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DILEMMAS OF BIOGAS TECHNOLOGY ADOPTION IN RURAL AREAS OF PUNJAB, PAKISTAN

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ABSTRACT

Pakistan is facing worst energy crisis of its history and dependency of oil for energy generation is another issue affecting the economy badly. Among the renewable energy sources biogas energy could augment the conventional energy sources. Despite of its immense potential, extended advantages and favourable conditions for its production in Pakistan, biogas generation in Pakistan is meagre due to economic and technical constrictions. Present study investigated the reason behind poor adoption of biogas technology among rural households. Inadequate awareness, insufficient role of government sector, reduced cooperation of public sector extension, absence of technicalities, inadequate management skills, finance shortage and lesser population of animals appeared leading factors behind non-adoption of biogas. Adoption could be raised through integration for public and private sector in extending capacity building program for potential users. Government would have initiate subsidy programs on biogas plants installation and interest free loans for rural communities. Public sector extension would have to offer plants managerial services and skills development among biogas users.

Keywords: Renewable energy source, Biogas, Livestock, Pakistan, Energy crisis.

INTRODUCTION

The Energy is the top most priority at present around the globe as none of the industry can be run without power. Energy and agriculture has strong relation (Kiani & Houshyar, 2010). In this regard generation of maximum for the extended development is another major priority. Furthermore, energy also affects all the developmental aspects viz. social, economic and environmental (Amigun *et al.*, 2008). Therefore, provision of adequate, durable, proficient and reliable energy with reduced impact on environment is critical. Ahmed *et al.* (2010) described that sustainable development only can be enjoyed by the efficient energy supply. Doudpota (2005) described that almost two billion people residing remote areas of developing nations have no access to electricity. Poor lightening in homes obstruct children' learning, family health status and also limits the opportunities for development as most of the industries are power dependent. Several

countries go for alternate for the power generation, for instance, fossil fuel. However, several issues are emerging in this regard as fossil fuels consumption is causing environmental and ecological problems (Karekezi & Kithyoma, 2002). The problems directly or indirectly associated with un-sustainable usage of fossil fuels have led to popularization and access of renewable energy sources (Amigun & Blotnitz, 2007).

Biogas energy is clean and renewable form of power having tendency to augment conventional energy sources. Biogas is produced through anaerobic fermentation process. It consists of 40-70% methane, with the remainder Carbon Dioxide, Hydrogen Sulphide and other trace gases (Singh & Sook, 2004). Due to high level of Methane, biogas could be used as a heating fuel, generating electricity and producing bio-fertilizer (JI-Quin & Nyns, 1996). Moreover, according the Han *et al.* (2008) biogas technology holds potential to mitigate greenhouse gasses emission, minimize eutrophication, lowering air pollution and enhanced utilization of crop nutrients (Lantz *et al.*, 2007). Biogas cut off cost of fuel woods and woods collecting efforts (Mwakaje, 2008).

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Pakistan is an agricultural country where majority of the population is dependent on livestock for the income generation. But because of unawareness and high investment these livestock farmers remain fail to utilize the potential of animal dung which is prime source of biogas. Hence, present study was conducted to determine key factors influencing biogas adoption in Pakistan.

METHODOLOGY

The present study was conducted in the District Toba Tek Singh of the Punjab Province. Toba Tek Singh is renowned for biogas plants. Several Non-Government Organizations have targeted this district and successfully conducted number of projects regarding Biogas technology implementation. Therefore, purposive selection of study area was made. Prior final data collection survey, preliminary survey was conducted to investigate the distribution of Biogas plants in district. Survey revealed that biogas adoption was persisting in scattered form. The farmers living in surroundings of those who have adopted biogas technology were

RESULTS AND DISCUSSION

Table 1. Socio-Economic Characteristics of Respondents.

Socio-Economic Characteristics		f	%
Age	Young	19	23.75
	Middle	37	46.25
	Old	24	30
Education	Illiterate	33	41.25
	Up to primary	15	18.75
	Middle	18	22.5
	Above matric	14	17.5
Land holding	Up to 12.5 acres (small)	44	55
	12.5-25 acres (medium)	17	21.25
	Above 25 acres (large)	7	8.75
	No land	12	15
Annual income	Below to 1 lac	35	43.75
	1-2 lac	21	26.25
	2-3 lac	14	17.5
	Above 3 lac	10	12.5
Income source	Farming only	13	16.25
	Livestock only	2	2.5
	Farming + livestock	32	40
	Farming +livestock+ Business	9	11.25
	Farming+ livestock+ Overseas migration	7	8.75
	Any other (service etc.)	17	21.25

Data mentioned in Table 1 indicate that farmers of middle aged category appeared prominent followed by

selected as respondent. These farmers were denoted as "potential users". These farmers were having enough awareness of biogas technology but were not adopters. For selection of sample, purposive sampling technique was adopted. Total 80 potential users were selected from 40 biogas adopters' villages.

Questionnaire was used as research instrument. Questionnaire was prepared in light of study objectives. Validity of questionnaire was checked through face validity technique. One of the expert from farm mechanization department of University of Agriculture Faisalabad, Pakistan checked the contents of questionnaire.

Further, questionnaire was pre-tested on 20 farmers who were other than sample size. After amendments questionnaire was administered through face to face interviews. Collected data were coded in excel sheet and later analyzed with the help of Statistical Package for Social Sciences (SPSS). Descriptive statistics (frequency, percentages, mean, and standard deviation) was applied for the meaningful interpretation of results.

23.75% young aged farmers. Educational level of the respondents was not much impressive as 58.75%

respondents were having formal education while rests of the farmers were found illiterate. Within the literate ones only 17.5% were having maximum educational level of more than matriculation. Moreover, greater than half of respondents were small landholders (up to 5hactare). One tenth respondents were rated as large farmers and these farmers were also observed as progressive farmers of the study area. About 15% respondents were not having single piece of land. Respondents were having variant income generating sources while some were having multiple income generating sources. Likewise farming+ livestock all together appeared most important income generating

source reported by 40% respondents. Furthermore, despite of the multiple incomes generating sources income of farmers was not up to the mark. Maximum income was up to 1 lac (o.o1 million). Only 12.5% respondents were getting maximum income of greater than 3 lac (0.03 million). The discussed demographic situation indicates that overall situation of the respondents was ordinary. If we look insight to the situation of country, increasing inflation, mounting energy crisis and charges, lack of opportunities, poor marketing and market fluctuations, it seems that farmers with existence situation will not be able to confront this hectic situation of country.

Table 2. Number of animals kept by the respondents.

No. of animals	f	%
Up to 5	41	51.25
5-10	17	21.25
Above 10	9	11.25
No animal	13	16.25

Table 2 represents that 16.25% respondents were not having any single animal of any kind. Most of these respondents were employed in public or private sector that’s why their job obligation didn’t allow them to go for another job.

Slightly greater than half respondents were having animals’ population of up to 5 followed by 21.25% respondents who owned 5-10 animals at their homes

and farms. It was observed that these animals were of various kinds. Majority of the animals’ population was of cattle and buffaloes which are lactating. Families were earning also through milk selling, also an income generating business. About 11.25% respondents also owned animals’ population greater than 10. These farmers were totally earning from the livestock for their better livelihoods.

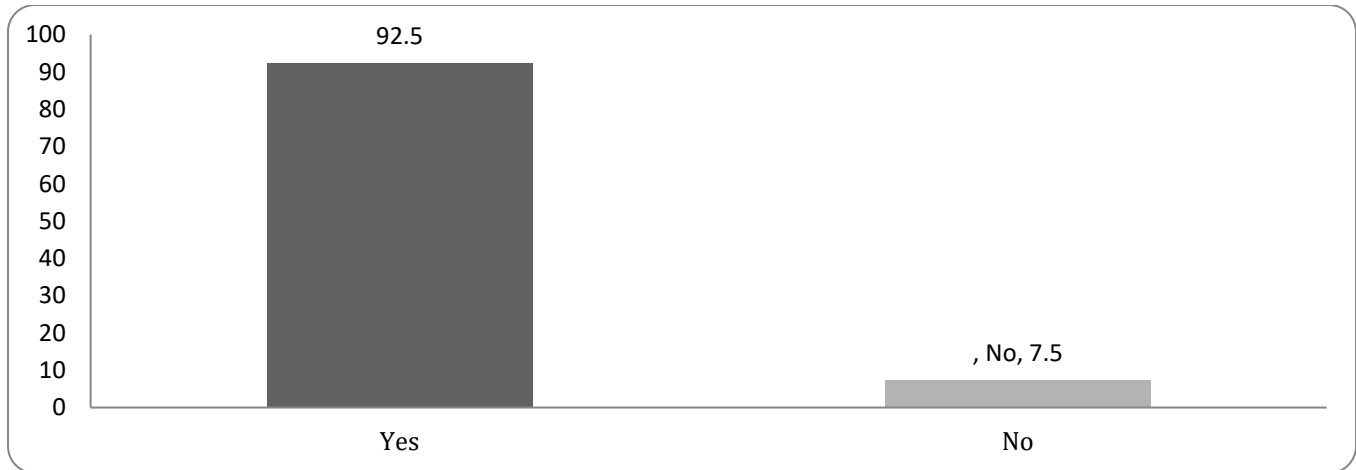


Figure 1. Awareness about Biogas Technology.

Mounting concerns over climate change and energy security are some of the reasons which led to the growing emphasis on renewable energy dispersion in energy sector especially power generation sector at global level (REN21, 2013). Pakistan is also putting efforts to the adaptations of renewable energy sources

not only on national level but also on farmers’ level. Figure 1 illustrates that overwhelming majority of the respondents was aware about the biogas technology and its multifaceted benefits. Slight percentage of respondents was found unaware and reasons probed during informal discussions were their infrequent

existence in the villages. Few of them were also remittent as they were living abroad and now they were there to spend some time with their families. Moreover, aware respondents were inquired about their sources of the awareness about biogas technology.

Information depicted in Figure 2 describes that neighbour farmers appeared most preferred information sources among the respondents. This situation illustrates the strong coordination of faring communities while on other hand also a notion of the failure or reduced role of public sector in awareness dissemination. In short, it can be said that progressive farmers or neighbour farmers have better influence. Anyhow, NGO's appeared also as convenient information source after neighbor farmers. In the study area NGO's

were working at good pace such as RSPN (Rural Support Network Programme). Electronic media and print media all together were also having some influence in awareness dissemination. Agriculture extension always works in bridging the information gap having specialization in awareness dissemination. Unfortunately, role of extension sector in this regard was almost negligible pointing a strong criticism on their performance and working strategy. Moving forward, another dilemma appeared that role of Government agencies was zero in awareness creation about the biogas technology which is valuable renewable energy source and has ability to support country in covering up the worst energy crisis that country is facing.

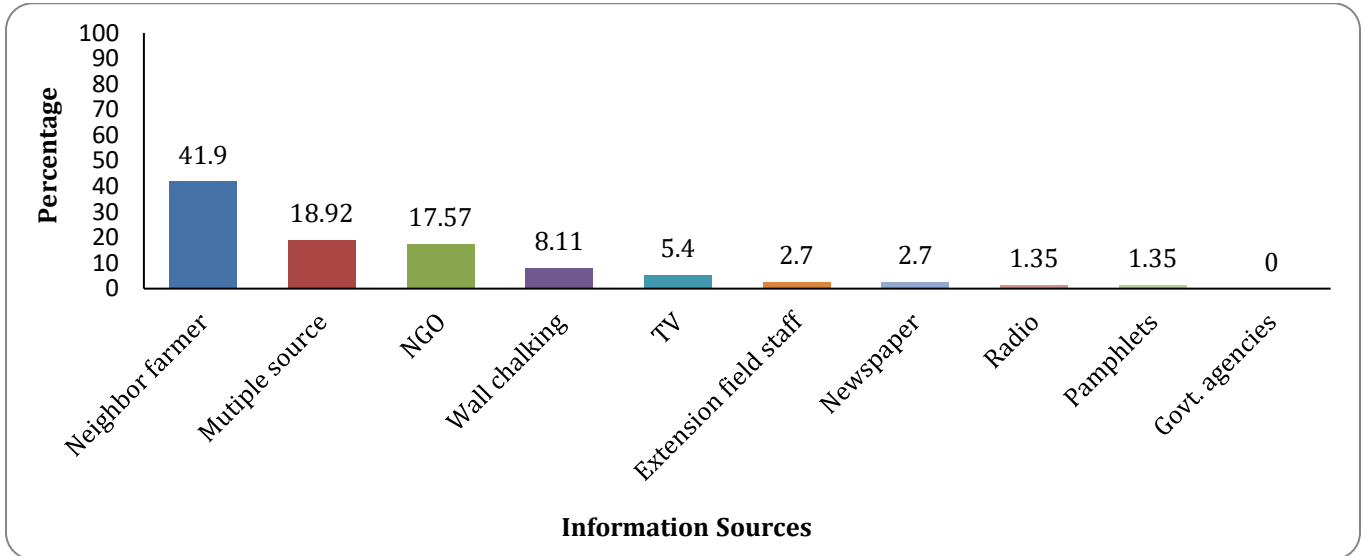


Figure 2. Information Sources of the farmers regarding biogas technology.

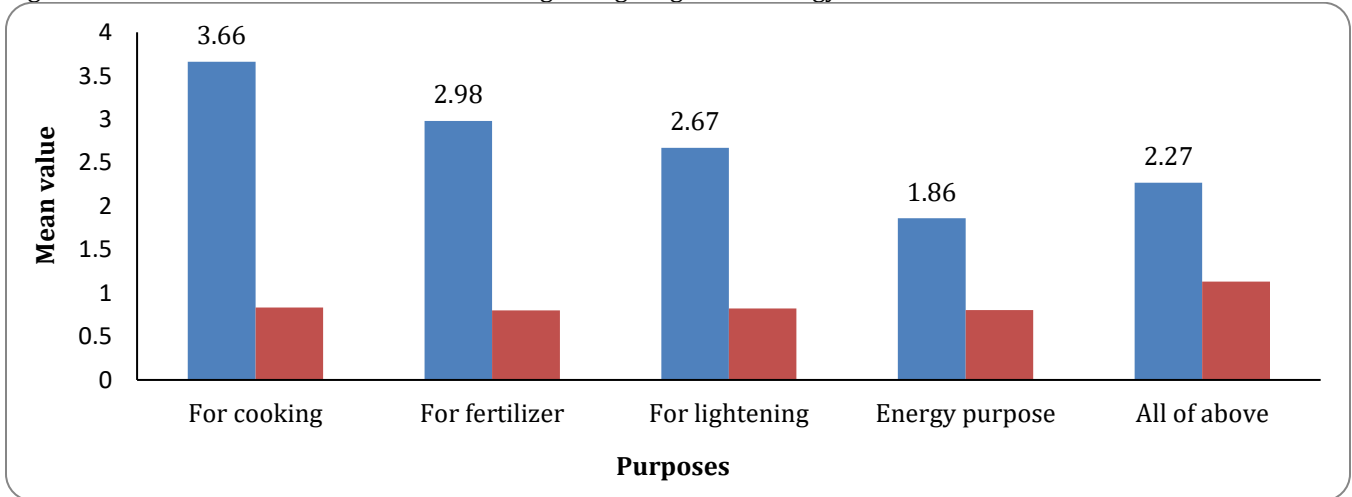
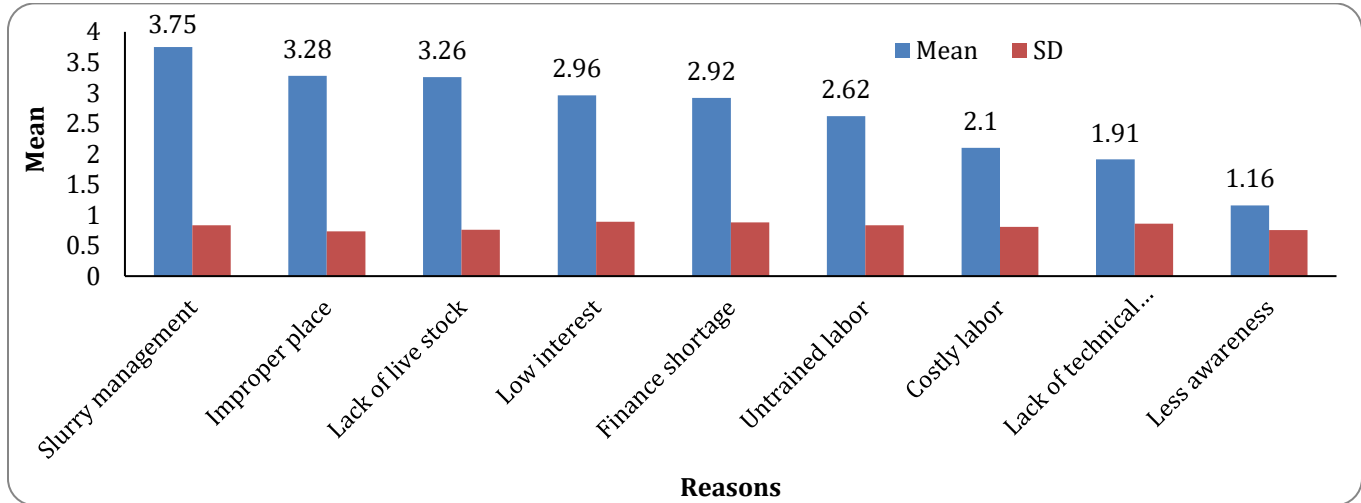


Figure 3. Awareness level of Respondents regarding various purposes of Biogas Technology.

It's obvious that biogas is renewable energy source and also has various purposes which are beneficial for the users. These purposes if fulfilled, can save economics for the users for instance, expenses of fuel wood, load shedding and as fertilizers which is also the most suitable against the high prices of chemical fertilizers. Meanwhile, it also happens that these purposes remain unknown to users. In this perspective, figure 3 illustrates that cooking purpose got maximum mean value of 3.66 followed by the fertilizer purpose getting mean value of 2.98. During informal discussion it was revealed that gases is common word used and also gas us used by households. That's why farmers were

having familiarity with cooking purpose as alternate to gas. Moreover, animal dung is used as Farm Yard Manure which was also the reason of familiarity with biogas as alternative fertilizer to chemical fertilizers. Lightening purpose also got the mean value of 2.67 means awareness falls near about medium level. Biogas is strong source to cover energy shortage but unfortunately awareness found was not good enough as mea value fell below low level. To explore the reasons behind this low level familiarity and adoption farmers were inquired about the reasons responsible for non-adoption of biogas technology despite of that they are known to the various benefits of biogas.



*Mean values greater than 3 were assumed most important

Figure 4. Reasons responsible for the non-adoption of Biogas technology.

Slurry is the extract of biogas that is used as fertilizer for the crops in replacement of chemical fertilizers. It's also very technical to handle slurry properly. In this context slurry management appeared most important constraint toward adoption of biogas technology. Farmers revealed that they lack in technicalities so they didn't consider them for slurry management. Several respondents also argued that they never had attended any workshop or training in this perspective so how would we do that. Respondents also narrated small population of livestock animals as constraints to the adoption. Respondents were having misconception that to generate biogas large number of livestock population is needed, infect reality is something else that biogas can be generated through small population on small level scale and respondents were having enough animals for this purpose. These respondents just needed capacity building, nothing much anything as low interest of farmers also appeared as significant reason. Investment is needed everywhere

for running or implementation of any project. Increased initial cost of renewable technologies is one of the major barriers in the way of high level of renewable energy based electricity generation.

To confront this problem a number of policies are being utilized for renewable based energy promotion in different parts around the globe. These are categorized as regulatory policies, fiscal incentives and public financing. At present, in country inflation is increasing, energy crisis are increasing, and rates of the power generation are too high resultantly bills of electricity are too high that the user are paying over and over again. If respondents go for the biogas technology as they already have resources and potential they will be able to save the cost of production of various aspects. Furthermore, costly labor, lack of technical knowledge and poor awareness were also rated as the constraints but of ordinary level which can be covered up easily through capacity building.

Table 5. Suggestions by the respondents for the improvement.

Suggestions	Mean	SD
Increase subsidy on biogas plant	3.37	1.023
Solve slurry management problem	3.20	0.973
Solve improper place problem	2.87	1.023
Increase biogas plant efficiency	2.20	0.919
Improve source of information	2.47	1.005
Provide loan for biogas plant	1.88	0.779
Provide free of cost repairing	1.72	0.655
Installment system	1.62	0.603
Provide technical knowledge about biogas plant	1.48	0.503
Higher the salary of biogas plant technicians etc)	1.20	0.461

Respondents were also inquired about their views as suggestions for the improvement. Within the suggestions, increased subsidy on biogas plant appeared as most important suggestion along with solution of slurry management problem. Initial cost of implementation of biogas plant seems high, that is why farmers remain reluctant to adopt. Moreover, risks of failure and loss of investment also put them away from eh adoption. In this perspective, farmers should be given subsidy by the government on implementation of biogas plants.

Farmers also should be motivated to implement the plants in their nearby fields on proper place. Slurry management is discussed as problem above so it's dire need to cover it up on priorities and involvement of public and private sector. There should be no compromise on durability of plant therefore, involvement of different companies should be ensured to enhance the efficiency of biogas plants for long term benefits. These companies should ensure their work from implementation to repairing along with the capacity building of farmers. To ensure biogas participation in energy crisis solution, its dire need for the public and private sector integration. Moreover, the investment from the national as well as international organizations should be encouraged maximum.

CONCLUSIONS AND RECOMMENDATIONS

In the light of energy crisis and costly energy generation from oil in Pakistan originated the need of renewable energy sources. Biogas technology proffers excellent potential energy alternative for Pakistan through its numerous advantages. However, the adoption rate is but lower at present despite of familiarity of its numerous advantages. Factors affecting the adoption identified are slurry management problems, improper place location, lesser population of animals, reduced interest because of

finance shortage and lack of technical knowledge. Moreover, zero role of Government in promotion of biogas technology along with reduced role of public sector extension in creating awareness is also the major factors. Following suggestions are made in the light of findings of the present study;

- Public (Government) and private sector integration for the promotion of biogas technology
- Government should launch some projects of biogas generation in remote areas
- Capacity building of farmers through trainings and workshops
- Media campaign to popularize the biogas benefits will also be beneficial tool
- Farmers should be provided with subsidy on plants implementation
- National and international organization should be invited to invest here for the development of deprived people here in Pakistan

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