emPOWERing rural India the RE way

inspiring success stories

CASE STUDY 7

BIO-ENERGY

Generating biogas from waste*

Biotech's initiative

Christened as 'God's Own Country', the state of Kerala is known for its palm-fringed beaches, majestic and undulating hills, and its pristine backwaters. No wonder, it has a thriving tourism industry with an abundance of exotic beach resorts. Another draw for tourists coming to Kerala are the famous Ayurveda centres.

The state is on a prosperous track and is observing a steady growth in the middle class population. The suburban areas demand clean and hygienic disposal of waste from homes, institutions, and municipalities as opposed to the rural practice of leaving out waste for animals. Though there are many local bodies providing door-to-door services for collecting waste, the stray animals often tear open waste bags kept outside, and thus create more litter. On the other hand, the market places are characterized by huge heaps of organic waste with barking dogs fighting for the garbage. The hovering flies and mosquitoes make the situation even worse as they are carriers of numerous diseases.

All this is due to the absence of a proper waste management system at the source of waste generation. Consequently, it creates a perennial problem for the local administration like panchayats and the municipal corporation.

Biotech, an NGO based in Kerala, has come up with some solutions to these problems. It has developed biogas digesters that capture food and other organic

Biogas unit in Pathanapuram

* *For further information, contact:* Mr A Saji Das, E-mail: asajidas@gmail.com

to lavatories replace 50% to 75% of their LPG use, through additional biogas production from the sewage waste. Energy-from-waste plants generate 3 kW to 5 kW of electricity from biogas, which is used for lighting the market and adjoining areas. Biogas works as an advanced and convenient means in rural areas where cooking is mostly done using firewood or kerosene. It is also safer than LPG, since it cannot be lit accidentally by a spark. The odourless effluent from the plant is used as garden fertilizer, as it contains high percentage of nitrogen, phosphorus, and potassium.

The installation of these biogas plants has also helped significantly in employment generation. The manufacture, installation, and maintenance of these biogas plants is estimated as 13 days for each domestic plant, 55 days for each institutional plant, and 80 days for each waste-to-electricity plant. An estimated total of 500 days/year is required for maintenance and servicing and 140 days/year for operation of the institutional plants.

The success story of Pathanapuram Gram Panchayat in Kollam district should be an eye opener for all the civic bodies who would like to create clean and hygienic environment in their localities. The panchayat-controlled public market area was facing many health and environmental problems as approximately 1000 kg of organic waste is daily generated in the market with the major contributors being slaughter-house waste, fish waste, vegetable waste, and waste water. In order to overcome these problems the Gram Panchayat committee approached Biotech and got a positive response.

Biotech first conducted an awareness programme for the panchayat members about the hygienic disposal of waste and the possibility of generating electricity from the same. This was followed by data collection about the quantity and type of waste and a site visit by the technical experts of Biotech. The project was found feasible and Biotech submitted a concept proposal to the panchayat that included a brief description of the waste treatment plant, approximate cost, return on investment, and the terms for the installation. The proposal was approved and subsequently Biotech submitted a DPR (detailed project report) to the panchayat. The panchayat committee approved the DPR and awarded the project to Biotech. An agreement was signed between the panchayat and Biotech and the proposed site was handed over to Biotech for the implementation of the project.

Biotech completed the project within the stipulated time frame and activated the plant using Biotech culture and cow dung as initial feed. Trial runs were conducted for seven days during which the panchayat president and other members visited the site to observe the functioning of the plant. The plant was formally commissioned in October 2003. An operational agreement was signed between Biotech and the panchayat at the time of commissioning of the plant after which Biotech selected three local unemployed youth and trained them to work as operators. Biotech conducted another awareness programme to educate the merchants of the market about systematic collection and hygienic disposal of the waste generated in the

waste, glass, plastic, and so on are sorted out by hand from the overall municipal waste and sold for recycling. The wet waste is then fed into the biogas plant. To hasten the digestion process, the organic waste is broken down to a uniform size by a mechanical chopper. Water separated from the output slurry can be recycled by mixing it with the feed material. The biogas produced in the process is used to generate electricity with the help of generators. Biotech has completed 52 such projects so far and another 8 are nearing completion.

Mr A Saji Das founded Biotech in 1994, and is still actively involved in the development of the organization. Biotech promotes biogas technology through its participation in symposia, seminars, exhibitions, and demonstrations at the state and national levels. It has its own workshops where it manufactures all the plants and also maintains a high quality of production. It also records the details of all plants in order to avail subsidy from the MNRE (Ministry of New and Renewable Energy). To ensure smooth functioning of the plants, Biotech sends its staff to each new customer every three months for two years and also provides necessary support for old plants.

The cost of a typical domestic biogas plant of 1 m^3 is about Rs 9500. MNRE provides a subsidy of Rs 4000 for a plant installation.

For each domestic plant with a capacity of about 10 m^3, MNRE provides a subsidy of Rs 8000, which is paid to the beneficiary through Biotech after a government official's inspection of the plant. The local and district panchayats (councils) also offer subsidies of Rs 2700 and Rs 3500 in urban and rural areas, respectively. The buyer pays the remaining amount directly.

There is an increasing demand for domestic-scale systems and this technology has a huge growth potential. In rural areas also, the potential is considerable, provided the panchayats work on creating awareness among people and arrange for budgets. However, there is a greater potential at the municipal level, where there are serious health risks due to the generation of large volumes of organic waste and pollution of water supplies.

The main benefit of Biotech plants is that they provide a clean disposal route for food waste from households and institutions, and huge amount of organic wastes from markets and councils. Therefore, they prevent the release of methane from uncontrolled decomposition of waste. Plants connected to lavatories help in avoiding contamination of ground water through human sewage. Additionally, all these plants produce clean biogas which partially replaces LPG (liquefied petroleum gas) or firewood as cooking fuel and in turn cut down carbon dioxide emission.

Biogas from domestic plants replaces about 50% of LPG and thus results in a saving of about Rs 2280 for a family per year. This means that the family can recover its share of the cost of the plant in about three years. Institutional plants attached

waste and waste water at the source and produce biogas through a technology called biomethanation. The organic materials are taken into air-tight vessels where bacteria break them to release biogas. This resultant gas, which is a mixture of methane and carbon dioxide (with the percentage of the latter being less), can either be burned directly as a cooking fuel or can be used to generate electricity after purification. The solid residue can be used as organic compost.

Biotech has developed plants of six different sizes to cater to three different sectors.

- Domestic sector (individual households)
- Institutions (schools, hostels, hospitals, and hotels)
- Local councils (market places)

The standard domestic plants with a volume of 1 m^3 produce about 1 m^3 of biogas per day with a maximum daily input of 25 kg of solids and 20 L of water.

For each domestic plant with a capacity of about 10 m^3, MNRE provides a subsidy of Rs 8000, which is paid to the beneficiary through Biotech after a government official's inspection of the plant. The local and district panchayats (councils) also offer subsidies of Rs 2700 and Rs 3500 in urban and rural areas, respectively. The buyer pays the remaining amount directly.

The digester vessel is made up of two components: a precast (from ferro-cement) digester tank sunk into the ground, and a gas holder drum made from FRP (fibreglass reinforced plastic), which floats over the tank. Biotech also manufactures portable digesters that stand on the surface, to be installed in areas where excavation is impossible or undesirable due to reasons such as high water table. Food waste, the main feed stock for the plant is mixed with organic waste water from the kitchen in a bucket and fed into the plant inlet with no additional water. Cow dung is used initially to provide a culture of suitable bacteria, which trigger the digestion process. Biogas is generated by the decomposition of waste, gets collected in the gas holder, and is finally taken to a special biogas stove in the kitchen through a pipe connected to the gas holder. A valve is used to open and shut the flow and a regulator controls the flame. Nearly 22,000 domestic plants have been installed serving 88,000 people. This includes many connected to lavatories.

The biogas plants in schools and hostels are bigger than the domestic ones. With a capacity range of 10 m^3 to 25 m^3, each plant on an average can serve about 200 people. The digester tank is built by excavating a pit and constructing a brick or ferro-cement wall with an impervious lining on top. A steel drum coated with FRP (or FRP only for smaller plants) floats on top and collects the biogas. About 200 institutional plants have been constructed to manage kitchen waste, and a further 22 include lavatory connections as well.

The large-scale energy-from-waste plants are built from one or two 25-m^3 biogas digesters and are installed in local councils or fish markets. Dry biodegradable

market and also demonstrated the functioning of the plant.

A part-time supervisor from Biotech monitors the performance of the plant and guides the operators who work on a regular basis. Through this arrangement, Biotech provides performance guarantee to the project.

Bio-electricity lighting up streets

The total cost of the plant was Rs 26 lakh, which proved to be an excellent investment. The successful performance of the plant encouraged the panchayat committee to increase the capacity of the plant from 250 kg/day to 1000 kg/day (in three phases) over the last seven years of operation. As a result, the lighting capacity has also increased from 20 CFL to 100 CFL. About 60 m^3 of biogas is produced everyday through which the plant generates 90 kWh of electricity to cater to the requirement of all newly constructed fish stalls. The plant also yields 400 to 500 litres of liquid fertilizer per day. With all the items put together, the net annual income from the plant is estimated to be Rs 10.73 lakh. This way the total cost of the plant could be recovered in three to four years.

Through this initiative, the Pathanapuram Gram Panchayat reduced approximately 22,000 m^3 of methane emissions per day, provided a clean and hygienic environment in the market area, and substantially reduced the electricity charges. This success story has encouraged other civic bodies to come up with similar projects. The Pathanapuram Gram Panchayat therefore deserves every credit for pioneering and revolutionizing the eco-friendly waste management project. The contribution of Biotech, Trivandrum, also should be acknowledged for proper implementation of the technology and smooth functioning of the plant.