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Original Research Paper

Socio-Economic Aspects of Mangroves: Potential of Biogas Production

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ABSTRACT

In the present study, biogas generation from mangroves is carried out to test the potential of mangroves as a substrate for biogas digester. Initially active slurry of cowdung was added in the biogas digester to produce proper concentration of methanogenic bacteria. Then continuously the mangove powder was added daily to bring out concentration of 8% for a hydraulic retention time of 25 days. The produced gas was tested by simple burning test. The biogas contents were variable in different species of mangroves. *Sonneratia alba* has got highest values followed by *A. marina* var. *acutissima* and *Avicennia officinalis*. The waste from biogas digester is also useful to obtain good manure as it has adequate N, P, K values.

INTRODUCTION

The green plants convert the physical form of energy into chemical form, the food energy, upon which the entire world depends. The forests (vegetation) play multiple role in the life of human beings. Protective, productive and bioaesthetic functions of forests are related to the several human activities. Maharashtra is the third biggest state in India with total forest area of 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 working and heating purpose is derived from the 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 sources. Before independence, the source of energy for most of the rural population was five wood and charcoal supplemented by agricultural wastes (Deshmukh 1987).

De Silva (1981) reported that in India 70 percent of energy requirement in villages are met by fire wood and other agricultural waste, most of which are used for burning. As much as 133 metric tons of fire wood, 73 metric tons of cowdung and 41 metric tons of agricultural waste are burnt in India every year. Goswami (1987) reported that although coal and kerosene oil are used for burning purpose, the bulk of energy needs of kitchen (more than 80%) are met from non commercial energy sources like fire wood, cowdung and agricultural wastes. The forests are made denuded by felling trees for fuel, the mangrove forests are not exceptions.

MATERIALS AND METHODS

Biogas generation is one of the important sources of energy. In the present study, biogas generation from mangroves is carried out to test the potential of mangrove as a digester biomass. The biomass used for cattle feeding (removing waste) and fire wood purpose has been collected, sun dried and powdered. This powdered form has been used an organic waste for anaerobic fermentation to produce biogas. In the present investigation, a digester designed and calibrated by Shivsadan Graha Nirman Society, Sangli was used.

Initially active slurry of cowdung (500 g) was added in the biogas digester to have proper concentration of methanogenic bacteria. Then continuously mangove powder was added daily to bring out concentration of 8% for a hydraulic retention time of 25 days. The increase in height of the cylinder was recorded daily. The produced gas was tested by simple burning test.

The collected left over from digester was used further for analysis of N, P, K components. The nitrogen was estimated by the method of Hawk et al. (1948). The phosphorus and potassium were extracted by wet digestion method (Toth et al. 1948). Phosphorus was estimated by the method of Sekine et al. (1965) and potassium was estimated by flame photometrically.

RESULTS AND DISCUSSION

The energy problem of rural Maharashtra is typical of most of the States in India. The State has more than 40.7 million people (65%) living in rural areas and present per capita

Table 1: Biogas contents from different species of mangroves and N, P, K contents from biogas residue.

Sr. No.	Name of the Species	HRT days	Height of the cylinder (inches)	Biogas L/kg	Residual		
					N%	P%	K%
1	*Avicennia officinalis*	25	4.8	15.36	1.16	0.15	0.19
2	*A. marina* var. *acutissima*	25	6.2	19.84	1.18	0.16	0.26
3	*Rhizophora mucronata*	25	5.5	17.60	1.08	0.14	0.16
4	*Sonneratia alba*	25	6.8	21.60	1.56	0.19	0.20
5	Mixture of above species	25	5.6	17.92	0.81	0.11	0.12

HRT- Hydraulic retention Time; 1 inch Height = 3.2 litres of gas; Average temperature 31-32°C

Table 2: Biogas contents from different sources and manure status of their residue waste.

Sr. No.	Name of the Sources	HRT Days	Biogas L/kg	Residue from waste (%)		
				N	P	K
1	Cattledung	45	35.00	1.50	0.94	0.83
2	Poultry dropping	40	38.00	2.50	0.70	0.81
3	Wheat straw	50	36.00	1.30	0.70	0.65
4	Willow dust	30	35.00	2.00	0.90	1.20
5	Water hyacinth	30	37.00	1.98	0.88	0.98

HRT- Hydraulic retention Time (After Nag & Mathur 1988)

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% forest area, 8.01% is under fuel wood which satisfies 13.5% of the total demand of fuel wood (Deshmukh 1987). To fulfil the need for energy of remaining population, other sources like coke, hard coke, solar energy, efficiency stoves and biogas are to be used.

Amongst alternate sources of fuel wood, generation of biogas is found to be most beneficial in the State of Maharashtra. Biogas generation technology offers a low cost alternative for energy requirement in the rural areas. It is based on recycling of a variety of organic wastes. It has been considered as a priority activity in the rural development programmes.

Extensive use of biogas may be substitute for commercial energy like kerosene and maintains the public health through use to organic wastes. Motivation of biogas is overall reduction of fire wood consumption.

Biogas contains following gases: methane 50-80%, carbon dioxide 25-35%, hydrogen 1-5%, nitrogen 2-7%, oxygen 0-0.1% and H_2S rare. The composition of methane in biogas is higher which is combustible and supplies the required heat energy.

In the coastal region of Maharashtra fuel wood is obtained from mangroves. To minimize the mangrove fuel wood, the alternative source, biogas, is thought of. However, as the mangrove wood contains sulphur in considerable amount, its potential for biogas production is doubted.

A common mangrove genus in Maharashtra is *Avicennia* with its 3 to 4 species. The twigs of these plants are excised as fodder. Therefore, in the present study an attempt was made to test possibility of biogas production from leaves and tender stems of *Avicennia*. It is always kept in mind that biogas generation is not based on litter produced by mangroves or cuttings of mangrove for that purpose. The understanding is that in spite of sulphur content (which is known to inhibit methanogenic bacteria) mangroves produce biogas, then the fodder waste can be used along with other material in the biogas plant.

The biogas content in different species of mangroves is given in Table 1. The biogas contents are variable in different species of mangroves. *Sonneratia alba* has got highest values followed by *A. marina* var. *acutissima* and *Avicennia officinalis*. The hydraulic retention time was 25 days. It can be stated here that temperature of the processes ranged between 31 and 32°C. Kulkarni (1985) reported that highest gas production was at 35°C, while the temperature lowest by 10°C completely stops the process of gas production.

Nag & Mathur (1988) have given the biogas content from different waste sources (Table 2). Their values range from 35 to 38 litres/kg of dried biomass. Similarly, they have estimated N, P, K contents from the slurry which show good nutrient status as fertilizer for soil. The hydraulic retention time was from 30 to 50 days depending upon the species.

The comparison of both the tables indicates that mangrove species can be used as source for biogas generation. The present quantity is less, which may be further improved by several trials. In the present attempt, the aim is testing potential of biogas production by mangroves and not optimization of the production.

The waste from biogas digester is also useful to obtain good manure. The present investigation reveals that the mangrove biogas residue is also useful. Biogas generation will give good source of energy to local inhabitants. If adopted, it will protect their hygienic condition if coupled with other waste creating pollution problems and will ultimately conserve the productive ecosystems like mangroves along the coastal belt of Maharashtra.

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