

Why do farmers take up biodigesters? An assessment from Bangladesh



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Key points

- Our assessment found no biodigesters that were collectively owned or managed by small-scale or landless farmers, as per Bangladesh's Integrated Livestock Manure Management (ILMM) policy and action plan. Instead, the study focused on those privately owned small and mid-sized digesters that did exist.
- Barriers to collectively owned or managed biodigesters included lack of social capital and community-based organizations to support collective installation, ownership and operation, and lack of financing for self-organizing community groups to invest.
- Where biodigesters did exist, there was evidence of health and environmental benefits, including a reduction in cooking smoke in the home owing to use of biogas as fuel, and a reduction in unmanaged manure and run-off. Livelihood and socio-economic benefits included fuel-security and, in the case of medium-sized digesters, opportunities to sell excess biogas product to other families in the community and to market.
- Microfinance was the most common means of financing installation of small biodigesters. In the cases where mid-sized digesters were in place, the Rural Development Agency had approached mid-sized livestock farms to offer financing.
- We found that the basic requirements for livestock farmers to install and run small and mid-sized digesters are: access to finance, technical knowledge, livestock and/or manure, and sufficient land.
- Because of the key roles that women play in manure management, we recommend that future studies specifically examine the role of women in adoption pathways.

1. Bangladesh and livestock manure management

Bangladesh has the highest density of livestock in the world: 21 million households have livestock, of which at least 10 million have cattle. Small-scale and landless farmers raise between 70 and 82% of the country's livestock, which are an important source of farm power, manure for fertilizer and fuel, cash in times of need, and food. Given the high intensity of livestock production in the country, livestock and manure production can become a source of pollution and a threat to public health. The storage of liquid manure on farms produces substantial amounts of methane, a potent greenhouse gas, and if not well contained the liquid slurry can cause water pollution and spread pathogens. Burning dried manure for cooking and heating causes air pollution, and the fine particulate matter produced can cause respiratory diseases (MoFL 2016).

2. Livestock manure management policy

To address these environmental and health concerns, and to increase the sustainability of Bangladesh's livestock sector, the Bangladesh Livestock Research Institute (BLRI)

BIODIGESTER BENEFITS

A biodigester creates conditions for the anaerobic decomposition of organic material such as cow dung and poultry litter, and produces two main outputs: biogas and bioslurry. Households with biodigesters can use the products in several ways. The use of biogas reduces the burning of solid manure and other biomass fuels. Biodigesters and their byproducts can create environmental and health benefits, including reduced air pollution and improved household hygiene. There are also multiple livelihood and socioeconomic benefits. For example, the use of biogas within households leads to reduced time for fuel collection and cooking, particularly for women. Additionally, the application of bioslurry to cropland can increase crop yields and reduce fertilizer costs (BLRI 2016).

under the Ministry of Fisheries and Livestock (MoFL) developed a national Integrated Livestock Manure Management (ILMM) policy and action plan (MoFL 2016). The policy aims to encourage livestock farmers to adopt improved manure management practices, such as the use of biodigesters and the creation of value-added manure products, and to develop a market for these products. A key target group for the policy is small-scale and landless farmers, because improved manure management can improve their health and livelihoods and have benefits for the environment.

The policy encourages farmers to set up societies, similar to the dairy societies under the Bangladesh Milk Producers' Cooperative Union Ltd. (BMPCUL), and the construction of "community" biodigester plants and/or environment-friendly manure storage and treatment facilities.

A number of government, non-government and private actors have well-established programmes to finance biodigester installation. Several key actors are the Rural Development Academy (RDA) under the Ministry of Local Government and Rural Development; BRAC and Grameen Shakti – non-governmental organizations with established microfinance programmes; and the Infrastructure Development Company Ltd (IDCOL) – a government-owned financing agency.

RDA, BRAC and Grameen Shakti have provided microfinance loans and technical support directly to livestock farmers, while IDCOL provides financial support to partner organizations (such as Grameen Shakti) for their biodigester programs. The government looks to engage these actors in the implementing the ILMM policy.

The team visited livestock farms (mainly cattle farms) ranging in size from less than 10 cattle per farm to more than 100. The farms had different types of biodigesters, including small (domestic) biodigesters and medium-sized biodigesters. Around half of the farms had none installed. After the field visit, we conducted an interview with the Rural Development Academy on their community biodigester programme.

3. Results

Below we report on whether our working assumptions were validated, and then summarize our findings.

Assumptions

1. We assumed that "community biodigesters" were large capacity units that would be collectively installed, owned and managed by members of multiple households, with the benefits being shared in an equitable way among group members.

However, while there were some large capacity biodigesters, none were collectively owned or managed by small-scale or landless farmers, as per the Integrated Livestock Manure Management (ILMM) policy and action plan. As such we find the term "community biodigester" to be misrepresentative and suggest it is more accurate to focus on biodigesters in terms of their functional capacity rather than ownership model. We observed the use of small-scale (domestic) biodigesters (1 to 6 cubic meters in size) and mid-sized biodigesters (100 to 130 cubic meters in size).

2. We assumed that there would be viable social structures for the collective installation, ownership and operation of community biodigesters. However, it became clear that no community-based organizations or community structures existed that were suitable for supporting them.

3. We assumed finance would exist for self-organizing community groups representing poor landless farmers to purchase and construct large biodigesters, and that the finance would come from three main sources: microfinance loans to groups of farmers, investment by a wealthier farmer, or NGO grants.

This proved to be false: no loans were provided to groups in any form of association. While microfinance loans were offered to individuals who had collateral and the sponsorship of a guarantor, they were not offered to associations.

While there was a model for lead-farmer financing, these cases could not be considered as community biodigesters because they were financed, owned and managed only by the lead farmer (although the outputs were shared among the farmer's community). Financing of community biodigesters through NGO grants did not exist.

Biodigesters: environment and health impacts

In all households we visited that had a biodigester, biogas was used as cooking fuel. In most cases it was used as the only cooking fuel, displacing solid biomass fuels such as dried manure, vegetation and fuelwood.

Several households commented that cooking with biogas reduced smoke, and that this was better for their health. Some of these households did not own biodigesters, but bought biogas from a neighbouring household with a mid-sized one, which spread health benefits beyond the household owning the biodigester.

Farmers without biodigesters sometimes stored manure in a pit during the rainy season, and applied it as fertilizer to their land or dried it for fuel during other seasons. Sometimes manure was unused and unmanaged, which was more likely if a household did not own cropland. Biodigesters eliminated or reduced unmanaged manure in many of the farms, and likely lessened nutrient pollution from run-off and leaching. Liquid bioslurry was used in different ways. Some households that owned cropland applied it as fertilizer. However, some farmers, particularly landless farmers, dumped it nearby environment or left it to run off onto nearby land.

Biodigesters: livelihood and socioeconomic impacts

Livestock farmers without biodigesters would typically dry manure during the dry season to use as cooking fuel. Some farmers used dried manure as their main fuel, while others used it as a supplement. One challenge these farmers faced was fuel shortages in rainy seasons, because the weather did not allow them to dry manure, plant residue or



Biogas from biodigesters can be used as a cooking fuel, avoiding the health impacts of cooking with biomass indoors. Credit: Pin Pravalkrukskul / SEI



Figure 2: Biogas being piped from a household with a medium-sized biodigesters to neighbouring houses for use as cooking fuel. Credit: Pin Pravalkrukskul / SEI

fuelwood. Some farmers earned income from selling dried manure. One farm with around 100 cows used paid labour to dry manure not used by the farming household. On another farm, workers were hired to clean the cowsheds of manure. The dried manure was sold to intermediaries at around 2 Bangladesh Taka (BDT) per kilogram. Intermediaries then sold it to restaurants and other clients for around BDT 5 per kg. The people hired to dry manure were usually women, and were given a portion of the manure they dried to supplement their wages.

Households with small biodigesters used biogas only for household consumption. All households with biodigesters appeared to be fuel secure, and reported having sufficient biogas for their everyday cooking needs. Extra fuels were bought only in special cases (e.g. to cook large amounts of paddy rice during the harvest season or for large celebrations). Unlike households that relied on solid biofuels, they did not report fuel shortages during the rainy season. A few households said that having a steady biogas supply for household use was their main motivation for investing in a biodigester.

The two households with medium-sized biodigesters also sold biogas and fertilizer to neighbouring households. One sold biogas to around 10 households in addition to using some of it for ghee production. The owner's view was that the biogas produced could support a maximum of 25 households. The other household sold biogas to 35 households for BDT 600 per household per month. The biogas was transported through plastic tubing (see figure 2).

The households regularly sold the organic fertilizer – made from dried liquid slurry – to intermediaries such as the RDA for around BDT 5 per kg. Organic fertilizer had a higher price on the market (BDT 5 per kg) than dried manure (BDT 2 per kg). RDA sent a lorry once a month to pick up organic fertilizer from the production sites.

Producing organic fertilizer is currently beyond the means of many landless and small livestock farms because the drying process requires an expanse of flat, sealed (e.g. concrete) land, and the farms must also have RDA as a regular buyer. It can also be labour intensive. Grameen Shakti and the Infrastructure Development Company Ltd (IDCOL) were both interested in expanding the organic fertilizer market and linking more households with biodigesters to market. Grameen Shakti is licensed to market organic fertilizer under the Grameen Shakti brand. IDCOL is interested in developing collection points and collective processing of bioslurry. Both stakeholders recognized an increasing demand for organic fertilizer, as well as a need to build awareness.



Figure 3: Bioslurry drying in a field. Fertilizer made from dried liquid slurry from biodigesters can be sold to neighbours and intermediaries. Credit: Pin Pravalkrukskul / SEI



Figure 3. Organic fertilizer produced from bioslurry. Credit: Pin Pravalkrukskul / SEI

6. Current installation pathways for biodigesters

Small biodigesters

Farmers usually learned about small biodigesters through microfinance organizations, such as Grameen Shakti, that work with local livestock offices to obtain information about livestock ownership and organize village meetings to present the benefits of biodigesters and their financing programmes. In one village in Dhamrai Upazila, over half of the households we visited had small biodigesters for household-level use.

Small biodigesters were most commonly installed through microfinance loans from organizations, such as Grameen Shakti or BRAC, or through the Rural Development Academy. Costs for small biodigesters depended on their size. Small biodigesters from Grameen Shakti cost between BDT 26 000 and 52 000 for 1.6 to 4.8 cubic metres. Farmers that took out loans paid back in instalments over a period of one to ten years, with interest rates ranging from 6% to 13%. Grameen Shakti and the RDA provided technical support in installing and maintaining the biodigesters. BRAC also provided insurance services linked to microcredit loans and the loanee's family. In a few cases, households bought biodigesters without taking any loans. There were no cases of NGOs granting biodigesters to households or communities at no cost.

At least three or four cows are needed to produce sufficient manure for effective use of a small biodigester. Installation of the biodigester also requires an area of flat and non-waterlogged land measuring at least 5 x 10 metres.



Figure 4. An example of a small biodigester at a local farm. In a village in Dhamral Upazilla, more than half of households had small biodigesters installed. Credit: Pin Pravalkrukskul / SEI

Mid-sized biodigesters

The two households in our study with mid-sized biodigesters were approached by the RDA because they owned medium-sized livestock farms, which have the potential to run larger biodigesters. We found no cases of joint ownership of a biodigester among different households, or of different households contributing manure to the same biodigester. In one case the biodigester cost BDT 1 400 000 (USD 17 000). The household received a 10-year loan from RDA and paid monthly instalments of BDT 12 000 BDT (USD 150). In the other case, the biodigester cost BDT 400 000 (USD 5000), but RDA provided subsidies of BDT 200 000. The household paid for the biodigester in one instalment.

As with small biodigesters, a household must have a sufficient number of cows and land to install and run a mid-sized biodigester, bioslurry pit, and other equipment.



Figure 5. A mid-sized biodigester. Credit: Pin Pravalukruskul / SEI

7. Discussion

What are the necessary conditions for livestock farmers – particularly small-scale and landless farmers – to adopt biodigesters?

Our findings suggest that the basic requirements for livestock farmers to be able to install and run small and mid-sized biodigesters are:

- access to finance
- technical knowledge
- livestock and/or manure, and
- sufficient land.

The scale of each requirement might differ according to the size of the biodigester. First, livestock farmers need to be able to secure finance for the biodigester, either through savings, having assets to sell or use as collateral for a loan, or having the political and/or social status for a third party to agree to act as a guarantor for a loan.

Second, a farmer needs access to an organization (e.g. Grameen Shakti or the RDA), that can provide technical knowledge and materials to help install and maintain the biodigester.

Third, farmers need to own a sufficient number of livestock or poultry, or have access to manure (e.g. through buying or collecting unused manure from other farms) to be able to feed the biodigester.

Our results indicate that in the study locations there are viable pathways for adopting small and mid-sized biodigesters, and future research could determine how to best encourage these.

Fourth, farmers need to own or have access to sufficient land to house a digester and make full use of its benefits (e.g. land for drying bioslurry, or cropland for applying organic fertilizer).

Additionally, as noted in section 5, mid-sized biodigesters provide business opportunities that go beyond the household level. Many small-scale or landless farmers miss out on these livelihood benefits because they are not able to fulfil the necessary requirements (e.g. access to land) to make full use of the biodigester products, or do not have access to the market.

Current and potential pathways for installation of community biodigesters

The ILMM policy explicitly states that it will encourage the installation of community (mid-sized) biodigesters through the organization of farmers into collectives, similar to the dairy societies under the Bangladesh Milk Producers' Cooperative Union Ltd. (BMPCUL). At present however the BMPCUL operates through a "lead farmer" model, in which one farmer collects milk from various producers in a community and handles the transactions between the community and the dairy society factory. The policy therefore implicitly proposes to expand the adoption of mid-sized biodigesters adoption through the use of this "lead farmer" model. While this may prove to be a successful model, it cannot be considered as a "community-based model", under which ownership and management of biodigesters are shared.

For a range of reasons, we found limited potential for joint investments and common ownership of community biodigesters among households. There were no community-based organizations in the communities we visited (apart from microcredit cooperatives for agricultural activities). Local government was largely centralized, which created a hierarchical structure and limited the potential for people to develop networks. The lack of household-to-household social ties might also imply that the potential socioeconomic benefits of a community biodigester would be inequitably distributed.

However, we did receive information through an interview with the RDA about their programme to support the installation of genuine community owned and managed biodigesters. Further research would have to be conducted to verify the functioning and success of such a model.

8. Recommendations for future research

Our results indicate that in the study locations there are viable pathways for adopting small and mid-sized biodigesters, and future research could determine how to best encourage these. For mid-sized biodigesters, a political economy study could examine the influence of market factors (e.g. proximity to demand sites, access to transport, operating costs) for the production and sale of organic fertilizer and biogas products. The results of such studies could support government authorities and organizations working with the ILMM policy.

While our team did not observe adoption pathways for community owned and managed biodigesters, the interview with RDA indicated that these may be viable in the future. New research could examine the household conditions and enabling environments needed to encourage these pathways. In addition to the need for finance (e.g. availability of group microfinance loans) and technical requirements (e.g. land, and technical expertise for maintenance), research could also include aspects such as social capital and group formation, the social dynamics of participation, and the distribution of benefits among group members. Another focus might be the behavioural aspects of technology adoption in groups, compared with individuals.



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We also observed that in households using traditional manure management practices, women were responsible for drying manure for fuel, while in households with biodigesters, women were the main users of biogas. Women might therefore have a substantial influence in adopting improved manure management practices (e.g. depending on their fuel preferences or perceived health benefits). In addition, previous studies indicated that biodigesters reduced women's labour and time spent collecting and drying biomass fuels (BLRI 2016).

We recommend that future studies on biodigester adoption examine the roles of women in adoption pathways as well as the impacts of these pathways on their livelihoods.

References

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