consultation on Assessment and Anlaysis for Wood Energy Planning, Organized by the FAO RWEDP in Asia, Chiang Mail February 23-27.

Prasad Ram and P. Bhattacharya (1998) , National Wood Fuel Energy Front, *Proc* of National Expert Consultation on Wood Energy in Curricula of Forest Training and Education in India (Dec ,15-18, 1998). (RWEDP, FAO Sponsored) Indira Gandhi national Forest Academy Dehradun India..

Prasad, Ram, N.B. Majumdar, P. Bhattacharya, B. R. Phukan and S.P. Singh (2001), Wood Fuel Trade in India, in Wood fuel Trade in India Food and Agriculture Organization of the United Nations Bangkok, July 2001. pp. 51-76, RWEDP Report No. 57.

Rathore, S.K.S (1993), Resource Utilization Patterns in a Central Himalyan Catchment, Ph.D. Thesis, Kumaun University, Ninital.

Saxena, N.C (1997), The Wood Fuel Scenerio and Policy Issues in India, FAO Bangkok.

Sharma, R.D. (1992), Economics of Fuelwood Production in Wastelands.

Singh. S.P. (2004), Socio-Economic Issues in Sustainability of Joint Forest Management in Madhya Pradesh, Ph.D. Thesis , Department of Regional Planning and Economic Growth, Barkatullah University, Bhopal.

Siwatibau S. (1978), A Survey of Domestic Rural Energy Use and Potential in Fiji. A Report to the Fiji Government and to the International Development research Centre, Canada Suva : The Center.

Somashekar, H.I. & N.H. Ravindranath (2001), Fuel Wood Consumption and Trade in Rural South India, *in* Wood fuel Trade in India Food and Agriculture Organization of the united Nations Bangkok, July 2001. pp 103-109, RWEDP Report No. 57.