Journal of Environment and Earth Science
ISSN 2224-3216 (Paper) ISSN 2225-0948 (Online)
Vol.6, No.5, 2016

Study Regarding Domestic Biogas Plants in Selected Villages of Kurukshetra, Haryana (India)

Meenakshi Suhag[1*] Alka Sisodia[2]
1.Assistant Professor, Institute of Environmental Studies, Kurukshetra University, Kurukshetra, Pin 136119, Haryana, India
2.M. Sc. Student (2011-2013), Institute of Environmental Studies, Kurukshetra University, Kurukshetra

Abstract
In order to contribute India's overall development the rural sector of the country must be given proper attention. Providing clean energy through sustainable use of clean fuels for cooking in rural households to promote the quality of life is one such area to be focused. In this, context biogas is one of the environmentally sound options which can be generated by regionally available raw materials and livestock waste. The use of agricultural substrates to produce biogas and electricity has grown tremendously in the recent past. To promote and disseminate information about biogas technology, the Indian government has organized National Projects time to time on Biogas Development and several NGO's have been active in implementing the programmes. The present study investigated the opportunities of biogas production in selected villages of Kurukshetra, Haryana. A survey based study was carried out to evaluate the benefits, popularity, financial assistance and problems associated with biogas generation. Rural household survey showed an overwhelming response by the farmers in favour of domestic biogas plants. Most biogas plants built were of Deenbandhu model and cattle waste was used as common feedstock for biogas production. In addition to biogas, useful soil conditioner and manure have been obtained from the residual slurry. Study revealed that majority of the plants built were functioning satisfactorily, providing domestic energy and improving hygienic conditions in respective houses. However, certain challenges of reduced efficiency during winter, insufficient cattle dung and lack of skilled manpower were reported by the users which needed to be rectified accordingly.
Keywords: Biogas, biogas plant, rural areas, cattle dung

1. Introduction

Energy affects every aspects of development- social, economic and environmental. With increasing industrialization, population and vehicular transport system the use of energy resources is going on and on. The effects of the increasing energy requirements and of the fossil fuels extraction reduction will result in a tremendous price increase of conventional fuels (Bove and Lunghi, 2005). To deal with this energy problem and our dependence on fossil fuels, biogas, a clean and renewable form of energy, could be the alternative (Walekhwa *et al.* 2009). Biogas with methane as the major component is now a day's considered as a source of energy for heating and electricity production and as a car fuel in many countries in the world (Teghammar *et al.* 2012). Biogas contains around 55-65% of methane, 30-40% of carbon dioxide and small quantities of hydrogen, nitrogen, oxygen and hydrogen sulphide (Mahapatra *et al.* 2009). Methane is the component chiefly responsible for a typical calorific value of 21-24 MJ/m^3 (Dimpl, 2010) or around 6 KWh/m^3. Biogas burns with a clean, blue flame and stoves have been considered the best means of exploiting biogas in rural areas of developing countries. The efficiency of biogas stoves has been quoted as 20%-56% (Itodo *et al.* 2007).

In a country like India, where nearly 70% of the total population inhabits rural areas, biogas can be easily obtained by anaerobic digestion of domestic and farm wastes, like cattle dung, abundantly available in the countryside (Satyanarayan *et al.* 2008). According to India's 19th livestock census 2012, there are estimated over 512.05 million numbers of cattle's. Biogas technology is a particularly useful system in the Indian rural economy and can fulfil several end uses. Biogas can be produced by regionally available raw materials and recycled waste and is environmentally friendly and CO_2 neutral. The use of agricultural substrates to produce biogas and electricity has grown tremendously in recent past. The Indian Government's National Biogas and Manure Management Programme (NBMMP) seeks to deliver renewable energy services to households across the country by facilitating the development of family-sized (< 6m3) anaerobic biogas digesters (Raha *et al.* 2014). To promote and disseminate information about biogas technology specifically, the government has organized the National Project on Biogas Development nation-wide and several NGO's have been active in implementing the program on the ground. The technology has the potential to contribute to mitigation of greenhouse gas emission (Han et al, 2008). According to Lantz *et al.* (2007) biogas systems lead to reduce eutrophication and air pollution and improved utilization of crop nutrients. Biogas certainly has a significant impact on rural women's lives. A regular supply of energy piped to the home reduces, the task of fuel wood gathering, the most time consuming in areas of scarcity (Mwakaje, 2007).

The present study has been proposed to investigate the opportunities of biogas generation from different selected villages of Kurukshetra (Haryana) of India. A survey based study was carried out to evaluate the

benefits, popularity, financial assistance and problems associated with biogas generation.

2.Study area and methods

2.1Study area description

This study was conducted in 10 villages (Table1) of Kurukshetra district in 2013. Kurukshetra is situated in Haryana (India). It is a land of historical and religious importance. Historically the land belonged to Punjab but now it is a district in Haryana State of India. Climate of the district is very hot in summer upto 47^0C and cold in winter down to 1^0C with rains in July and August. It is a holy place and is also known as Dharmakshetra. The importance of the place is attributed to the fact that the kurukshetra war of the Mahabharata was fought on this land and the Bhagavad Gita was preached by Lord Krishna to Arjuna during the war. Haryana is a state in India and it is located in the northwest part of the country. 10 villages of Kurukshetra district were selected for convenience or as per the information from agriculture office.

2.2 Data Collection Methods

- House hold survey by using Questionnaire
- Interview method
- Visit/ physical verification of the biogas plants
- Information collected from Department of Agriculture, Kurukshetra

3. Results and discussion

As per the study, it has been observed that villagers having biogas plants in their houses were found to be satisfied with their output. Majority (80%) of the plants visited in Karami village were about 15-20 years old. Main raw material feed to the biogas plant was cowdung as most of the villagers are farmers and have their own cattle. Studies showed that cow dung might be one of feedstock for efficient biogas production and waste treatment (Umar Ibn Abubakar and Ismail, 2012).

In some villages kitchen waste (vegetables and fruits waste) and human waste is also used along with cowdung. Anaerobic digesters also function as a waste disposal system, particularly for human waste, and can, therefore, prevent potential sources of environmental contamination and the spread of pathogens. The construction cost of family type biogas plant (2-4m^3) was 13000 to 15000 Rs/- and subsidy received by the owner was 8000 Rs/-. A family biogas plant usually requires a daily supply of at least 20 kg of dung in order to produce considerable gas for daily cooking for 5-6 members of a family which helps to save 7-9 LPG cylinders annually. Deenbandhu biogas plant design (2m^3 capacity) was found to be most popular (99%). Size of the plant depends on the daily availability of cattle dung, and space. The Deenbandhu digester has a dome structure forming both the digester and the gasholder and is constructed of bricks. Input factors for the production of biogas may be livestock and poultry wastes, night soil, paper wastes, aquatic weeds, water hyacinth and seaweed, hay, corn maize and crop residues such as cane trash and plant stubble (Corato and Moretto, 2011).

Few farmers were found to use biogas for electricity generation in Gamdi village by connecting gas pipe to the generator nossel. The biogas along with only 1- 1½ liter diesel was sufficient to provide electricity for the whole night. Bio-manure (slurry), a by-product and having fewer odours, which obtained from the biogas plant after the digestion, is used as a fertilizer by the farmers. By using slurry in fields further solved disposal problem. Additionally extra income is generated by landless farmers by selling the slurry. Some plants have low gas production because of choking of gas holder/gas pipe by dung which can be solved by regular cleaning of plant. Some respondents reported cracks in house walls which may be due to moisture/faulty constructions and can be rectified by using moisture removal device. The gas production is less during winter season as compared to summer. Kalia and Singh (1996) reported that biogas production reduced from around 1700 l/day in May-July to around 991 l/day in January-February. Biogas production depends on many factors such as temperature, pH, loading rate, and type of raw material. Various suitable biomasses have been identified for their potential as a supplement to the cattle dung digesters for enhancing gas production. Biomass with a carbon: nitrogen ratio between 20 and 30 has been reported to produce optimized biogas composition (Neves et al. 2009). It is believed that fresh human excreta are suitable for biogas production, whereas sludge collected from septic tanks, pit latrines, etc. is not. According to a study (Khoiyangbam et al. 2004) difference in the ambient temperature under the two climatic conditions of Hills and plain regions affects the CH_4 flux. The annual average methane emission from the biogas plants in plain areas was 83.1 gm^{-2} d^{-1} as compaired to 43.1 gm^{-2} d^{-1} in the hilly areas. The study reveals that soya sludge has a good potential as an energy source. Soya sludge addition to cattle dung digesters improves gas production, manorial value and capillary suction time. Also soya sludge in any ratio is beneficial to cattle dung digesters for enhancement of gas particularly in winter season (Satyanarayan et al. 2010).

4. Conclusions

Biogas technology offers a very good potential energy option for the rural communities as it is a clean renewable energy source. Biogas use can dramatically improve the health of users particularly women. Installation of biogas plant improves economic conditions of the farmers as they can trade the bio-manure. In addition to this low cost fertilizers would be available for enhance the yields of crops in their own fields. Instead off its various benefits people still not fully aware about its potential which hinders its wide acceptance.

Acknowledgement

We gratefully acknowledge all the respondents who participated in the study. We are thankful to Department of Agriculture, Kurukshetra for providing necessary information.

Competing Interests

The authors declare that they have no relevant competing interests.

References

- Bove, R. & Lunghi, P. (2005), "Experimental comparision of MCFC performance using three different biogas types and methane", *Journal of Power Sources,* 145, 588-593
- Dimpl, E. (2010), "Small-scale Electricity Generation from Biomass", *Part II: Biogas*, Deutshe Gesellschaft fur Technische Zuusammenarbeit (GTZ)-HERA
- Han, J. L., Mol, A. P. J., Yonglong, L. & Zhang, L. (2008), "Small-scale fuelwood projects in rural China-lessons to be learnt", *Energy Policy*, 36, 2154-2162
- Itodo, I. N., Agyo, G. E. & Yusuf, P. (2007), "Performance evaluation of a biogas stove for cooking in Nigeria", *Journal of Energy in Southern Africa*, 18(3), 14-18
- Lantz, M., Mattias, S., Bjornsson, L. & Borjesson, L. (2007), "The prospects for an expansion of biogas systems in Swedwn-incentives, barriers and potentials", *Energy Policy*, 35, 1830-1843
- Mahapatra, S., Chanakya, H.N. & Dasappa, S. (2009), "Evaluation of various energy devices for domestic lighting in India: Technology, economics and CO_2 emissions", *Energy for Sustainable Development*, 13, 271-279
- Mwakaje, A. G. (2008), "Dairy farming and biogas use in Rungwe district, south-west Tanzania: a study of opportunities and Constraints", *Renewable and Sustainable Energy Reviews*, 12(8), 2240-2252
- Neves, L. C. M., Converti, A. & Penna, T. C. V. (2009), "Biogas production: new trends for alternative energy sources in rural and urban zones", *Chemical Engineering and Technology*, 32(8), 1147–53
- Srivastava, L., Goswami, A., Diljun, G. M. & Chaudhury, S. (2012), "Energy access: revelations from energy consumption patterns in rural India", *Energy Policy*, 47, 11-20
- Teghammar, A., Karimi, K., Horvath, I.S. & Taherzadeh, M.J. (2012), "Enhance biogas production from rice straw, triticale straw and softwood spruce by NMMO pretreatment", *Biomass and Bioenergy*, 36, 116-120
- Umar Ibn Abubakar, B. S. & Ismail, N. (2012), "Anaerobic digestion of cow dung for biogas production", *ARPN Journal of Engineering and Applied Sciences*, 7(2), 169-172
- Walekhwa, P. N., Mugisha, J. & Drake, L. (2009), "Biogas energy from family-sized digesters in Uganda: Critical factors and policy implications", *Energy Policy,* 37, 2754-2762

Table 1 Name of selected villages in the study area

Sr.No.	Villages	Sr.No.	Villages
1	Pindarsi	**6**	Adhouni
2	Gharsi	**7**	Ajrani
3	Bhansi majra	**8**	Ajrana Khurd
4	Karami	**9**	Gamdi
5	Kamoda	**10**	Gamoorkhedi

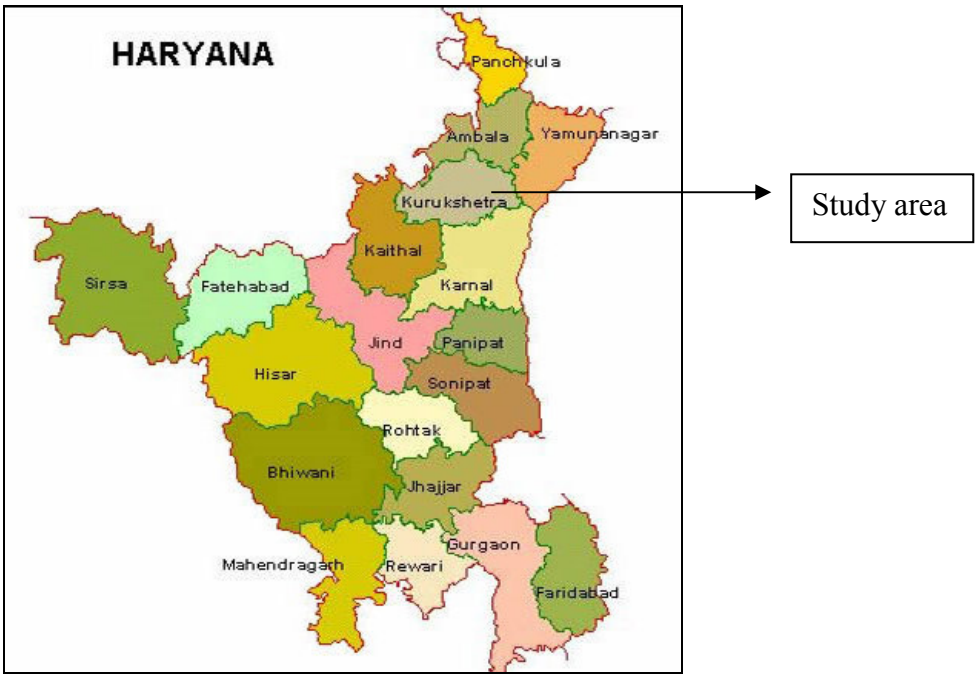

Figure 1Location of the Study area

Figure 2: Deenbandhu biogas plant in Pindarsi Village