International Journal of Forestry and Crop Improvement
Volume **4** | Issue 1 | June, 2013 | 28-31

Research Article

A study on fuel-wood consumption pattern from coffee based agro-forestry systems in the Cauvery watershed region of Kodagu district

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ABSTRACT : In the present study the fuel-wood consumption patterns of 108 households have been studied. The area was divided into six study clusters at three different zones two each in Eastern zone (Kushalnagar and Siddapur) with annual rainfall ranging from 40 to 70 inches with deciduous vegetation, Central zone (Madikeri and Virajpet) with annual rainfall ranging from 70 to 110 inches with semi evergreen vegetation and Western zone (Napoklu and Bhagamandala) with annual rainfall ranging between 110 to 200 inches with evergreen vegetation. The study revealed that though fuel-wood was the major source of energy consumed by the community, the other sources of energy were LPG, electricity, kerosene, bio-gas and solar energy. About 17.59 per cent households followed Fuel-wood + LPG+ Electricity + Kerosene combination of energy sources. The seasonal consumption of energy revealed that Total average energy consumption from fuel-wood and kerosene was highest for monsoon season and lowest for summer season, whereas energy consumption from LPG and electricity was highest during summer season.

KEY WORDS : Fuel-wood, Consumption, Household, Energy source

How to cite this Article : Shwetha, B.A., Kushalappa, C.G. and Gana Shruthy, M.K. (2013).A study on fuel-wood consumption pattern from coffee based agro-forestry systems in the Cauvery watershed region of Kodagu district, *Internat. J. Forestry & Crop Improv.*, **4** (1) : 28-31.

Article Chronical : Received : *28.01.2013;* Revised : *17.05.2013;* Accepted : *25.05.2013*

INTRODUCTION

Fuel-wood is the important source of energy in the Cauvery watershed region of Kodagu district. Commercial energy is generally beyond the reach of ordinary people, due to their increasing prices and limited supply. Wood energy has been used for years for cooking, heating and it remains as the primary source of energy throughout the world, especially in the developing countries. Fuel-wood is the most important source of biomass energy as it is the primary energy source for more than two billion, primarily constituting the poor (Pattanayak, 2004).

In order to supply the fuel-wood agro-forestry systems, beyond doubt plays a very important role as fuel-wood supplier. A major part of fuel-wood has been found to originate from trees on non-forest land, which in many cases will mean from some kind of agro-forestry system. Coffee based agro-forestry is extensively advocated as a sustainable and productive form of land use. They are the major suppliers of fuel-wood (Muthappa, 2000). Hence, Kodagu district bestowed with adequate tree diversity in coffee agro-forests is the supplier of fuel-wood. The rainfall plays a major role in regulating the shade in coffee agro-forests. This is the reason for the difference

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in fuel-wood consumption.

Fuel-wood consumption pattern of Kodagu region has not so far been investigated. This paper reports the fuel-wood consumption patterns of the people of Cauvery watershed region at three different climatic zone with special reference to seasonal variation.

EXPERIMENTAL METHODS

The present study was carried out for a period of 2010-11.The study comprised of six clusters at three different zones in the district, two each in Eastern zone (Kushalnagar and Siddapur) with annual rainfall ranging from 40 to 70 inches with deciduous vegetation, Central zone (Madikeri and Virajpet) with annual rainfall ranging from 70 to 110 inches with semi evergreen vegetation and Western zone (Napoklu and Bhagamandala) with annual rainfall ranging between 110 to 200 inches with evergreen vegetation were selected for the present study. The Cauvery watershed area of Kodagu district which is located in the Central part of Western Ghats extends between 11º 56'– 12º 52' N longitude and 75º 22' - 76º 11' E latitude. The lowest altitude in the district is about 300 meters and the highest peak, Thadiandamaol is at 1,734 meter above mean sea level.

A preliminary survey was conducted at three different zones with scheduled questionnaire to count the number of members in each household. The economic status was determined in terms of land holdings, type of employment and total income of the family. Households in each village were categorized into small (less than two hectares), medium (two to four hectares) and large (more than four hectares) for studying the consumed fuel-wood by each sample household of each cluster was calculated by stack measurement. The dimension of the stack was measured using measuring tape by recording the length, width and height of the stack. The respondents were instructed to use the fuel-wood for 30 days from the measured stack. The volume of the fuel-wood remaining after 30 days was measured to compute monthly fuel-wood consumption by household. The data was collected for three seasons *i.e.* monsoon, winter and summer. Simultaneously, observations were also made in each sample household to quantify the fuel-wood used for various purposes, such as for cooking, heating, boiling of water and protection of crops from wild animals during the experimental period. Fuel-wood consumption per household per day was calculated on the basis of total wood consumed by a household

Table 1 : Usage of different energy sources among sampled households

LPG	Electricity	Kerosene	Solar	Fuel-wood	Biogas	Others	Total households
+	+	+	-	+	-	-	19
+	+	-	-	+	-	-	10
+	+	+	+	+	-	-	9
+	+	-	+	-	-	-	7
+	+	-	-	+	-	-	7
+	+	+	-	+	-	+	6
+	+	+	-	-	-	-	4
+	+	+	+	-	-	-	3
+	+	-	-	+	+	-	3
+	+	+	+	+	-	+	2
+	+	-	-	+	+	-	2
+	+	-	+	+	-	-	2
-	+	+	-	+	-	-	2
+	+	-	-	+	-	+	2
+	+	-	+	+	-	-	1
+	-	+	-	+	-	-	1
+	+	-	+	-	-	+	1
-	+	-	+	+	-	+	1
+	+	-	+	+	-	-	1
+	+	+	-	-	+	-	1
-	+	+	-	+	-	+	1
+	+	-	-	-	-	-	1
+	+	-	+	+	+	+	1
-	+	+	-	+	-	+	1

+ Present - Absent

per day.

EXPERIMENTAL RESULTS AND ANALYSIS

The results obtained from the present study have been discussed in detail under following heads :

Energy sources by households:

The sources of energy used by the community in the study area were fuel-wood, LPG, electricity, kerosene, biogas, solar energy, coconut husk and twigs. The energy was mainly used for cooking, water heating and cattle food preparation. Out of 108 respondents surveyed, 19 households used LPG + Electricity + Kerosene + Fuel-wood followed by 10 households using LPG + Electricity +Solar + Fuel-wood (Table 1).

Energy consumption pattern in different seasons:

Among the different seasons, highest consumption of fuel-wood (17.236±3.525 kg/household/day) and kerosene (0.064±0.011 liter/household/day) was recorded for monsoon season followed by winter (10.933±2.498 kg/household/day of fuel-wood and 0.057±0.009 liter/household/day of kerosene) and lowest for summer (8.884±1.484 kg/household/day of fuel-wood and 0.053±0.008 liter/household/day of kerosene, respectively) (Table 2). On an average, the fuel-wood consumption was found to be lowest in summer and it gradually increased with decrease in temperature and increase in rainfall.

Surprisingly, energy consumption during the winter did not differ much compared to summer, and similar trend was observed in the study by Sangay in 2011 . The fuel was mainly used for water heating, cooking, space heating and lighting which were on similar lines with the study conducted by Singh *et al* . The higher fuel consumption during monsoon was due to additional energy needed to cook food and boil water in the high rainfall region of Kodagu .

Energy consumption pattern in different zones :

The average consumption of fuel wood and kerosene was highest for Western zone (13.614±4.194 kg/household/day and 0.063± 0.010 liter/household/day) followed by Central (12.383±5.224 kg/household/day and 0.060±0.005 liter/household/day) and lowest in Eastern zone (11.057 ± 3.837 kg/household/day and 0.0517 ± 0.001 liter/household/day) (Table 3). The studies also revealed that consumption of fuel-wood and kerosene was highest in Western evergreen zone with heavy rainfall region with availability of free fuel-wood, compared to Eastern deciduous zone with low rainfall region, where LPG and electricity was available to the farmers more easily. It was clear that farmers in the heavy rainfall Western

Table 2 : Energy consumption pattern among different seasons **(n=108)**

Energy	Monsoon	Winter	Summer
Fuel-wood ^ (kg /household/day)	17.236 ± 3.525	10.933 ± 2.498	8.884 ± 1.484
LPG (kg/household/day)	0.395 ± 0.044	0.406 ± 0.057	0 .498 ± 0.070
Electricity (Unit/household/day)	5.371 ± 1.688	5.962 ± 1.797	6.759 ±1.899
Kerosene (Liter/household/day)	0.064 ± 0.011	0.057 ± 0.009	0.053 ± 0.008

^ Includes fuel-wood consumed for both water heating and cooking
Kg= kilogram, n= no. of households

Table 3 : Energy consumption pattern in different zones **(n=108)**

Zones	Fuel-wood (Kg /household/day)^	LPG (Kg/household/day)	Electricity (Unit/household/day)	Kerosene (Liter/household/day)
	M ±SD	M ±SD	M ±SD	M ±SD
Central	12.383 ± 5.224	0.444 ± 0.051	6.161 ± 0.478	0.060 ± 0.005
Eastern	11.057 ± 3.837	0.469 ± 0.077	7.587 ± 1.019	0.051 ± 0.001
Western	13.614 ± 4.194	0.392 ± 0.044	4.345 ± 0.610	0.063 ± 0.010

^ Includes fuel-wood consumed for both water heating and cooking
Kg= kilogram, n= no. of households

Table 4 : Energy consumption pattern based on farm size **(n=108)**

Farm size	Fuel wood (Kg /household/day)^	LPG (Kg/household/day)	Electricity (Unit/household/day)	Kerosene (Liter/household/day)
	M ±SD	M ±SD	M ±SD	M ±SD
Large	7.368 ± 2.259	0.533 ± 0.079	9.722 ± 1.109	0.049 ± 0.007
Medium	13.515 ± 5.008	0.419 ± 0.054	5.285 ± 0.439	0.052 ± 0.002
Small	16.171 ± 5.849	0.337 ± 0.034	3.086 ± 0.550	0.074 ± 0.009

^ Includes fuel-wood consumed for both water heating and cooking
Kg= kilogram, n= no. of households

zone used fuel-wood and kerosene due to easy availability at lower cost and where as newer sources of energy like LPG and electricity were preferred by economically sound farmers from Central and Eastern zone. The Western cluster consumed more fuel-wood compared to Eastern cluster , where usage of LPG was higher. This was mainly because villages in Bhagamandala cluster have less accessibility to other sources of energy due to low connectivity with the urban areas hence the alternative sources of energy were not easily available, making the population entirely to depend on wood resource. Similar trend was observed in the studies conducted by Bhatt *et al.* in North-Eastern Himalayan region.

Size of the farm directly influenced the energy consumption pattern of the farmers (Table 4). As the farm size increased, there was decrease in the quantity of fuel-wood consumed. The results indicated that, the consumption of fuel-wood (16.171±5.849 kg/household/day) and kerosene (0.074±0.009 liter/household/day) was high among the small farmers followed by medium and large farmers. Large farmers had higher usage of LPG (0.533±0.079 kg/household/day) and electricity (9.722±1.109 unit/household/day) followed by medium and small farmers . Smaller famers were the highest consumers of fuel-wood and kerosene where as LPG and electricity was used in excess by the larger farmers.

Conclusion:

From the global climate change point of view firewood can be considered as one form of renewable energy source. The carbon that is emitted due to combustion of biomass fuel is termed as 'carbon neutral', because this carbon is basically removed from the atmosphere by the trees through photosynthesis and when burned is simply returned to the atmosphere resulting in no net addition of carbon to the atmosphere. Agro-forestry that included fuel-wood production were most consistent and had the greatest potential to accumulate carbon**.** However coffee based agro-forests are already a very important fuel-wood supplier and have the potential to meet the wood fuel demands.

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