Mangrove as source of energy for Rural development with special reference to Ratnagiri and Sindhudarg district (MS) India

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ABSTRACT

The Mangroves are unique form of the ecosystem found all over the world. In India mangroves occur along the east as well as west coast and Andaman, Nikobar group of Islands. The state of Maharashtra has got about 720 km. coastline running in the five districts called Konkan region where mangroves are distributed in estuaries, deltas, mudflat areas. The mangroves are rich in biodiversity because of both micro and macrophytes. The use of mangroves for fish, fuel and fodder (Three Fs) is ethnically very popular. No form of energy is more crucial for human survival or more sensitive to the environmental conditions than the energy needed for cooking. The main source of energy for cooking and heating in the rural areas is derived from forests in the form of firewood and charcoal. In Konkan region the residents nearby utilize mangroves as source of energy. Hence during the present study an attempt is made to determine calorific values as well as charcoal formation in mangrove plant species. The present investigations indicate that the calorific value though differs from species to species in mangroves; it is good for cooking as fire wood. Similarly charcoal production percentage is also variable. These findings are important to evaluate the species for their proper use as a source of energy needed to rural population along estuaries of Ratnagiri and Sindhudurg districts of Konkan.

Key words: Mangrove, source of energy, rural development, calorific values, charcoal formation, estuaries, Ratnagiri, Sindhudurg, Maharashtra.

INTRODUCTION

Green plants are always responsible for harvesting the energy from the sun. They convert the physical form of energy into the chemical form, the food energy, upon which entire world depends. The forests (vegetation) play multiple roles in the life of human beings. Protective, productive and bio aesthetic functions of forests are related to the several human activities. They are the habitats of not only flora but also fauna, which both together, constitute the desired ecological balance (Stoddart, 1965). Mangroves are known as primary producers, shoreline protectors, nursery grounds and habitat for variety of animals, bridging components and unique biological resources. They provide erosion control and shoreline stabilization, they are also involved in complex detritus food webs (Odum and Heald, 1972).

Globally mangroves are distributed in 112 countries with coverage of 10 million hectares (Bunt, 1992) while India has only 2.66% of the worlds mangroves as per Kathiresen (1998). India has a total of 4, 482 square km under mangrove (Panneerselvam, 2008). Maharashtra is the third biggest state in India with an area of 3, 07, 702 sq. km. The total forest area of the state is 64, 078 sq. km. which is 20.8 percent of the total geographical area of the state. The forest area of the state is inadequate and shows uneven distribution in respect to forest cover, its quality and productivity.

No form of energy is more crucial for human survival or more sensitive to the environmental conditions than the energy needed for cooking. The main source of energy for cooking and heating purpose in the rural areas is derived from forests in the form of fire wood and charcoal. This vital source of energy however is being depleted rapidly and the rural areas are facing acute shortage of energy for most of the rural population was fire wood and charcoal, supplemented by agricultural waste (Deshmukh, 1987).

De Silva (1981) reported that in India 70 percent of the energy requirement in villages are met by fire wood and other agricultural waste, most of which are used for cooking. As much as 133 metric tons of fire wood, 73 metric tons of cow dung and 41 metric tons of agricultural waste are burnt in India every year. The demand is far more outstripping the supply.

Goswami (1987) reported that although coal and kerosene oil are used for cooking purpose, the bulk of energy needs of kitchen (more than 80%) are met from non-commercial energy sources like fire wood, cow dung and agricultural wastes. The forests are made denuded by felling trees for fuel.

Taylor et al., (2003) stated that throughout the tropics mangroves exist in intertidal areas and are utilized as a habitat by thousands of animal species and as fuel, medicine, food and timber by human coastal populations.

MATERIALS AND METHODS

In the present study the plant material was collected from estuaries viz., Kolamb, Tarkarli, Sarjekot-Kalawali and Achara (Sindhudurg District) along Konkan Region. The mangroves are extremely used for fuel purpose the calorific values were determined from air dried samples by using Bomb Calorimeter. A pyrolytic study was carried out from the charcoal by heating weighed wood in the Muffle Furnace at 250° C for a period of 20 minutes.

RESULTS AND DISCUSSION

The energy problem of rural Maharashtra is typical of most of the states in India. The state has more than 45.7 million people (62%) living in rural areas and at present per capita demand for the firewood is 0.5 Cu.m. solid wood or 0.9 Cu.m. piled wood per annum. In Maharashtra out of 20.8 percent forest area 8.01 percent is under fuel wood which satisfies 13.5% of the total demand of fuel wood (Deshmukh, 1987). To fulfill the need of energy of remaining population other sources like coke, hard coke, solar energy and efficiency stoves are to be accepted.

A. Calorific Values:

Table 1 represents the calorific values of different species. It is clear from the table that the calorific values of the different species differ greatly. In case of members of family Avicenniaceae the calorific values range from 3108.38 to 3668.80 cal/g for the leaves. The calorific values of air dried leaf powder of other mangrove species also varies as depicted in the table. *Sonneratia alba* shows lowest values (1182.00 cal/g) the highest being in *Avicennia officinalis* (4062.28 cal/g).

Gaykar and Bhosale (1989) have reported calorific values of some mangrove leaves from Ratnagiri district. They found the range as 1182.00 cal/g to 2009.60 cal/g. The present analysis from Malvan area shows that *Sonneratia alba* has the same values (1182.00 cal/g) whereas *Rhizohora mucronata* has considerably higher level of energy. Untawale *et al.,* (1978) reported seasonal variation in major metabolites of mangrove foliage. There is seasonal variation in calorific values in mangroves from Goa coast. Maximum calorific values in mangroves have been reported in *D. tritliata* followed by *B. gymnorrhiza*, *R. mucronata* and many others. Calorific values of leaves indicate the energy may available for detritus based food chain; whereas that of wood indicates energy available for heating. It is observed from the Table -1 that *R. mucronata* shows higher energy in wood (6739.95 cal/g) followed by *A. officinalis*, *A. marina* var. *resinifera* and *R. apiculata*. The lowest calorific value is recorded for *Avicennia* sps. (2042.10 cal/g)

The fuel value of wood is judged by measuring calorific values of the wood sample. As the mangroves shows variation in their physiology from place to place, the wood properties may also vary. Therefore, in present study calorific values are determined. It has been observed that the wood logs of *Aviennia officinalis*, *Rhizophora mucronata* and *Sonneratia alba* are destructed continuously for fuel purpose. Brown and Fischer (1918) reported that in Philippines the wood from mangroves was sold in the market for fuel purpose. They stated that *Rhizophora* sps., *Aviennia officinalis* and *Bruguiera parviflora* are in great demand for their wood as a fuel. Rodger (1984) reported that in Burma people prefer wood of *Heretiera* sps which is excellent source of fuel in the delta. The mangrove wood is readily available to the local people for fuel purpose. Taylor *et al*. (2003) reported that *Rhizophora* species are especially used as fuel as they are rich in tannins and burn smokelessly, imparting a pleasant taste to cooked food.

Table 1: Calorific Values of different mangrove species.

Sr. No.	Name of the mangrove species	Calorific Value Cal/g	
		Leaves	Wood
1	*Avicennia officinalis*	3668.69	5922.12
2	*Avicennia marina* var. *acutissima*	3396.64	4901.05
3	*Avicennia marina* var. *resinifera*	3347.15	5309.47
4	*Avicennia* Sps.	3108.38	2042.10
5	*Rhizophora mucronata*	2256.00	6739.95
6	*Rhizophora apiculata*	1436.00	5105.26
7	*Sonneratia alba*	1182.00	4062.28

Table 2: Moisture and Charcoal percentage of different mangrove wood at 200-250°C.

Sr. No.	Name of the Mangrove Species	Moisture %	Charcoal %
1	*Avicennia officinalis*	41.45	44.55
2	*Avicennia marina* var. *acutissima*	60.59	51.76
3	*Avicennia marina* var. *resinifera*	74.36	40.74
4	*Avicennia* Sps.	78.79	37.32
5	*Rhizophora mucronata*	66.33	51.95
6	*Rhizophora apiculata*	66.97	53.04
7	*Sonneratia alba*	80.49	54.48

Green *Avicennia* marina logs, however are smoky and slow burning so are often used by honey collectors and fishermen to keep away biting insects at night.

B. Charcoal production:

Mangrove plants are cut away not only for fuel but also they are used for the charcoal production. Malaya is known for export of charcoal from the mangroves, but in India this use is very limited. It is found in the present study that along the coast of Maharashtra charcoal is produced from mangroves by individuals on illegal basis.

The information taken from the coastal people's shows that charcoal of *Rhizophora* sps is good for burning followed by *Avicennia* and *Sonneartia* sps. In Achra estuary (Sindhudurg District) and Bhatye estuary (Ratnagiri District) few charcoal forming furnaces are seen. This serves their basic need of energy.

Based on the above observations, in the present study an attempt is made to produce charcoal from different species of mangroves at the laboratory level. The charcoal produced from mangrove wood is given in the Table 2. The charcoal produced from different species yield ranges from 37 to 54%. It is found that higher percentage of the coal can be obtained from *S. alba* followed by *R. mucronata* and *R. apiculata*. The different species of *Avicennia* show variation in charcoal yield percentage. *A. marina* var. *acutissima* shows higher percentage (51.76) than other species of *Avicennia*.

Even though the percentage of charcoal production is highest in *S. alba*, the coal quality is possibly low, therefore, the calorific values are low for the species. Considering the Table 1 and 2 together it is seen that *R. mucronata* stands first followed by *R. apiculata*. In *Avicennia*, *Avicennia offcnalis* has highest energy contents. Their findings are important to evaluate the species for proper use. Naskar and Guha-Bakshi (1987) has reported that twigs of *Acanthus ilicifolius* are used as source of fuel in Sundarban delta by local inhabitants. Singh *et al*., (2000) reported that species of mangroves are used as fuel source. They have also reported that *Rhizophora apiculata* are used in charcoal production. Singh (2000) has reported similar type observation along Gujarat coast. Similarly Kumar (2004) recorded that the mangrove like *Rhizophora mucronata*, *Sonneratia alba, Sonneratia apetala* are being used for fuel as well as biogas production in Goa region.

Bhosale (2003, 2005) has given a detailed account of mangroves as natural sources for timber, fuel and charcoal production, food, fodder and medicines. She has given entire enumeration of uses of mangroves for mankind along West-Coast of India.

From the above results and conclusion it is clear that, local inhabitant use mangrove plants as a source of fuel wood due to its good utility. Taylor (2003) reported that many villagers of East Africa produce salt by boiling brackish water in clay bowls over fire and mangroves are heavily exploited as a fuel source using this technique. With seven tones of wood needed to produce one tone of salt some coastal forests are now bare. Hence, it can be further stated that the use of mangrove plants as fuel wood or fire wood should be done in proper manner without harming this vital ecosystem of prime importance to the coast of India.

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How to Cite this Article:

Sanjay S Sathe, Rajendra A Lavate and Leela J Bhosale, 2013. Mangrove as source of energy for Rural development with special reference to Ratnagiri and Sindhudarg district (MS) India. *Biosci. Disc.,* **4**(2):198-201.