SOCIOECONOMIC IMPACT OF BIOGAS ON PADAMPUR VDC IN CHITWAN, NEPAL

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Abstract

Biogas as a new and modern alternative energy resource generated within the households of the rural premise is studied in order to assess the socio-economic condition of the users. The study was carried out in the Padampur VDC of Chitwan District in 2010. The study is based on a sample of 35 biogas users (14 percent of the installed plant). The study found that the use of biogas energy has saved 80 percent of fuel wood and kerosene consumption and 50 percent use of electricity in the households surveyed. Likewise, the use of biogas effluent, by-product from the domestic plant, is proved useful as bio-fertilizer in the agriculture field. More than 71 percent biogas users found increase in their agricultural production. Thus, the installation of biogas has brought some positive changes in health, hygiene and the sanitation including household income.

Key Words: Biogas plant, fuel, household, dung, installation, socio-economic benefit, cooking stove.

Introduction

Biogas is a gaseous matter produced from the organic waste such as animal dung, human excreta and plant residues by the action of bacteria in anaerobic condition. It is one of the major alternative sources of energy generated and used exclusively in the rural sector of Nepal (Gewali, 2009). The primary feed stock used to generate biogas in the country is still limited to the cattle dung. Although the biogas production using dung is one of the safe ways, particularly in the rural areas, the lower rate of gas generation during the winter season is one of the primary limiting factors and the other organic waste of the household remains unutilized in the biogas plants. Although it is an essential system of alternative energy sources in rural sector, only 260,000 units of biogas plants are installed in about 70 districts of Nepal. The potentiality of cattle dung based biogas plants in Nepal is about 1.9 million units (BSP/N, 2009). However, only 13.64 percent of the total potential has been achieved until January 2012. The chief purpose behind the installation of biogas plants are cooking and lighting. It burns with a clear blue and smokeless flame. The utensils remain neat and clean and cooking environment becomes healthier. It requires lesser time for cooking than that of firewood. There are many limiting factors associated with the biogas promotion in the country including the financial subsidy, enhanced technical supports and the socio-economic benefits in the worked out quantitative format. The practical benefits of the domestic biogas plant should be well elaborated before the socio-economic benefits assessment.

In Nepal, the standard model of biogas plant in mass implementation was introduced by the Gobar Gas Company (GGC) in 2047, which has been officially accepted. The model was a fixed dome type and standard specifications are available for 4 to 20 cubic meters n size. The plant can be built with bricks/ stones, cement, sand and some still rods. Normally it works well up to an altitude of 2100 meters, but with slight modification it can be implemented up to 3000 meters and above (Singh, 2004). The standardized feed stock rate is 6 kilograms of fresh dung per cubic meter plant size in hilly districts. Under the standard condition, one kilogram dung generates about 40 liters of biogas. One cubic meter of fresh biogas retains the net heating value of 23 Mega Jules (MJ). A standard 6 cubic meter domestic biogas require 36 kilograms of fresh dung and 36 liter of fresh water every operating day. Theoretically such biogas plant if feed up with required input, it will generate 1.440 cubic meter of domestic biogas with the energy potential 33.12 MJ. If the biogas is used in the standard cooking stove, it can provide about 60 percent energy efficiency during the cooking time. It means the daily use of biogas can provide 19.87 MJ of useful energy at each household (Singh, 2004).

Installation and use of biogas for household use has a significant contribution in enhancing people's livelihoods affecting different aspects of the lives and livelihoods. In this connection, this paper attempts to analyze the socioeconomic impact of biogas on livelihoods of people living in Padampur Village Development Committee in Chitwan district, central Nepal.

Materials and Methods

The study is based on both primary and secondary data. The primary data was collected through household survey and group discussions with extensive field observation during January 2011. A total of 35 households having biogas plants were selected randomly from total 261 households having biogas plants from Padampur VDC in Chitwan. Structured questionnaire was used for household survey. Relevant secondary data/information was obtained by reviewing literature such as published and unpublished documents and reports. The analysis is based on quantitative and qualitative assessment. Both statistical and non statistical tools are applied for data analysis.

Study Area

The study area Padampur VDC is one of the 38 VDCs of the Chitwan district. It is situated in the northern part of the district. The area is surrounded by Jutpani VDC on the east, Khagari Khola on the north and Barandwar jungle on the south. The old Padampur is situated near the Chitwan National Park. The average elevation of the VDC area is 210 meter above the mean sea level. The average maximum and minimum temperature recorded is 40 ^{0}C and 6^{0}C respectively. The VDC enjoys sub-tropical type of climate. The rainy season lasts from June to August with slight rain in February. The small rivulets/streams are mixed into the Khagari River in the west of the VDC. According to population census 2001, the total number of households in the VDC was 2036 with 12260 populations (male 52.42 percent and female 47.58 percent) (CBS, 2002). The population of the VDC is composed of different ethnic groups. Brahmin, Chhetri, Tharu, and Magar are the main ethnic groups of this area. Average household size is 6.02, which is slightly higher than the average national family size. In this VDC, 57 percent households own less than 10 Kattha land. The proportion of households owning 10-20 kattha and 21- 30 kattha is about 31.4 and 11.4 percent respectively. The average income of the household ranges from NRs 40,000 to 80,000 per annum.

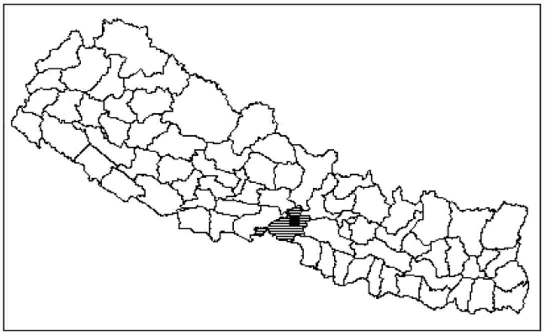

Figure 1: Location of study area (Padampur VDC)

Development of Biogas in Nepal

The first cooking practice by using biogas in Nepal actually took place in St Xavier School, Godavari in Lalitpur. In the year 1955, Reverend B. R. Souboll constructed the digester plant making use of a 200 liter metallic drum, with the facilitation of the inlet as well as the outlet devices along with the rubber pipe attached with the top hole of the drum head that release the biogas produced within the drum. Souboll has used to order his students to collect the cattle dung from the villages around the school area (Bhusal, 2008). One of the students, Mr. Mahindra Man Singh, Managing Director of TMB Energy technique is still active in his enterprise in Kathmandu. Father used to prepare the tea by using the dung generated biogas and call back his students, who spent time in collection of the cattle dung for him and offered tea and biscuits as an award to them. This way the rural people of the country came to know about knowledge of biogas energy.

Afterwards during 1973/74 the *Gobar gas Company tatha Krishi Aujar* Company was established in Butawal, Rupandehi district that took initiatives to build and promote biogas plants in Nepal. The organization experimented with the floating drum type, Dinbandhu model and various other models of biogas plants in different parts of the country. The fixed dome type Chinese model was also tried in Nepal. During 1980s they concluded by preparing a typical Nepalese design of fixed dome type brick-cement made biogas plant based on the Chinese Model modified to suit the Nepalese condition economic and implementable in rural conditions (Governmet of Nepal, 2007). The same model of Nepalese biogas plant was adopted by the Biogas Support Program, Nepal (BSP) in 1992, with elaborated technical specifications standard and named as GGC 2047 model.

Biogas technology has been in development and implementation phase particularly in the rural areas of the country since last two decades. It is one of the foremost active renewable energy technologies in Nepal. Currently, the biogas energy generates about 96 percent of the total renewable energy in the country; Government of Nepal, Ministry of Environment through the AEPC-BSP/N provides the financial subsidy (Rs 8000-12000) for the rural household biogas plant installation. So far 260000 plants have been installed covering about 70 districts of the nation. In Nepal, the government policy is still dependent upon the dung based biogas plants, which gives the synonym as the Gobar gas. Every year the biogas users' survey has been conducted in order to get the important feedback on the installed plants. But the reports either are not well circulated or the vital information is not properly taken care which has been felt by the users and the concerned stakeholders widely.

Biogas in Padampur VDC

The development of biogas in Padampur VDC is a recent phenomenon. It is obvious that the first biogas plant in this VDC was installed during 2062/63 B.S. Currently, there are altogether 261 biogas plants installed. Out of total 2036 households in Padampur VDC, only 12.81 percent owned biogas plant. All the plants are of GGC-2047 model. In this study, only 35 households were covered. The distribution of biogas plants by caste/ethnicity is shown in table 1.

Table 1: Ownership of biogas plant by caste/ ethnicity

Ethnic Group	Number of plants	Percentage
Brahmins	15	42.8
Chhetri	10	28.6
Tharu	5	14.3
Magar	2	5.7
Others	3	8.6
Total	35	100.0

Source: *Field survey, 2011*

Table 1 shows that majority of the plants were owned by the Brahmins. Almost 43 percent of the plants are owned by Brahmin followed by the Chhetri (28.6 percent), Tharus (14.3 percent), Magar (5.7perecnt) and others (8.6). The plants installed in the VDC are of different size (Table 2). The size of plant ranges from 4 to 8 cubic meters.

Table 2: Distribution of biogas plants by size

Size (m^3)	Number	Percentage
4	2	5.7
6	28	80.0
8	5	14.3
Total	35	100.0

Source: *Field survey, 2011*

Table 2 shows that 80 percent of the biogas plants are 6 cubic meter in size. The proportion of biogas plants having size of 8 m^3 and 4 m^3 is 14.3 percent 5.7 percent respectively. Smokeless and easy cooking is the main reason for the installation of biogas in this VDC. The availability of cattle dung is another reason as people raise livestock along with farming. All households kept some livestock in their house. On an average, the household kept one buffalo and/ or cow and some goats.

In Padampur VDC, each plant generates biogas as per the daily feed of the fresh dung and the water. On an average, 50 liters of water is used for each plant daily. Six hundred liters of biogas generate by 4 m^3 plant each day i.e. equivalent to 13.8 Mega Jules of power and 6 cubic meter plant generate 800 liters (0.8 cubic meters) of biogas equivalent to 18.4 MJ. Similarly, 8 cubic meter plant generate 1200 liter (1.2 cubic meters) of biogas. The generation of biogas varies by households that depend on the amount of cattle dung production. The production of cattle dung varies by households ranging from 10 to above 30 kilograms daily. All the installed plants are under feeding (Table 3).

Table 3: Daily dung feed rate to the biogas plants (kg)

Plant size (m^3)	Recommended amount	Feeding Amount	Difference (%)
4	30	15	15 (50.0)
6	45	20	25 (44.4)
8	60	30	30 (50.0)
Total	135	65	70 (48.0)

Source: *Field survey, 2011*

Table 3 clearly shows the under feeding condition of biogas plants of this area. Almost 50 percent of the installed capacity is utilized.

Socioeconomic impact of biogas on Users

The installation of biogas has brought some changes on socioeconomic condition of the people of Padampur Village Development Committee. After installation of biogas plants, people have started to feel prestigious and easy in cooking food. Saving time and money and reduction of health risks are other aspects of impact of biogas on the people. People especially housewives benefitted well. They got more time to involve in social woks, income generation activities and others.

Impact on health: Installation of biogas had a positive impact on the personal health of family members, especially of women. Though the relation of biogas with health hazards is not clear and factors are not clearly examined, the users are of the opinion that the major cause of health problems is the use of firewood. Table 4 shows the opinion of the biogas user households that they suffered from various health problems before installation of biogas in their house. After using biogas, these problems are being reduced remarkably.

Table 4: Health problem before biogas installation

Health problem	Households	Percentage
Respiratory	18	51.4
Eye burning	8	22.9
Headache	4	11.4
Coughing	3	8.6
No change	2	5.7
Total	35	100.0

Source: *Field survey, 2011*

The majority of households (51.4 percent) reported that they suffered from respiratory problems, 22.8 suffered from eye infection, 11.4 percent from headache and 8.6 from cough but now they got relief due to smokeless biogas. About 6 percent of the respondents feel no change before and after installation of biogas in their house. People claimed that the installation of biogas has reduced the health treatment cost.

Reduction in workloads and time saving: After installation of biogas, there was a considerable reduction in work loads of family members, especially the woman members who were basically involved in household chores like firewood collection, cooking and washing utensils. The reduction in workloads as measured in terms of saving time, observation was made on three categories of works- firewood collection, cooking and washing utensils. The time consumption of women in household activities before and after installation of biogas plant is given in Table 5.

Table 5: Reduction in workload and time saving before and after biogas installation

Work	Average time taken per day		Average time saving (hrs. per day)
	Before	After	
Firewood collection	5	1	4
Cooking activities	3	1	2
Washing utensils	1.5	0.5	1
Total	9.5	2.5	7

Source: *Field survey, 2011*

Table 5 clearly shows that the reduction of time for household activities especially for firewood collection, cooking and washing utensils. Installation and operation of the biogas plant saved four hours in fuel wood collection, two hours in cooking activities and one hour in washing activities daily. On an average, installation of biogas has saved 7 hours working load of a woman. The female of biogas user have now extra time to involve themselves to the other domestic, income generation and social works. The users responded that about 57 percent of the surveyed households utilized the surplus time in household work, 20 percent in the income generation activities, 14.3 percent social works and 8.6 percent in income generation activities like seasonal cash crop production. After installation of biogas the use of firewood, kerosene and even electricity has declined sharply (Table 6).

Table 6: Use of fuel before and after installation of biogas plants

Types	Before	After	Difference	%
Firewood (kg)	500	100	400	80
Kerosene (liter)	5.5	1.1	4.4	80
Electricity (units)	20	10	10	50

Source: *Field Survey, 2011*

The installation of biogas has reduced the use of firewood and kerosene by 80 percent and electricity by 50 percent. The use of electricity for cooking has completely replaced by use of biogas. The average amount of firewood used was 500 kg before installation and it is 100 kg after use of biogas. Local people also saved considerable amount of money that was previously spent on firewood, kerosene and others. On an average a household has saved NRs 700 monthly (Amgai, 2011).

Impact on agricultural production: The slurry, decomposed manure from biogas plant is being used in agricultural activities. The slurry is more useful than ordinary compost manure that helps increase in agricultural production by increasing soil fertility. Response of local people regarding the use of slurry and agricultural production is given in Table 7.

Table 7: Use of slurry for agricultural production

Production	Households	Percentage
Increase	25	71.4
Decrease	4	11.4
The same	6	17.2
Total	35	100.0

Source: *Field survey, 2011*

The use of slurry as the bio-fertilizer was found beneficial to agricultural production. The overwhelming majority of the respondents (71.4 percent) opined that the use of slurry increased in agricultural production as compared to compost manure used before the installation of biogas. Seventeen percent of the respondents experienced no change in agricultural production with the use of slurry and 11 percent reported a decline in production.

Conclusion

Biogas is a recently developed technology, being popular in rural areas of Nepal. The development and implementation of biogas in Padampur is also a recent phenomenon, less than a decade. There are altogether 261 biogas plants installed so far in the Padampur VDC. The installation of biogas has significant implications on livelihoods of people affecting in-house environment, especially, in health and hygiene, household expenditure and workload of women. Easy cooking and time saving are other noticeable aspects. The use of biogas energy has reduced up to 80 percent of expense on household fuel especially of firewood and kerosene and reduced 50 percent electricity consumption. The biogas has played a vital role to get rid of respiratory problems. The use of biogas effluent- slurry, by-product from the biogas system, is proved useful as bio-fertilizer in the agriculture field. More than 71 percent biogas users reported an increase in agricultural production due to the use of slurry. Thus, the installation of biogas has brought about some positive changes in health, hygiene and the sanitation including household income.

References

Amgai, K. (2011). *Socio-economic impact assessment of biogas plants in Padampur VDC of Chitwan district*, Unpublished Master's thesis, Department of Rural Development, Trichandra Campus, Tribhuvan University Kathmandu.

Biogas Support Program (BSP). (2009). *Annual Report*, Kathmandu: BSP.

Bhusal, R. B. (2008). *Socioeconomic impact of biogas plant installation in rural Nepal*, unpublished Master's thesis, Central Department of Sociology/ Anthropology, Tribhuvan University.

Central Bureau of Statistics (CBS). (2002). *Population census report of Nepal 2001*, Kathmandu: CBS.

Gewali, R. K. (2009). *Biogas development in Chitwan district*, (Project Report), Pokhara: Institute of Forestry.

Government of Nepal (GoN). (2007). *Tenth Plan (2002-2007)*, Kathmandu: National Planning Commission.

Government of Nepal (2009). *Economic Survey 2008/09*, Kathmandu: Ministry of Finance.

Singh, R. B. (2004). A technical evaluation of renewable energy biogas in Nepal, *SCITECH Journal*, 7(2), 1-17

Water and Energy Commission Secretariat (WECS). (1995/96). *The study of alternative energy technology and overview: Assessment of perspective energy plan*, Kathmandu: WECS.