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Perceptions of the Impact of Biogas: A Case Study from Pakistan's Southern District Muzaffargarh

Muhammad Zubair[1*], Muhammad Sajid Imran[1], Syed Bilal Hussain[2] and Akash Jamil[1]

[1]Department of Forestry and Range Management, FAS&T, Bahauddin Zakariya University, Multan, Pakistan.
[2]Institute of Molecular Biology and Biotechnology, Bahauddin Zakariya University, Multan, Pakistan.

Authors' contributions

This work was carried out in collaboration among all authors. Author MZ designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors MSI and SBH collected data and managed the analyses of the study. Author AJ managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

In the era when climate change is causing havoc on the health, economics, infrastructure and environment of the mankind, alternatives to fossil fuel energies being promoted. Renewable energy resources are more sustainable as compared to fossil fuels and have the potency to replace conventional and pollution inducing energy resources. Biogas an alternative green energy resource that generates energy from organic matter has been introduced in Pakistan. This energy resource has found to have a great potential and many initiatives of biogas has been initiated by the government and non-government organizations. The present study was designed in order to understand the level of awareness and preference of using biogas as an alternative energy resource for day to day household activities. The study involved a primary data collection from 10 villages in District Muzaffargarh. Data were gathered from 70 livestock farming households in the study sites using purposive sampling. Descriptive analysis was used in order to depict the status, level of utilization and preference of biogas over other conventional sources. It was observed that addition of a biogas among the already present fuel sources have divided the burden on solid biomass fuels.

**Corresponding author: E-mail: zubair.fast@bzu.edu.pk;*

The empirical evidence displayed that the people experienced a cut in their expenses, smaller number of ailments has been registered since the use of this green energy. The study concluded that awareness and information regarding the biogas technology must be publicized in order to generate eminent profits.

Keywords: Biogas; renewable energy; fossil fuels; impact; socio-economics.

1. INTRODUCTION

Energy consumption throughout the world is rising swiftly and the usage of fossil fuels is nearing to their limits [1,3,6]. Energy based on fossil-fuel is linked with emission of pollutants in large quantity, that are the causal agent of recent catastrophic environmental disasters. These negative impacts could be reduced if bioenergy is used for all kinds of development purposes. As its flexibility and its potency for providing maximum and clean energy resource for all kinds of development strategies is well studied and tested [2].

It is a well-known fact that bioenergy is not only a perfect energy source replacement to fossil fuels but is known to emit zero greenhouse gas emissions. According to a global environmental watchdog more than sixty countries all over the world have started to implement renewable energy options [4]. A study has shown that Europe is on top in using renewable sources for their energy requirements as the biomass is the leading resource for generating fifty percent of their total energy use [5].

Biomass among all renewable energy resources is known to have an important role in generating clean energy. It is known to have contribution of about 10% in all global energy supply. It is well documented that the developed countries are now replacing fossil fuels to generate energy from biomass and a similar trend is now been followed by the developing countries as well. Biogas as a fuel is different from other renewable energy sources as more sustainable and effective greener fuel. It is the only carbon-based renewable energy source that has the ability to substitute fossil fuels and is now generating heating, fuel and electricity whenever needed [7]. The usage of biomass for the application of direct cooling and heating is a truly objective in the European promotion of renewable energies.

There are quite a few countries in the developing world that have complete dependence upon conventional energy generating resources that includes biomass (charcoal, crop residues firewood) electricity derived from grid and petroleum products are critical in the development of these countries. Among these resources biomass is the main driver in generating energy as it is involved in about 94% of power generation while the power generation from petroleum in the household sector is just about 6% [8]. Further the utilization of commercial petroleum such as kerosene and Liquefied petroleum gas in rural scenario is quite substantial making it as the main resource of providing energy to about 91% of households and about 58% of this energy is used as cooking fuel in the urban settings [9].

Pakistan similar to various developing nations is rapidly facing an increased energy demand. But the supply is dwindling thus not providing appropriate requirement for the community [10]. Pakistan harbours certain energy resources such as geothermal, hydro, wind, biomass, solar and a few fossil fuels reserves. These resources are generally classified in to categories i.e. conventional (biomass), marketable (non-biomass) and alternate energy sources. Conventional energy sources comprise of agricultural wastes, fuelwood for household use. Commercial or Marketable energy includes petroleum products and electricity. While the alternate energy resources consists of renewable or green energy such as solar or biogas energy [11].

Biogas is a green clean and renewable type of energy that has a strong potential for replacing traditional energy sources. It is because of its environment friendly nature that it has proved beneficial in using animal dung that otherwise may go into waste and involve recycling of nutrients [11]. Biogas is usually produced from various sources ranges from animal wastes, to industrial, agricultural, and households' wastes [12]. Recently the introduction of biogas digesters has made this waste generated energy as a symbol for accession of modern energy services in most of the rural setting of the country. It has not been able to generate better

quality of energy for cooking and for daily requirements but has been able to create better health and sanitation opportunities. Apart from this it has also been able to generate better socioeconomic and environmental benefits. As the residents using this energy for lighting, power generation and cooking has reported less expenses as compared to the use of conventional energy [13,14,15,16]. It has been reported that most of the communities have concluded that using energy from biogas have better combustion and are more efficient as compared to conventional resources. Further it is far more hygienic and cleaner as it is free from various pathogens and bacterial related diseases [14].

With the presence of frequent advantages and verified practices of biogas production and application of it as a green energy resource and appropriate dung waste administration approach, the potentil of biogas has yet to be fully explored in Pakistan. The expansion and application of this greener, pollution free and sociable form of suitable technology lost wider adaptability [17].

In this study, it is assumed that households have understanding of the energy generation problems in their villages. It is hypothesized that they are aware of the alternative energy generating resources and can describe their specific preference from the available alternate technologies that have potential to address this particular problem. This assumption is dependent upon the preference theory based upon the implicit cost of the household and their expectation of benefits from the available alternate intercessions depending upon the endowment resource. This preference can be described by a utilization function and can be modelled as utility expansion problem [18]. Therefore, the present study was conducted to find out best interventions for fire instead of fuelwood particularly in Tounsa Barrage region South Punjab Pakistan.

2. MATERIALS AND METHODS

2.1 Study Area

Taunsa Barrage is a village present in Kot Adu, District Muzaffargarh, Punjab Province and lies to the 30º42' N, 70º50' E; 20 km northwest. The reason for the selection of study area is that population inhibited in and around the barrage are holding large number of animals as well as growing agricultural crops for their livelihoods. Such numbers yielded heap of cow dung that is being used for burning and as well as gone waste. Therefore, author selected this area as a potential biogas site.

2.2 Sampling

In the current study selected 10 villages in and around Tounsa Barrage were purposively nominated for this study. These comprised villages of Sheikhan, Patalmor, Jannoo, Gadi, Daira Din Panah, Allah wali Ahmad kot, Chahudri, Somandri and Pacharwala. These were carefully chosen because they had been precisely targeted by various non-governmental organizations encouraging biogas technology. In Tounsa Barrage, cow dung was the chief feeding material required for bio digesters at the time of the study and it was hoped that the potential of adopting biogas technology in areas with adequate supplies of raw materials would be higher in these regions. The 70 sample households were selected having biogas units. Seven households per villages were randomly sampled comprising a total sample of seventy respondents.

2.3 Data Collection Procedure and Instruments

The data collection was based on the gathering of demographic and socio-economic features of household viz education, age, experience of people in biogas production and the status of household head. The perception of household relating biogas development and its, financial status was determined. Further supplementary data from the biogas technicians and suppliers of the equipment regarding the promotion of biogas technology was also obtained in the vicinity of Taunsa barrage.

2.4 Data Analysis

Data were analysed using Statistical Package for Social Scientists (SPSSv12) and descriptive statistics were performed.

3. RESULTS

3.1 Demographic Analysis of Respondents

The respondents during the survey were observed with respect to the usage of biogas

among various households in the study site. In this section a comparison was conducted among the people in which they were asked to describe prevalence of various conditions before and after using biogas. It was depicted that 89% of the respondents reported better health conditions after using biogas techniques. Further the respondents (57%) reported that using biogas techniques they were able to save more time that could be utilized for other income generating activities. Similarly, people (42%) said that they were generating more income after using biogas facilities. But on the other hand, it was observed that only 17% people said that their frequency and intensity of wood collection has decreased (Table 1).

3.2 Socioeconomic Profile of the Respondents

Socio economic characteristics (age, education, occupation, land holding, tenancy, income and farming experience) are shown in Table 2. Out of 70 respondents interviewed, 30% belonged to young age (Less than 35 years old) and 70% were under old age (More than 50 years age). Majority of the respondents 56% were belonged to farming and fishing profession. Almost 76% respondents completed their education (Higher Secondary School Certificate) followed by 24% as illiterate. A total of 40% respondents earned more than 18000 US dollars and 36% were having experience of 1-5 year.

3.3 Biogas Plants Status, Factors, Major Faults and Fixing

There were 77% of the bio-digester in good condition and never had any problem. Among 24% of the bio-digesters faced with a problem, 10% were having technical faults, 16 have social problems and reaming 74% were fixed and remained functional. While 70% biogas were working well followed by 97% faults fixed by trained mason are shown in Table 3.

3.4 Bio Gas Plants and Socioeconomic Uplifts of Heating & Cooking

Bio gas plants and socioeconomic uplifts of heating & cooking are shown in Table 4. Almost 74% respondents used bio gas followed by 16% conventional stove and gas cylinder as 10%. While after the biogas 91% respondents stated that cost of fuel was less than half of US Dollar /day. After bio gas 80% respondents consumed 1-20 kg/day wood followed by 81% 1-5 kg/month gas cylinder used.

3.5 Benefits of Using Bio Gas Over Other Fuels

Biogas provided the maximum benefits over other fuel such as it is clean to use (97%), safe to use (97%), having less problems and less physical pressure (96%, 94%), body cleaning (98%) with minimum headache (4%) problem are shown in Table 5.

4. DISCUSSION

The current study has depicted that the intervention of biogas in the energy generation among the rural communities of Pakistan has brought up quite a few notable and positive effects. It is observed that the addition of a green and renewable energy among the already present various fuel sources have divided the burden on solid biomass fuels such as agricultural wastes, dung cakes, LPG and firewood [19]. These sources of cooking and lighting fuels are not only expensive on the budgets of the people but also are a potent source of creating environmental pollution. Further in national context the country each year end upon spending almost 7-8 billion US$ on importing fossil fuels [20,21]. Much of this expenditure could be cut down if only the use of biogas in every village is made compulsory [22]. As described in the current research the rural community of the study site after using biogas has overall felt a relief in expenditure in terms of cooking fuels. This is supported by a similar study in the country describing a saving of almost 550 US $ per year while using biogas [19]. Most of the respondents in the study had described that they had observed less health problems after the use of biogas which supports the results of Abadi et al [23] which revealed that households using biogas technology had lower incidence of illness as compared to the households not using the technology. It was observed in the current scenario that people using this technology were actually saving time. It is due to the fact that people utilizing this technique did not have to go fetch wood for the fuel purposes hence saving time and utilizing it for another purposes [24]. The most striking thing observed in the study was the amount of savings the people were able to make on the basis of reduction of health problems and the total of sum of money saved in terms of fuel wood buying [25].

Table1. Demographic analysis of respondents (n=70)

Particulars	Before bio gas	After bio gas	Percentage %
Health Problem	Yes	No	89
Time saving	Nil	Yes	57
Income	Nil	Yes	42
Wood Usage	Yes	No	17

Table 2. Socioeconomic profile of the respondents (n=70)

Variable	Categories	Percentage %
Age	Young (Up to 35)	30
	Old (Above 35)	70
Education	Illiterate	24
	Literate	76
Occupation	Farming	23
	Fishing	21
	Both	56
Land holding	Low (< 12 acres)	77
	High (> 12 acres)	23
Tenancy	Owner	60
	Tennent	16
	Owner cum tenant	25
Income	Less than 1 lac	14
	1-3 lac	40
	More than 3 lac	46
Farming experience	1-5 years	36
	6-10 years	30
	Above 10 years	34

Table 3. Biogas plants status, factors, major faults and fixing

Statements	Categories	Percentage %
Status of biogas plants	Yes (Working condition)	77
	NO	23
Non-functional factors	Technical	10
	Social	16
	Working well	74
Major faults	Not reported	24
	Pipe defects	4
	Filter defects	2
	Working well	70
Fixing of faults	Self	3
	Trained Mason	97

In Pakistan the production of biogas was started back in 1959 and till then significant number biogas units have been established in various villages. Further under the project of biogas support program about 10000 biogas units have been placed all around the country under having potential of generating 27% of country's biogas production [19,26]. Similarly, the study site consisted of the biogas unit established under that same project. It was observed that the unit had full working capacity and there were workers especially dedicated for its maintenance. The community of the research area had depicted considerable awareness regarding the use and benefits of biogas production and utilization. As the respondents were feeling this technology to not only save their money but they had to face fewer physical problems and experience cleaner environment.

Table 4. Bio gas plants and socioeconomic uplifts of heating & cooking

Sources	Categories	Percentage %	
Bio gas sources	Conventional stove	16	
	Bio gas	74	
	Gas cylinder	10	
Status	Categories	Before bio gas	After bio gas
Wood need & wood consumption	1-20 kg/day	29	80
	21-40kg/day	46	16
	above kg/day	25	4
Cost of fuel wood	Less than 100 rupees/day	56	91
	101-200 rupees /day	34	6
	More than 200 rupees	10	3
Gas cylinder	1-5 kg/ month	74	81
	6-10 kg/month	12	7
	More than 10 kg/month	14	12

Table 5. Benefits of using biogas over other fuels

Benefits	Biogas (%age)	Other fuels (%age) [gas, fuelwood]
Ready to use and clean	97	3
Safety	97	3
Less problems	96	4
Less effort to obtain it?	94	6
Potential future	91	9
Body cleaning	98	2
Less frequency of disease	95	5
Causing headache	4	96

5. CONCLUSION

If biogas technology in Pakistan has to thrive and move in wider acceptability it is important that various operational support networks must be established. It is of dire importance that focused and efficient research regarding the rectors and process of the biogas equipment must be made. It is of extreme importance that the biogas technology must be flourished in the developing countries. The awareness and information regarding the biogas technology must be publicized using appropriate and efficient methods such as print and electronic media.

Biogas has a critical role in developing various rural communities in most of the developing nations. There are eminent profits for farmers installing biogas plants. It is important that lessons should be learned from various successful and unsuccessful biogas initiatives. There are various encounters and challenges faced in response to financial support but expectantly if various non-governmental organizations and governments join hands the success of biogas plants will soon start reaping the expected benefits.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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