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Biogas plant in Chittorgarh district of Rajasthan: A case study

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Abstract
The study focused on evaluating the performance of biogas plant among the Chittorgarh district of Rajasthan state. Data from existing biogas plant located in Chittorgarh District was used for the study. Survey of 32 randomly selected biogas plant was completed. Only Deenbandhhu biogas plants were identified. 27 biogas plants were found operational and 5 biogas plants were found nonoperational. Lack of dung availability and water was main reason for nonfunctional biogas plant. Farmers are practiced to collect bio-slurry in a pit and used it as organic manure twice in a year.

Keywords: Deenbandhu, Survey, functional, Bio-Slurry, Rajasthan, BDTC, NBMMP

Introduction
By virtue of its generation from waste and readily available animal dung, biogas is a well-established, sustainable, and widely-popular source of energy around the world. Biogas is a fuel and fertilizer replacement; the plant produces gas while also increasing the fertilizer value of manure. According to estimates, 69 percent of the total dung available is used as manure, 29 percent as fuel cakes, and the remaining 2% is used for various uses (Nesmith, 1991) [5].
India can generate roughly 17000MW of power utilizing biogas in general. This power is projected to account for more than 10% of India's total electricity (Chauhan, 2009, Ranga Nathan, 2010) [17]. The heat produced by biogas is more efficient than that produced by burning of biomass. Biogas is only allowed to be used for cooking in Rajasthan. If the Plant fails to meet expectations, it should be considered a country loss (Kumar et.al, 2014). In the current scenario, total gas and slurry availability in Chittorgarh district varies slightly depending on the capacity of installed biogas plant. Anaerobic digestion is used to generate biogas from animal dung and other agricultural wastes. This energy can be used to meet the current and future energy needs of rural areas. Biogas provides 13% of the world's total energy, equivalent to 25 million barrels of primary energy (Mittal, 1997) [14].
Most popular primary source for biogas production is cattle dung. India has the world's largest livestock population, with over 300 million animals producing 980 million tonnes of animal excreta. If all available cattle manure is used for biogas generation, over 195 billion kW-h of energy may well be generated annually (Govil and Gaur, 2000) [10]. Dung energy is not yet thoroughly explored, thus its contribution is restricted to 1.2 percent, whereas other energy sources, such as coal (32.5 percent), oil (38.5 percent), and gases (19 percent), provide significantly more (Rai., 1997) [16].
Only these sources of energy are fast depleting, necessitating the research for a low-cost substitute that can meet the energy needs of both rural and urban populations. Currently, India's energy generation system relies heavily on indigenous sources of wood, straw, and dung for combustion. However, a lack of affordable and appropriate energy frequently impedes rural development and slows the improvement of village life quality.
According to data obtained from the Biogas Development and Training Center, Udaipur, a total of 77 biogas plants have been constructed out of the 2734 biogas plants during 2009-10 to 2016-17 under national level scheme of National Biogas and Manure Management Programme supported by Ministry of New and Renewable Energy (MNRE), Government of India. In order to find lower adoption rate of biogas technology, scheme's performance, implementation method and impact at the ground level, an assessment study at local level is required (CMS, 1996 & 2008). The study may recommend changes to the scheme's design and implementation that could lead to better performance of scheme at ground level. Findings of this study could also aid in identifying areas of strength and weakness.

Material and Methodology

In the Chittorgarh District, a survey was performed to gather input from the owners. Out of total 77 biogas plant constructed in District Chittorgarh 32 biogas plants were selected on random basis. A questionnaire was created for this study after evaluating numerous research publications which included beneficiary's information, biogas plant history, and socio-economic characteristics. A door-to-door survey was performed. The primary goal of biogas plant is to increase gas generation efficiency, application uniformity, and maintain input raw materials. Main aim of data collection is to understand the beneficiaries level of satisfaction and issued faced during operation.

Conceptual Framework

The purpose of this study was to determine the current state of rural household energy use and to identify factors influencing household acceptance of biogas technologies. It was necessary to investigate the relationship between several parameters affecting household adoption of biogas technology (Bhatia, 1990). The following factors were discovered as a result of the literature review. Various socioeconomic, demographic, and institutional factors, as well as technology awareness, have influenced rural household adoption of biogas technology.

Result and Conclusion

Biogas installation pattern

Out of the thirty two biogas plants, a total of 20 biogas plants were found of 2 cubic meter capacity with an average of 5 family members and average 6 livestock. This information indicates that their daily biogas generation meets their daily energy needs for cooking. A total of 7 biogas plants with a capacity of 3 cubic meters were found with an average of 8 family members and average of 9 cattle. Three beneficiaries have biogas units with a capacity of four cubic meters with an average 11 number of family members and cattle. Two biogas plants with a capacity of 6 cubic meters were found. Owners of these biogas plants have an average of 13 family members and 23 animals and the beneficiary was a dairy owner (Fig.1.). These plants are rarely erected.

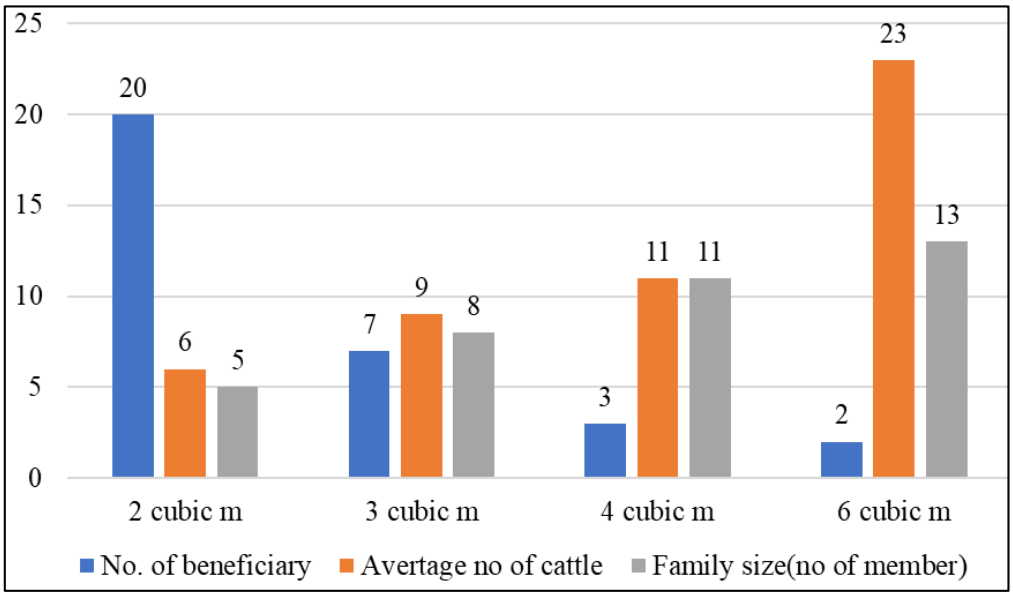

Fig 1: Availability of cattle

Source of information about biogas plant:

Farmers got information about biogas technology mainly by the BDTC or NGO working in their respective areas as shown in Table 1. According to their information, the Biogas Development and Training Centre Udaipur regularly were conducting programmes for awareness creation about biogas technology. It is observed that once a biogas plant is established in a community, neighbors were quick to adopt the technology after seeing the benefits of the plant in terms of fuel savings, time savings, and improved health.

Biogas is used solely for cooking and the production of organic manure by each biogas beneficiary as shown in Table 2. Sometimes it is used for heating the water for domestic application. On average, biogas is used for cooking for roughly 4 hours each day, though this varies from 2 to 5 hours depending on the family. Only double burner biogas stove is used by the beneficiaries. As per the survey, total 93% beneficiaries were satisfied with the technology as cooking fuel is available at free of cost and 7% beneficiaries are disappointed with the technology as labour work to mix cattle dung with water is associated (Fig.2.).

Table 1: Information about biogas technology

Size of Biogas Plant (in Cubic meter)	Neighbors	News Paper	Friends & Relatives	BDTC/ NGO	Total
2	5	-	5	10	20
3	2	-	-	5	7
4	1	-	-	2	3
6	-	-	-	2	2

Table 2: Applications of biogas

Purpose of install Biogas plant	Capacity of biogas plant (m^3)				Total
	2	3	4	6	
a) For cooking	20	7	3	2	32
b) For organic manure	20	7	3	2	32
c) For lightening	-	-	-	-	-
d) increase social prestige	-	-	-	-	-
e) As a hobby	-	-	-	-	-

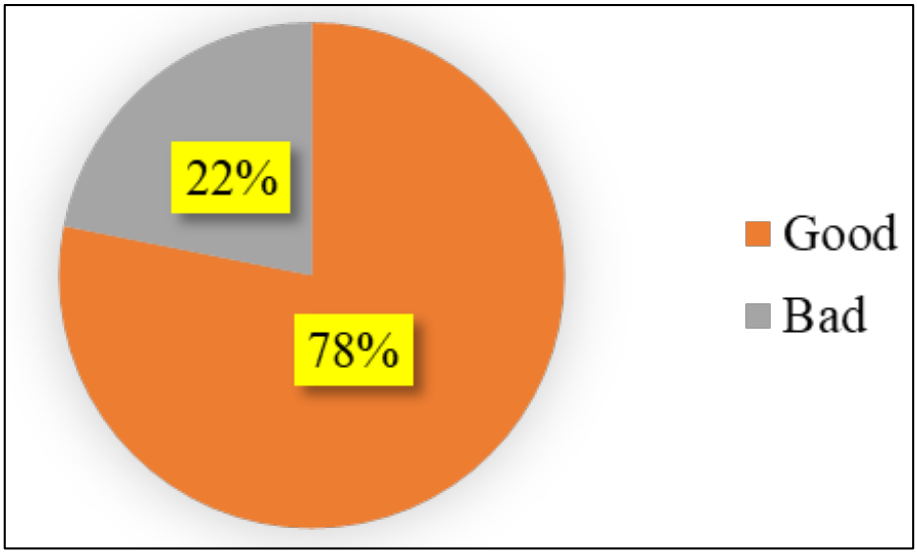

Fig 2: Satisfaction level of beneficiary

Non-functional biogas plant

Out of 32 plants 5 plants wore found nonfunctional. There are four common reasons which are mentioned in table 3 and fig.3.

Table 3: Reason for non-functional biogas plant.

S.N.	Reason for non-functional	Number of plants non functional	Remarks
1	Lack of dung	1	Due to migration of cattle.
2	Lack of water	1	Less availability of water
3	Technical Issue	2	Burner and pipeline issue
4	Structure Failure	1	Hair crack over dome found

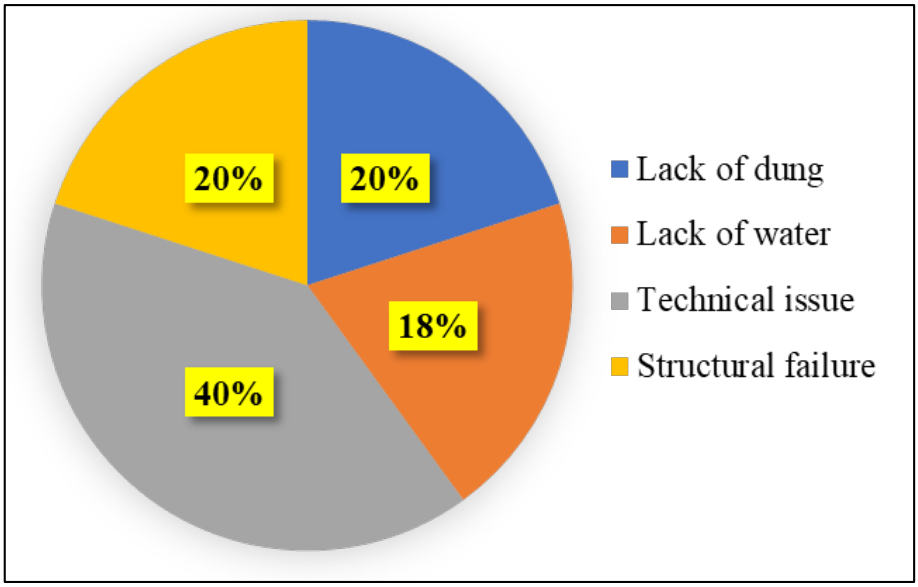

Fig 3: Reason for non-functional of biogas plant

Dung and water is required for the operation of a biogas plant. For a biogas plant to work smoothly, a specific daily rate of dung with equal amount of water is required. 2 biogas plants have been observed nonfunctional due to migration of cattle and lack availability of water. It was observed that Biogas beneficiaries were not been well aware technically about

biogas plants or other related accessories like biogas Challahs. So, when any technical problems occur in biogas plants and related accessories, they simply stop it. There were total 2 plants not working due to this problem. Structural failure also leads to stop production of biogas plant. A biogas plant was found with structure issue.

Conclusion

In this study, it was aimed to analyze the consent of biogas plant owner through randomly selected biogas plant in Chittorgarh District. Only Deenbandhhu biogas plant was found during survey. The study focused on evaluating the performance of biogas plant among the district of Rajasthan state. Data from existing biogas plant located in Chittorgarh district, was used to study the operational performance of randomly selected biogas plant. Out of 32 biogas plants 27 biogas plants were operational and 5 plants were found nonoperational. Reason found behind non-functional plant is mainly lack of dung, lack of water, technical issue and structural failure. As per the survey, it is concluded that the technology is more beneficial for the farmers and might be helpful to double the farmer's income (Bajgain, 2005) [1]. Subsidy on the biogas plant can also be raised so more biogas plants can be constructed (Devkota, 2001) [8].

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