State of the Market on Biogas

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Overview:

Through field research and expert interviews, this report seeks to understand the existing conditions - social and technological - that affect biogas generation and utilization. Primary data was used extensively for this report. Interviews were conducted with experts and professionals in the field including Dr. Chanakya - Centre for Sustainable Technologies (CST), Mr. Dattatreya - KSCST, Dr. Anand Karve - Appropriate Rural Technology Institute (ARTI); Mr. Manjunath - Karnataka Renewable Energy Development Limited (KREDL); Dr. Vidya Sagar - SKG Sangha; Mr. Bulla, BAIF; Mr. Anshuman Lath - Gram Oorja Solutions Private Limited, Mr. Raghavan, Ekal Vidyalaya and Mr. Umesh Rai. Household sized and institutional biogas plants that were at different stages of construction and operation were visited in the following areas - Neeralkatti (Dharwad), Ibasapura and Beedigaanahalli (Devanahalli), University of Agricultural Sciences (Dharwad) and Pinjarapole Goshala (Mysore).

The report explores the factors contributing to the success of particular Biogas- based projects. It also seeks to identify the factors that restrict the dissemination and utilization of the technology with the aim of suggesting modifications that could mitigate risks associated with failure of the system. In particular, this report concentrates on household biogas units for cooking energy requirements and larger units for cooking gas and electricity generation. There is also an attempt to understand the main innovations in the field and the market players at the fore of these innovations.

Summary of Technology and Designs:

Three main designs:

1. Fixed dome or Deenabandhu model:
   - Low cost has made it attractive in the past as part of Government commissioned units.
   - Requires good quality masonry and good quality components (bricks, pipes etc.) to avoid cracks
   - Quality checks will overcome problems of low pressure; they can also be overcome by simply lifting the pipe to release water deposited within pipes

2. Floating Drum model:
   - Relatively higher cost, but poor workmanship tolerated
   - Maintenance requires painting of drum and oiling sides to prevent rusting
   - Easy availability and compactness of Sintex tanks to be used as plants - however locals may be unfamiliar with the technology, making repairs appear more difficult than they actually are
   - Kitchen waste based plants require more attention: segregation, pulverizing feedstock, threat of vermin.

3. Balloon type plants:
   - Extremely low cost and can easily be manufactured as independent units since raw materials are easily available. Yet to
be commercially proven and disseminated.

- After sufficient training is given, plants can be constructed locally by households themselves.
- Maintenance involves adequate safety and protection for the digester itself which is susceptible to bursting.

There are certain issues associated with household-sized toilet linked plants such as the quantity of feedstock available per day, the treatment and mixing of waste before letting into the digester and the exact ratios of liquid to solid waste make the use of these plants cumbersome and inconvenient for households. Biogas or dual fuel engines exist but may not be off the shelf products, and often regular diesel engines have to be retrofitted to accept biogas fuel.

These engines may work out economical for large-sized plants with larger amounts of gas being generated, but are uneconomical for smaller plants. Other appliances such as pipes and stoves are easily available in the market are not very expensive. However, the biogas lantern, often locally manufactured, is not considered to be very safe.

**Main insights and recommendations:**

1. **Baseline Studies and Need assessment**
Very often baseline studies which are the basis for the project overestimate or miscalculate the needs of a community, the willingness to pay or the feedstock available (CST). Underestimating the needs of the household, overestimating the amount of dung that a cattle can produce or the amount of gas a certain quantity of feedstock can generate; calculations about existing cook-stove efficiencies; willingness to pay etc. affect the future sustainability of the project.

**Recommendation:** Baseline studies and need assessments must be carefully conducted to ensure that the needs of communities, feedstock available and willingness to pay are considered thoroughly before project implementation and plant construction. This is particularly important for government commissioned projects to prevent a situation where a certain fixed design is used for all households across the village.

2. **Village leaders and 'power groups'**

Informal heads often make decisions that are socially binding on all community members and convincing these leaders of the benefits could further the interests of the project (CST, Ekal Vidyalaya). In this regard, demonstration projects are found to be particularly useful in convincing village power groups as well as potential users of the technology, while testing out the technology.

**Recommendation:** Ideally, prior to actual implementation of the project the informal consent of village heads should be sought. Their confidence can be gained through demonstration projects that also help spread the word among villagers. Banking on aspects like social capital and trust that exist among villagers can help perpetuate and sustain an organization’s work in the village.

3. **Feedstock**

Feedstock availability is one of the most significant issues affecting the effective functioning of existing biogas plants (KREDL; UAS, Neeralkatti, Ekal Vidyalaya, CST). There has been a reduction in the numbers of cattle owned by households, owing to labour shortages in rural areas with people migrating to urban areas. Cattle of any sort can only be afforded by households that are of a certain income level. Thus, the current technology cannot be afforded by households forming the bottom of the pyramid.

Overfeeding must be avoided and a certain ratio of cow dung to water has to be ensured. The feedstock must be in a paste form and mixed with the right quantity of water (ratios are important) before letting it into the digester. (KSCST, Ekal Vidyalaya, SKG Sangha). Failure to properly mix the feedstock into this semi-solid paste like form affects the digestion process and consequently affects gas generation.

**Recommendation:** There must be an emphasis on utilizing other forms of feedstock on a commercial basis. If biogas plants could easily accept different materials such as straw, agricultural bio waste, excreta from hens and goats, it could benefit larger masses of people who cannot afford cattle. Proper training must be given to users of the biogas plant and demonstrations must occur to emphasize not just the ratios of water and dung, but also the process of mixing the two till the required consistency is reached. Feedstock collection and maintaining detailed accounts of the same are particularly important in community sized plants.
4. Maintenance and after-sales servicing

Majority of interviewees agreed that most problems with biogas plant occur not because of technology design but as a consequence of the way technology is maintained (SKG, Ekal Vidyalaya, Gram Oorja Solutions private Limited, KSCST; CST). While construction of the plant is of importance, its maintenance is equally if not more important in the long term functioning of the plant. There is believed to be some reluctance from villagers to call for help to maintain/repair a plant (Ekal Vidyalaya). This may be due to the use of certain equipment or techniques unfamiliar to rural users.

Problems associated with low pressure of cooking gas are constantly raised. This is attributed to improper construction, (quality of materials used and inexperienced labour) and improper maintenance (lack of quality checks and monitoring). It may also be due to the deposition of water within the pipes that prevents the free flow of gas.

In addition to the above mentioned issues, the lack of a visible presence of the implementer could make the locals distrustful of the technology (SKG Sangha).

**Recommendation:** The quality of components used in construction and prior training of labour engaged is extremely important. Ideally, all maintenance and repairs must be simple enough to be carried out locally by the users themselves. Easy maintenance and repairs (that can be handled by the household) using material that is locally available and familiar to locals are more likely to make the technology useable and operational over a longer time period. However, given that most existing biogas plants are professionally constructed, any repairs and cracks in the plant must be dealt with by experienced labour. This can help avoid most problems associated with low pressure. Incorporating a Pressurizing pump-worth approx Rs.3000 is regarded as another solution (KREDL). Low gas pressure when attributed to the condensation of water on the insides of the pipe can be dealt with merely by lifting the pipe to release this water and allowing gas to flow freely (Ekal Vidyalaya, Pinjarapole society). Agitation of the feedstock inside the digester by using a stick can also stimulate bacterial activity and gas production.

Employing local personnel for supervision in particular jurisdictions is useful for the organisation in ensuring that there is a moral obligation to attend to post-installation issues. This also increases the accountability and visible presence of the implementer without which villagers may be skeptical of adopting new technology (as is the case with government commissioned plants).
5. Costs and Financial models

Successful models for Biogas among underserved in rural areas are donor-based with small amounts of contribution from beneficiaries (SKG Sangha). Some part of its financing is also through the sale of carbon credits. A cash-sales based low cost biogas plant model has been developed by Ekal Vidyalaya but is yet to be proven. This model could also be manufactured by users themselves once they have been trained by personnel from Ekal Vidyalaya. Most implementers don’t seem to have been involved with facilitating the purchase of technology through financial institutions. In cases where a loan is taken, it has been the household’s own initiative. An exception to this is the BAIF model which trains villagers to construct and maintain biogas plants and also provides the members of affiliated SHGs with loans to purchase biogas plants. Government subsidies for biogas are quite substantial and often cover nearly 50% of the initial costs, however, the paperwork involved affects smooth sanction of subsidies.

**Recommendation:** This is probably one of the areas where enough scope exists for innovation. There is a need to evolve more sustainable financing models since there are significant savings in terms of LPG and fertilizers that can be realized by households. Making the system more affordable would go some way in increasing access to a biogas based solution. But
this would need to be balanced with a substantial contribution from the users to create a sense of ownership and responsibility. The financing would need to be looked into more carefully for larger community sized units. Gram Oorja Solutions aim to use an entrepreneur to sustainably run a community sized plant for electricity generation, but the commercial viability of this model is yet to be proven.

6. Income generation

By linking small scale biogas plants with some form of income generation—vermi composting, market-linked fertilizer production, mushroom cultivation, manufacturing pest repellants etc., a potential source of income is created for rural households (irrespective of whether or not this potential is tapped into by all users). The mere provision of a plant can reduce household consumption of LPG or firewood and the purchase of fertilizers, which results in savings in household expenditure.

**Recommendation:** Since there are beneficial byproducts such as organic fertilizers accruing to households beyond the generation of cooking gas, there must be some effort to make them aware of the benefits of organic farming. The organic farming process is known to be slow and often villagers lose interest and prefer chemical fertilizers that are more effective in the short run. Training can be provided through concerned NGOs and civil society bodies to draw attention to the byproducts of biogas and consequently the benefits to the land, water and the farming process.

7. Government intervention:

The approach of the Government is largely target-oriented and their designs and construction are motivated primarily by low costs alone. Government subsidies cover nearly 50% of capital costs of the plant, however, these subsidies are sanctioned on paper with no check on whether the plant has actually been installed or not. Existing policies enforce standards on paper, but reduce the ability to customize since benchmark costs are often low and subsidies cannot cover installations of higher value that are likely to be of better quality. The procedures associated with Subsidies and the lack of any monitoring of plant installation affect the accountability and effectiveness of the system.

**Recommendation:** Governments may need to revamp their need assessment studies to include the differences in the requirements and feedstock availabilities of different beneficiaries. The National Biogas Mission that is to come into effect during the 12th five year plan for which the guidelines are currently being developed with TERI. This is said to touch upon issues of monitoring, financing, carbon credit market etc. This mission must take note of the deficiencies existing within the subsidy scheme and make amends. There is a need for a designated agency (or agencies) with more technical expertise to work on the field that can collaborate with the SNA and Rural Development department specifically for post-installation maintenance and monitoring.

8. Large sized biogas plants

Community plants have largely failed (even within homogenous communities) owing to perceived inequality in distribution of costs and benefits. However, institutional plants are seen to work well, particularly when there is a reliable and continuous source of feedstock and demand for manure. Institutional plants have the advantage of being able putting a single person in charge of feeding and maintaining the system.
Community plants suffer from collective action problems such as lack of responsibility and perceived uneven distribution of costs and benefits. For eg: The amount of dung collected from different households differ and this raises questions of why a certain family contributing less should avail of same services and benefits (electricity or gas) as a family contributing more dung (CST, SKG Sangha) or low pressure in cooking gas experienced by houses further away from the plant. In North east India with village leaders being more powerful, community sized plants are found to be more successful (SKG Sangha).

**Recommendation:** Electricity generation, as presented in the Pura case study, can be a huge value addition to the life of an un-electrified community. Given present circumstances, there is a need for pilot projects to work around the collective action issues and better understand how a large biogas based plant could generate electricity and be sustainably operated. There is a large scope for more institutional plants to engage in electricity generation could also lead to indirect income generation, provided the right technology partners are available (for efficient functioning of the engine or generator and understand the electricity needs that can be met).

(From left to right) An institutional biogas plant, floating drum model in Pinjarapole Society, Mysore, that uses feedstock from the Goshala for gas production; The single biogas burner in the UAS hostel, Dharwad, is used solely to meet heating requirements and not for regular cooking as it consumes time.
A failure to frequently remove the water deposition within pipes can affect pressure of gas and its flow; since mixing the feedstock with water is difficult for larger plants, this plant uses a motorized mixer that runs on grid electricity. All gas produced is used as cooking gas.