Livestock farmers' knowledge, Perceptions, and Attitudes toward Biogas Plant in Bangladesh

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Received: 08.12.2013 Accepted: 09.02.2014

Abstract- Target group participation in planning is a key factor to set up strategies to disseminate any technology. The present study was conducted to know the knowledge, perceptions and attitudes of livestock farmers' about biogas plant and compare it with people who are not involved in livestock farming activities. The study was conducted in 25 villages from 3 districts of Bangladesh. Total number of participant was 320, among them farmers with biogas plant were 80, farmers without biogas plant were 80, and non farmers were 160. People making at least 25% of their total income from livestock farming activities was considered as farmer. Farmers' knowledge and perceptions about energy sources, raw materials of biogas and environmental impact of biogas were judged with dichotomous type of questions, and their attitudes about biogas was judged by a likert chart type question having 1 to 5 scale where 1 is strongly disagree and 5 is strongly agree. All the survey was conducted by visiting the farm and data was collected directly talking with the farm owner or with the respondent. Among the renewable energy, biogas and solar were well known to respondent compared to wind and water sources. All three non-renewable sources like fossil oil, coal, and natural gas were well known to the respondent. Among the five raw materials for biogas production, cow dung was well known as feeding materials to both livestock farmers and non farmers. 100% farmer and 75% non farmer were aware about cow dung. All the respondent with biogas plant has agreed that biogas could effectively control the odor of cow dung and poultry litter, and could provide a smokeless cooking environment. All farmers with biogas plant (100%) strongly agreed that biogas is good for their family and for the country and they will support and encourage others to built biogas plant. In conclusion, Bangladesh has a bright future for biogas technology because it has huge raw materials mainly cow dung and poultry litter and farmers have very positive attitudes towards biogas technology.

Keywords- Livestock farmer, Biogas plant, Knowledge, Perception, Attitude

1. Introduction

Livestock farming plays a pivotal role in village micro-economy of Bangladesh. It usually generates more regular cash income than crop production [1, 2]. As a result, livestock farming has shown a positive trend of development both in numbers and in production levels [3, 4]. Unfortunately, in nearly every step of meat, egg, and milk production, climate changing gases are released into the atmosphere which has adverse effect on weather, temperature and ecosystem health [5]. As the number of farm animals increases, so does their green house gas (GHG) emission. According to Food and Agricultural organization [5], the livestock animals are responsible for approximately 18%, or nearly one-fifth of human induced GHG emissions. Therefore, it is important to set up a mitigation program for GHGs.

The hazardous effects of livestock production on environment could be effectively mitigated by biogas technology [6, 7]. Biogas could be produced through

anaerobic digestion of biomass, such as livestock waste, agricultural and kitchen waste, municipal and industrial waste [8]. According to Parawira [9] anaerobic digestion consists of several interdependent, complex sequential and parallel biological reactions in the absence of oxygen, during which the products from one group of microorganisms serve as the substrates for the next, resulting in transformation of organic matter (biomass) mainly into a mixture of methane and carbon dioxide. This methane is as good as natural gas and could be used for cooking or for generating electricity. Aside from the production of heat and/or electricity, biogas has numerous other benefits for the agricultural farming system, such as the production of a nutrient rich effluent (digestate) which can be used as a fertilizer, pathogen and odor reduction, weed seed reduction, and manure volume reduction [10-12]. In addition, methane, which has a global warming potential of 21 times that of carbon dioxide, is destroyed through its combustion and thus there is a global warming benefit to the use of biogas [13].

Bangladesh is one of the least energy consuming countries of the world. Although, it has natural gas but only 3% population are enjoying the piped gas for cooking, per capita generation of electricity is still very low at about 170 kWh/year in 2006 [14]. About two-thirds of the total energy consumption in Bangladesh is attributed to the various forms of biomass: fuel wood, cow dung, straw, bagasse, etc [15]. In order to meet the energy demand of the rural households and other industries, deforestation is increasing at an alarming rate. So, efficient use of this biomass through biogas technology could be the best option for saving the environment and generation of power such as gas and electricity in Bangladesh. The first biogas plant was established in Bangladesh Agricultural University, Mymensingh almost 40 years back [16]. After that numerous government and nongovernment organization is providing services and training for biogas installation and maintenance.

Bangladesh has an ambitious plan to provide electricity to its all citizen by 2020 [17]. Biogas technology could be a great help to implement this strategy. Accordingly, various organizations are trying to speed up the installation of biogas plants. Information about behavior, attitudes, and knowledge through regular surveys is essential to disseminate any technology to end user. This is even more important for a country like Bangladesh where education level is very low and information pathway is very week. Unfortunate, there is no information about livestock farmers' thinking on biogas plant in Bangladesh. Therefore, the present study was conducted to know the livestock farmers knowledge, perceptions and attitudes, toward biogas plant and compare it with people who are not involved in farming activities.

2. Methodology

2.1. Selection of Study area

Twenty five villages from three districts were selected for the present study. The three districts are namely Pabna, Tangail and Mymensingh. Dairy and poultry farm activities were considered carefully before selecting the villages. Pabna is famous for dairy farming where as Tangail is famous for poultry farming and Mymesingh has a culture of both poultry and dairy farming. Farmers not installed biogas plant and non farmers were selected from villages where no biogas plant was installed.

2.2. Selection of Participant

The farmers were selected randomly with in some specified selection criteria. Those who generate 25% or more money of their total income from livestock farming activities were categorized as farmers. Accordingly, who generate less than 25% income of their total was considered as non farmer. For poultry farmer, only layer farm with above mentioned income criteria was considered for this study.

2.3. Development of questionnaires

The questionnaire for this study was developed mainly with dichotomous type of questions. However, the first part of questionnaire has some short answer type of questions about respondent personal and socioeconomic information like name and address, age, income from farming activities. Farmers' knowledge about renewable and non renewable energy was judged and then they were asked about seven energy sources (Table 2). The next set of questions was asked to determine farmers' knowledge about raw materials for biogas plant (Table 3). Farmers' perceptions about the impact of biogas on environment were judged by asking five questions (Table 4). Finally, farmers' attitudes about biogas were determined by asking five questions (Table 5). This set of questions were used five scaling frame where 1 corresponds to strongly disagree, 2 corresponds to disagree, 3 corresponds to I don't know, 4 corresponds to agree, and 5 corresponds to strongly agree. However, the figure presented in table 5 represents percent of only strongly agree. The questionnaire usually took approximately thirty minutes to interview each respondent.

2.4. Data collection and analysis

All the survey was conducted by the researchers themselves during October 2012 to March 2013. The researchers visited the farm and collected data directly talking with the farmer and non farmer. SPSS 18 was utilized to analyze the data. General descriptive statistics, percentage were used to present the data. Proportion test was used to compare the farmers' with or without biogas plant and the average score of farmer (both with and without biogas plant) judged with non farmer by proportion test (Z-test) with respect of knowledge, perceptions and attitudes towards biogas plant. The differences were calculated to compare percentage values at 5% level of probability.

3. Results

Table 1 presents the number of districts and villages where the survey was carried out and the number of respondent based on livestock farming activities together with installed or not installed biogas plant.

A total of 320 people were interviewed among them 160 were farmer and 160 were non farmer. There were 80 poultry and 80 dairy farmers among them 40 dairy and 40 poultry farmers installed biogas plant.

Table 1. Categorization of respondents according to livestock farming activities in different districts (n=320)

Respondents categories and living places	Pabna	Tangail	Mymensingh	Total
Number of respondents Village	7	10	8	25
1. Farmer				
i. Poultry with biogas plant	07	20	13	40
ii. Dairy with biogas plant	15	8	17	40
iii. Poultry without biogas plant	08	20	12	40
iv. Dairy without biogas plant	17	10	13	40
2. Non farmer	50	55	55	160
Total number of participants	97	113	110	320

Table 2 summarizes respondents' ability to determine the renewable and non-renewable energy sources, and their knowledge about seven different types of energy sources. Among the renewable energy biogas (100, 87 and 70% for farmers with biogas plant, farmers without biogas plant and non farmer, respectively) and solar (100, 85 and 90% for farmers with biogas plant, farmers without biogas plant and non farmer, respectively) were well known to respondent compared to wind (30, 20 and 17% for farmers with biogas plant, farmers without biogas plant and non farmer, respectively) and water (41, 37 and 30% for farmers with biogas plant, farmers without biogas plant and non farmer, respectively) sources. Among three non-renewable sources fossil oil and natural gas were well known to the respondent (95 to 100%) compared to coal (44 to 48%). The farmer installed biogas plant have better knowledge ($P<0.05$) on biogas and solar energy sources then non farmer and the farmer not installed biogas plant. No significant difference was observed among farmer categories and farmer to non farmer in relation of non renewable energy.

Table 2. Farmers' ability to determine the nature of energy sources

Energy Type	Farmers (%)		Average score of farmer (%)	Non Farmer (%)	Proportion test (Z- value) (Asymp. Sig. (2-sided)	
	Installed BP	Not Installed BP			Farmers	F & NF*
1. Renewable						
i. Biogas	100	87	93	70	3.335 S	5.2979 S
ii. Water	41	37	39	30	0.5186NS	1.6933 NS
iii. Wind	30	20	25	17	1.461 NS	1.7567 NS
iv. Solar	100	85	93	90	3.601 S	0.9621 NS
2. Non-renewable						
i. Fossil Oil	100	99	99	95	0.8966NS	2.09729NS
ii. Coal	48	44	46	48	0.5075NS	-0.3548NS
iii. Natural gas	100	99	100	98	0.8966NS	1.797NS

*F & NF means Farmer and non farmer

Farmers' ability to determine about the various sources of raw materials for biogas production is summarized in Table 3. Among the five raw materials, cow dung was well known as feeding materials to both livestock farmer and non farmers. 95% farmer and 70% non farmer were aware about cow dung. Most of respondent (92% farmer and 97% Non farmer) failed to recognize agricultural waste as a raw material for biogas plant. There are significant different ($P<0.05$) among farmer and non farmer; and farmer installed biogas plant and farmer not installed biogas plant to determine the different sources of raw materials for biogas production except for kitchen and agricultural waste.

Table 3. Farmers' ability to determine about the various sources of raw materials for biogas production

Type of raw materials	Farmers (%)		Average score of Farmer (%)	Non Farmer (%)	Proportion test (Z- value) (Asymp. Sig. (2-sided)	
	Installed BP	Not Installed BP			Farmers	F & NF*
1. Cow dung	100	89	95	70	3.051S	5.8848S
2. Poultry litter	87	50	68	33	5.037S	6.2613S
3. Kitchen waste	50	35	42	27	1.919NS	2.8223S
4. Agricultural waste	11	5	8	3	1.3987NS	1.9616S
5. Municipality waste	66	38	52	28	3.5445S	3.5102S
6. Combination of one or more together	51	20	35	14	4.097S	4.3672S

*F & NF means Farmer and non farmer

Respondent's perceptions about the impact of biogas on environment are mentioned in Table 4. All the respondent with biogas plant has agreed that biogas could effectively control the odor of cow dung and poultry litter, and could provide a smokeless cooking environment. About 64% of farmers who did not installed biogas plant think that biogas is environment friendly but they were not aware that biogas could reduce odor in farm area (68%) and could provide a smokeless cooking environment (55%). Farmers with biogas (82%) and without biogas plant (63%) thought biogas could reduce deforestation while only (41%) non farmers agreed on this issue. Respondent's perception about the impact of biogas on CO_2 emission is very low. There are significant perceptions differences ($P<0.05$) about environmental elements among the farmers groups and farmer and non farmer except for CO_2 emission.

Table 4. Farmers' perception about the impact of biogas on environment

Impact	Farmers (%)		Average score of Farmer (%)	Non Farmer (%)	Proportion test (Z- value) (Asymp. Sig. (2-sided)	
	Installed BP	Not Installed BP			Farmers	F & NF*
Biogas could reduce odor	100	32	66	24	9.0787S	7.551 S
Biogas could reduce smoke	100	45	73	26	7.7903S	6.4867S
Biogas could reduce deforestation	82	63	73	41	2.2912S	5.7812S
Biogas could reduce CO2 emission	5	4	5	3	0.3050NS	0.9128NS
5. Biogas is environment friendly	91	64	77	45	4.0893S	5.868S

*F & NF means Farmer and non farmer

Respondents' attitude towards the biogas plant were judged in five questions and presented in Table 5. All farmers with biogas plant strongly agreed that biogas is financially good for their family and for the country, and they will support and encourage (91%) others to built biogas plant. In case of raw material shortage, 74% farmers with Biogas plant, 35% farmers without biogas plant and 17% non farmer strongly agreed to install community based biogas plant. Significant difference exists ($P<0.05$) among different groups where farmers with biogas plant have better attitudes toward biogas plant.

Table. 5. Farmers' attitude about the impact of biogas as a whole

Impact	Farmers (%)		Average score of farmer (%)	Non Farmer (%)	Proportion test (Z- value) (Asymp. Sig. (2-sided)	
	Installed BP	Not Installed BP			Farmers	F & NF*
Encourage others to install biogas plant	91	25	58	40	8.4573S	1.7978S
Willing to install community based biogas plant	74	35	55	17	4.9532S	6.5854S
Biogas can save money from buying fire wood/ others	100	64	82	57	5.9263S	4.8567S
Women can involve cash generating activities as they can save cooking time	100	57	79	37	6.6193S	7.611S
5. Biogas is good for country's economy	100	84	92	51	3.7300S	8.1236S

*F & NF means Farmer and non farmer

4. Discussion

Farmers involved in livestock farming are the primary target group for installation of biogas plant in Bangladesh. Accordingly, the main objective of this study was to investigate the attitudes, perceptions, and knowledge of livestock farmers' toward biogas technology and compare it with the people who are not involved in livestock activities. Our results indicate that farmers have comprehensible knowledge, better perceptions and positive attitudes toward biogas compared to non farmers.

Respondents of present study were varied according to their knowledge about different energy sources presented in Table-2. Livestock farmers in general have better knowledge about biogas compared to the non-farmers group (93% vs. 70%; $P < 0.05$). However, all respondents both farmers and non farmers have low level of conceptions about the term renewable and non-renewable energy sources, like they have knowledge about biogas or solar energy but they could not recognized them as renewable energy. Low level of education could be the cause, only 5.21% population has 10 years formal education [18]. Farmers may not show interest on theoretical aspects of renewable energy rather install biogas plant and get benefit of it. Technology transfer worker also may not explain in details about renewable energy. However, periodical training of farmer, technology transfer worker and other people involved with this technology could improve the situation.

The result presented in Table 3 indicated that most of the respondents (100%, 89% and 70%; and 87%, 50% and 33% farmers with biogas plant, farmers without biogas plant and non farmers, respectively) could recognize cow dung and poultry litter as raw materials for biogas production. Indeed, in absence of organized waste management system cow dung and poultry litter are the only available raw materials of biogas production in Bangladesh [19]. Kitchen or agricultural waste is extremely difficult to manage. Respondents have limited knowledge about combined use of raw materials for biogas production. In Bangladesh context combined use of raw materials can booster biogas plant installation as most of the dairy or poultry farms do not have enough raw materials. If farmers combine cow dung, poultry litter, kitchen and agricultural waste together then they can have enough raw materials for gas production. It is well known that all biodegradable substances could produce biogas [9]. However, the gas production rate depends on its carbon and nitrogen content which is known as CN ratio. Substances having CN ration be 20 to 30 is considered good as feeding materials for biogas plants [20]. Based on this both poultry litter and cow dung are good feeding materials for biogas plant.

Bangladesh is one of the worst sufferers of climate change. Huge number of livestock population is further aggravating the situation. It is known that livestock produce huge methane which is twenty one times more dangerous than carbon di oxide [9]. The traditional burning of cow dung can not be effectively control the release of methane to the environment. Furthermore, the rural people (80% of total population) also use fire wood for cooking which accelerating the deforestation process [21]. Considering all these factors, both the government and nongovernment organization is giving much importance to installation of biogas plant. Accordingly, Table 4 indicates that 100% famers with biogas plant recognized that biogas could reduce odor in farm area and could reduce smoke during cooking hence can improve environment of their surrounding where as 32, 24% and 45, 26% farmers without biogas plant and non farmers were aware about these two questions, respectively. Farmers with biogas plant have conception that biogas could slow down the deforestation process (82%), and it is an environmental friendly (91%). However, respondents of all categories were confused how biogas could reduce carbon di oxide emission to environment.

Table 5 indicates that 100% farmers with biogas plant strongly believe that the biogas is good for them and their family as they could save money and females could save time to involve other cash generating activities. They also recognized that biogas could improve child education as they could also save time. Traditionally, in rural areas of Bangladesh children especially the girls devote a considerable amount of time to collect fire wood or leaves for cooking.

5. Conclusion

In conclusion, Bangladesh has a bright future for biogas technology because it has huge raw materials mainly cow

dung and poultry litter and farmers have very positive attitudes towards biogas technology.

Acknowledgements

The generous funding from National Science and Technology Ministry, Peoples Government of Bangladesh is highly appreciated and acknowledged.

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