Making nightsoil-based biogas plants viable in Maharashtra's Pune district
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Biogas generated from nightsoil serves a dual purpose of providing energy and helping manage human waste. Human nightsoil is a good substrate for generating biogas. However, nightsoil from 25-30 persons per day is required for generating 1 cubic metre biogas. While biogas generated from nightsoil of community toilets, which are used by larger numbers of people, have proved viable, gas produced from individual toilets used by 5-10 persons are inadequate for any practical use. Keeping this in mind, a new strategy has been evolved in Dehu village of Maharashtra's Pune district, where some families allow their neighbours to use their toilets for a nominal maintenance charge making attached biogas plants economically viable. Currently, there are about 75 family-owned human nightsoil-based biogas plants in Dehu providing kitchen fuel for villagers. The strategy has also eased the village Panchayat's responsibilities for human nightsoil management and reduced environmental pollution due to open defecation.

Improper management of human excreta has long posed a major health and environment threat in India. Open defecation, especially in rural areas, is a major sanitation problem. In a push towards achieving universal sanitation various agencies have joined efforts to come up with various low-cost, on-site technologies suited to local requirements. These are largely based on two biological degradation processes: (1) aerobic digestion through two-pit latrines and (2) anaerobic digestion as exemplified by an aqua privy or septic tank latrine. The latter is more commonly used but it is now accepted that a total pathogen kill is not ensured by the process. In addition, the methane produced is allowed to escape. This is not environment-friendly as methane is an ozone-depleting gas. Besides, it is a source of energy being wasted. But if the same human nightsoil is anaerobically digested through a process of biomethanation, the wastes are better managed and valuable energy in the form of biogas is recovered.

Initially, about two household-owned biogas plants functioning on the strategy of involving neighbours were constructed. Usually, a person with the required space and funds opts for the construction of the biogas plant. The experience in Dehu has shown that this is most often a person who already feels the need for a latrine for his household. Along with the latrine, he prefers to install a biogas plant as he is convinced through an information, education and communication (IEC) campaign that the technology is functionally better and financially viable. The capacity of the plant and the number of latrines is based on the number of possible users from neighbouring families. The capacity of the plant may vary from 1 cubic metre to 3 cubic metres.

The user families usually pay Rs.10-20 per month to the owner. Families that do not use the latrine properly, may be asked to discontinue. More user families mean more the money for the owner. If latrine users are tenants, the rate of rent may be higher because the latrine facility is available. Latrine maintenance is done by the owner.

By letting neighbours use their latrines, the owner benefits in three ways: (1) He gets maintenance charges from the user families. (2) He uses the biogas generated in his own kitchen. (3) Wherever possible, the recovery of manure is also an advantage. The latrine user families gain by access to latrines at a nominal cost. The village benefits because open defecation is reduced and the latrines are maintained by the owners and are not a responsibility of the Panchayat.

Biogas plants have enormous environmental benefits as well. It has been calculated that the installation of the 75 biogas plants in Dehu village has reduced the demand for LPG gas in

the village by about 100 domestic LPG cylinders per month. The health benefits are also significant as faecal pollution is reduced.

The cost of construction of a human nightsoil-based biogas plant is comparable to the cost of a septic tank and is, therefore, a much better choice given its environmental, health and financial advantages. The initial capital outlay may vary between Rs. 8000 and Rs. 12,000 depending on the local rates of construction material. If the plant is used to full capacity the designed quantity of biogas would be generated. One cubic metre of biogas in energy terms is equivalent to 0.433 kg of LPG or 4 units of electricity or 4 kg firewood. Thus, the comparable cost of firewood would be around Rs.10 per cubic metre. The cost of biogas recovered in a year would be about Rs. 3,500. Thus, even after the initial cost, interest and depreciation are considered, the recovered biogas itself provides for a pay back period of around five years. The health benefits, convenience and so on are extra factors which are not considered in financial terms.

Most of the biogas plants in Dehu village are installed in densely populated localities where houses are virtually attached to each other. With little open space available, some of the biogas plants had to be installed inside houses. The plants had to be close to the toilets and in many places the toilets were partially constructed on top of the biogas plant. Therefore, the designs had to be as compact as possible and totally odourless. From the point of view of health and prevention of pathogen spread, it had to be ensured that not a bit of raw human nightsoil was exposed to the atmosphere or to insects. Aesthetically, it should not be an eyesore and the approach for maintenance purposes needed to be convenient.

From the array of different biogas plant designs available, two were found to suit requirements at Dehu: a floating dome water-jacketed type devised by the late Appasaheb Patwardhan, a Gandhian who did pioneering work for rural sanitation in India, and the Malaprabha biogas plant devised by the author in 1980. Because of rectangular shape of this design, it can be constructed inside the house.

From the point of view of health, the hydraulic retention time was designed for 45 days to achieve total pathogen kill and avoid any chances of infection spread. The effluent slurry of human nightsoil as a substrate contains less than 0.5 percent solids and this could be diluted for use in plantations. In some cases, it was used in a compost pit along with agricultural waste or garbage. Where this was not possible, it was absorbed in a leach pit.

The technology selection and high-quality workmanship ensured that all the biogas plants functioned satisfactorily. In case of a need for advice or change of spares, the Appa Patwardhan Safai wa Paryawaran Tantraniketan, was always available at short notice. This sort of a maintenance service has contributed significantly to the success of the project.

IEC activities are an important component of making the project a success. Before the biogas concept was introduced, the Jyotsna Arogya Prabodhan and Appa Patwardhan Safai wa Paryawaran Tantraniketan had carried out communication activities to convince the villagers on the need for sanitation and construction activity had already taken root in the village.The biogas plant project required further IEC activities to gain acceptance for the use of biogas from human nightsoil.
The project at Dehu has shown that the strategy of pay-and-use latrine facility for the privately-owned biogas plant can be a very successful approach for the utilization of human nightsoil for biomethanation in small-sized biogas plants in a decentralized way.

It was the change in the mindset of the people that was the most crucial aspect of the project. Once that was achieved, providing technology and other assistance was relatively simpler.

There have been exposure visits to Dehu by several groups from other villages in Maharashtra and the demand for construction of similar biogas plants is on the rise. Once the change in mindset and behaviour is achieved, it has been found the strategy has fairly good replicability and sustainability.
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