BIO GAS: ITS POTENTIALITY AND UTILIZATION AS A RENEWABLE ENERGY- CASE STUDY OF JHARI VILLAGE (MAHARASHTRA)

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ABSTRACT
Exhaustible/ non renewable resources like fossil oils, fuel wood etc forms an important energy source for Indian villages. Simultaneously India which has the world’s largest cattle population has a considerable amount of cattle wealth in its villages. Here case study of an Indian village- Jhari in Maharashtra state of India has been done to see if the cattle waste can be utilized in more profitable way in the form of producing Bio-gas, the potentiality of Bio-gas in the study area, whether bio-gas is utilized at present in the study area, whether the gas produced has capability of reducing the village exhaustible fuel resource use. Through the study the cost-benefit factor of the various fuel sources is calculated for the study area. The study also shows the usefulness of this renewable source as an alternate energy and the consequent reduction in exhaustible energy source.

Key words: Bio-gas, Gobar gas, Panchayat, dung, cu.m, calorific value.

INTRODUCTION
Energy is a necessary concomitant of human existence. It is evident that no single source of energy would be capable of replacing fossil oil completely which has diverse applications. On the other hand, dependence on fossil oil will have to be reduced at a faster pace so as to stretch its use for longer period and in critical sectors till some appropriate alternative energy sources preferably renewable ones are made available. Apart from fossil fuel, Indian villages depend heavily on fire wood/fuel wood. Fuel wood is the primary source of biomass, derived from natural forests, plantations, woodlots and trees around the homestead [Kumar, 2007]. Although many sources of energy exist in nature, it is coal, electricity and fossil oil which...
have been commercially exploited for many useful purposes. To reduce the pressure on these exhaustible/non-renewable energy sources, Biogas has a bright future as an alternate renewable source of energy for domestic and farm use. It is a clean and efficient fuel containing about 65 % methane, 34 % carbon dioxide and traces of other gases, such as hydrogen sulphide and ammonia [Deublein et al, 2011]. Biogas is produced when organic materials, such as cattle dung, are digested in the absence of air, in ‘Biogas Plant’.

**Objective:** The objectives of the present study are as follows:-

(i) To find out the potentiality of bio-gas in the study area
(ii) To find out whether bio gas is used at present in the study area and its usefulness mainly for cooking purposes for reducing use of conventional fuels
(iii) To find out the hindrances if any towards the universal development of bio gas in the study area

**Study area**

The area of study (Fig 1) is in Loha taluka of Nanded district of Maharashtra. The district is bounded by 18°15’ to 19°55’ North latitude and 77° to 78°25’ East longitudes. The study area has a total of 120 families. The total population is 870 of which 412 are females and 458 males. On an average each family has 10-12 members.
DISCUSSION

i) To find out the potentiality of bio-gas in the study area

Livestock is a renewable source for this type of fuel. Fortunately India is blessed with a tremendous livestock wealth. India boasts of the largest cattle population [Singh, 2011].

Table 1 shows the potentiality of bio-gas in the state vis-à-vis achievement of the same. The achievement is far less than potentiality.

Table 1 National Biogas and Manure Management Programme (NBMMMP)

<table>
<thead>
<tr>
<th>State</th>
<th>Estimated Potential for 10-11</th>
<th>Physical Achievements during ’10-2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maharashtra</td>
<td>897000</td>
<td>21456</td>
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</tbody>
</table>


The potentiality of bio gas depends on (a) availability of technological help, (b) availability of economical help and (c) availability of cattle (as raw material).

Central Sector Scheme on National Biogas and Manure Management Programme provides for central subsidy in fixed amounts, turn-key job fee linked with five years free maintenance warranty, financial support for repair of old-non functional plants; training of users, masons, entrepreneurs, etc. Setting up of family type bio gas plant in the study area requires a one time cost of Rs 20,000. The local village Panchayat provides subsidy of Rs 15,000 for setting up of family type bio gas plant.

The State Level Biogas Development and Training Centre is functioning at KVIC, Nasik. Nasik is quite far (465 Kms) from the study area which hinders technological help from Nasik. However in the absence of any government technological help, the village gets private technological help from a firm in Latur (this is the neighboring district at 121 kms). The firm provides free technological help & required training in lieu of setting up of the plant.

In India 1.5 m³ of gas/day is sufficient for a household of 12 [NIIR, 2004]. 5 kg dry dung = 1 m³ of gas [Nijaguna, 2006]. Table 2 shows the equivalent quantities to 1 m³ of Bio-gas for the various exhaustible fuels.
Table 2  Equivalent quantities to 1 m³ of Bio-gas for the various fuels

<table>
<thead>
<tr>
<th>Name of the fuel</th>
<th>Kerosene Equivalent quantities to 1 m³ of Bio-gas</th>
<th>Firewood</th>
<th>Cow-dung cakes</th>
<th>Charcoal</th>
<th>Soft coke</th>
<th>Furnace Oil</th>
<th>Coal gas</th>
<th>Electricity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.620</td>
<td>3.474 kg</td>
<td>12.296 kg</td>
<td>1.458 kg</td>
<td>1.605 kg</td>
<td>0.4171 m³</td>
<td>1.177 m³</td>
<td>4.698 kWh</td>
</tr>
</tbody>
</table>


In a community bio gas plant in Thiruvananthapuram 250 cattle generated 3950 cft gas/day. This was used for 22 households averaging 12 family members. The daily requirement/22 households only for cooking stood at 333 cft [Bhagat, 1993].

The study area has a total of 104 cows & 360 buffaloes. The average minimum dry dung yield in the study area is 10-12 kg/day/buffalo or cow. Sparing 14 families the rest 106 families have livestock. The number however varies from 2-7/family. Thus as far as dung is concerned the total dry dung that can be obtained from the study area is around 4500-5500 kg/day. Of these only around 160 kg/day is utilized by the 16 families in bio gas plants (Plate 1). From the above statistics it is clear that the study area has enough cattle population to take care of bio –gas plant raw material requirements for rest of the families having livestock.

Plate 1  Bio gas plant in Jhari
ii) To find out whether bio gas is used at present in the study area and its usefulness mainly for cooking purposes so as to reduce use of conventional fuels

In the study area, 16 families have domestic bio-gas plant. The remaining 104 families use a variety of fuel ranging from firewood, kerosene, diesel, dung cake and petrol (LPG). The calorific values in kilo calories of these commonly used fuels are given in Table 3.

Table 3 Commonly used fuels and its calorific value

<table>
<thead>
<tr>
<th>Commonly used fuels</th>
<th>Calorific values in Kilo calories</th>
<th>Thermal efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bio-gas</td>
<td>4713/M3</td>
<td>60%</td>
</tr>
<tr>
<td>Dung cake</td>
<td>2092/Kg</td>
<td>11%</td>
</tr>
<tr>
<td>Firewood</td>
<td>4708/Kg</td>
<td>17.3%</td>
</tr>
<tr>
<td>Petrol</td>
<td>10550/Kg</td>
<td>66%</td>
</tr>
<tr>
<td>Kerosene</td>
<td>9122/Kg</td>
<td>50%</td>
</tr>
</tbody>
</table>

Source: [Khoiyangbam, 2011]

These calorific values or heat values indicate that bio-gas can perform works similar to fossil oil in domestic cooking, lighting etc. The 16 families mentioned have a family size of 12-14 members. These families have set up their individual bio gas plants. Bio gas plants are of two types- one made of iron and the other made of cement. The study area has cement bio-gas plants. Size of the bio-gas plants in the study area ranges from 4 ft × 4 ft, 8 ft ×8 ft, 8 ft × 16 ft. The 1st type of plant serves for a family of 10, the 2nd type of plant serves for a family of 15 while the 3rd type of plant serves for a family of 25. It is the 2nd & 3rd type of plant which is more common in the study area. Technological & economical help was obtained as discussed in point 1 above. Once the plant is set up, it does not have any other input cost. Since the families have livestock, thus this involves zero costing. Survey yielded, 10-15 kg of dry dung is fed everyday in the plants. The dry dung is diluted to obtain 15-19 kgs of wet dung. This gives cooking time capacity of 4 hrs/ 2 days (Plate 2). The sludge obtained is utilized as fertilizer by these families which have yielded satisfactory results.
The finding related to the use of various cooking fuels along with their respective cost incurred by the families of the study area is given in Table 4.

### Table 4 Types of fuels used in the study area vis-à-vis cost incurred/month

<table>
<thead>
<tr>
<th>Commonly used fuel</th>
<th>No of families</th>
<th>Amount required/family/day</th>
<th>Cost/month (avg/family of 10-14 members)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bio-gas</td>
<td>16</td>
<td>10 kgs</td>
<td>NIL</td>
</tr>
<tr>
<td>Dung cake</td>
<td>18</td>
<td>7-8 kgs</td>
<td>Rs 170</td>
</tr>
<tr>
<td>Firewood &amp; saw dust</td>
<td>39</td>
<td>2.5 kg</td>
<td>Rs 250</td>
</tr>
<tr>
<td>LPG</td>
<td>02</td>
<td>1 cylinder/2 months</td>
<td>Rs 230</td>
</tr>
<tr>
<td>Kerosene</td>
<td>45</td>
<td>0.5-0.8 litres</td>
<td>Rs 330</td>
</tr>
</tbody>
</table>

**Source: Survey**

Table 4 helps us understand that the village is utilizing a considerable portion of exhaustible natural resource which can otherwise be saved. The per month costing clearly indicates that use of this free waste will not only reduce the household fuel cost but also save conventional exhaustible natural resource.

Bio-gas apart from being an excellent zero-cost cooking fuel is also used as organic manure. The sludge has high fertilizing value. It contains a full range of plant nutrients in the digested slurry as is indicated in Table 5. The nitrogen present in cattle dung is conserved totally when processed through a bio gas unit whereas in open pit composting most of the nitrogen (over 50%) is lost due to leaching or evaporation [Nijaguna, 2006]. This sludge is more useful than...
farm yard manure. Table 5 shows the comparative NPK content of sludge and farm yard manure.

Table 5 Comparative plant nutrient content in digested slurry (DS) and Farm yard manure (FYM)

<table>
<thead>
<tr>
<th>Plant nutrient</th>
<th>DS (%)</th>
<th>FYM (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen (N)</td>
<td>1.5-2.0</td>
<td>0.5-1.0</td>
</tr>
<tr>
<td>Phosphorous (P'O')</td>
<td>1</td>
<td>0.5-0.8</td>
</tr>
<tr>
<td>Potash (K'O)</td>
<td>1</td>
<td>0.5-0.8</td>
</tr>
</tbody>
</table>

Source: [Nijaguna, 2006]

The number of cattle dung manure users in the study area has increased over a period of 8 years. In the study area a total of 30 families use sludge in their agricultural fields (Plate 3). 15-19 kg of wet dung produces around 7-10 litres of sludge/ day. Apart from the 16 families (those having bio-gas plants) using sludge, the rest of the 14 families buy sludge from these 16 families at a nominal rate of Rs 5/10 litres. The sludge manure users have obtained satisfactory crop growth, increase in soil fertility, low cost high yielding production etc - the reasons attributed for the steady increase in the dung manure users in the study area.

(iii) To find out the hindrances if any towards the universal development of bio gas in the study area

In the study area households with a large family size (12-14 or above) and families with a considerable cattle wealth have shown interest towards the setting up of family bio gas plant owing to economical reasons (zero cost benefit).
The one time capital input, 80% of which is refundable only after the completion of the project, is quite high for the families. In general a lack of proper knowledge due to governmental/panchayats level callousness, shortage of space & household labour are also hindrances. However the hindrances found out was not of any major rationale against the universal development of bio gas in the study area.

On the other hand when all the dung resource of the village is pooled it is possible to provide several energy services to all the village households. Such bio gas plants are often called community sized bio gas plants. As per an estimate the available cattle dung in India can support 20 million family bio gas plants having 1.8 m3 average capacity and 0.65 million community plants with the average capacity of 145 m3 [Sharma, 2009].

At present more than 4000 community bio gas plants have been set up in the country [Khoiyangbam, 2011]. One such plant in Gujarat, Methan village supplies gas to all the houses for cooking and pumping drinking water facility Since the concept of community sized bio gas plant is not a new notion in India, the survey pointed out the fact that the study area having good cattle population, a community sized bio gas plant for the entire village can be considered as part of block level planning which will open up possibilities for other villages and save national wastage. This pro-bono work will not only consider the economic constraints of the villagers but also the technological and spatial problems.

CONCLUSION

With technological advancement in today’s world it is very much necessary to reduce use of exhaustible energy resources. Biogas has a bright future as an alternate renewable source of energy for domestic and farm use. The study area has good potentiality for bio gas plants. The study area has high dung production from its 464 cattle, economical help in the form of subsidy is present accompanied with technological help. Since raw material, economical and technological assistance is available thus it can be said that the bio gas potentiality is quite high.

Bio gas is not a new concept in Jhari which already has 16 bio gas plants. Survey yielded that these plants once set up, involves zero costing and saves exhaustible energy. As far as hindrances are concerned the one time capital input, technological and spatial problems are
minor problems. These hindrances can be easily dealt with if the government decides on community based bio gas plant for the entire village.

REFERENCE


