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CONTRIBUTION OF BIOGAS PROGRAM ON CLIMATE CHANGE MITIGATION AND FOREST CONSERVATION IN MERU DISTRICT ARUSHA TANZANIA

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ABSTRACT

The study examined the contribution of biogas program on climate change mitigation and forest conservation in Meru District, Arusha Tanzania. A total of 70 respondents were involved in this study. The study adopted mixed research design both qualitative and quantitative paradigms; where by farmers were sampled using random sampling to obtain sample size of 10%. Data collection instruments were questionnaires for the biogas users, in-depth interview guides for village leaders and biogas experts, observation guide and document analysis guides. The study findings revealed that effectiveness of biogas program was moderate because few respondents were using biogas twice per day. It was discovered that there was strong relationship between biogas program and climate change mitigation in Meru District. Majority 54.3% respondents agreed that biogas is environmental friendly and believe it has positive impacts on their livelihoods. The above facts conclude that the biogas program has positive impact on peoples socio economic well-being and conservation of forest resource in the area. The researcher recommends that biogas program should be integrated with other development program like livestock improvement, agriculture and community agro forestry programs, income generating activities. Education provision, and frequent monitoring of biogas plants is also required along with some incentives to biogas users.

INTRODUCTION

Global warming is named due to increased burning of fossil fuel and degradation of ozone layer which in one way contributed to climate change and its associated imapcts. There are severe impacts of climate change has been observed around the world where by human beings and other species are at high risks of dissepering on the planed earth (Stearn, 2006). Climate change has lead increased number of extreme weather events, such as flooding in different countries such as China and Pakistan, also rising of sea level, food insecurity, deforestation, diseases and shortage of water exposed billions of people at risk particularly those living in developing countries (World Bank, 2010).

According to Johnsen (1999), Tanzania has serious energy problems despite the fact that it is endowed with diverse energy resources including biomass, natural gas, hydro, coal, geothermal, solar, wind and uranium much of which is still untapped. It is anticipated that solar, wind and other renewable energy sources account for only 0.5% of total energy consumption in Tanzania.

Fuel wood collection and charcoal production is the main degradation driver for the African continent forests, and is less prominent in (sub) tropical Asia and Latin America. In Tanzania more than 80% of energy delivered from biomass is consumed in rural areas. This heavy dependence on biomass as the main energy source contribute to deforestation. The present sourcing of wood for charcoal making and firewood is not a sustainable (World Bank, 2009). Deforestation was estimated more than 19.4% from 1990-2010 with large deficit in forestry management and replanting in a country (UNCTAD, 2012). The high amount of emissions resulting from deforestation and forest degradation due to biomass consumption is named caused of global warming and climate change. Poor implementation or at least failure to effectively implement low-emission carbon sources in both rural and urban areas led to unreliable sources of energy (Yanda, 2010). In order to adress the impacts of deforestatation, climate change and solving problems of energy, preventive and concrete adaptation stratergies are urgently required so as to avoid further damage and future cost explosion using alterative energy (IPCC, 2010).

Statement of the research problem

The world is facing the problem of the climate change impacts, where by currently people are experiencing flooding, rising of the sea level, food insecurity and shortage of water which put a billions of people at risk (World Bank, 2010) Clearing the forest for firewood and production of charcoal is increasing and this is caused by povery and population pressure. This problem of climate change should be mitigated by implementing renewable energy, sustainable forest management, since will contribute to the food security, poverty reduction and economic development. According to the IPCC (2007) it is stated that renewable energy contributes to the social-economic, energy access, and secures energy supply. Furthermore the renewable energy specifically biogas contribute on the generate new local employments opportunities for women and reduce poverty(Karlsson, 2009). This research examines contribution of biogas program on climate change mitigation and forest conservation in Meru District.

RESEARCH OBJECTIVES

The general objective of the study was to examine the contribution of biogas program on climate change mitigation and forest conservation in Meru District. Specifically the study aimed:

(i) To examine the effectiveness of biogas energy program in Meru District
(ii) To identify the relationship between the biogas program and climate changes mitigation in Meru District
(iii) To analyze the positive and negative effect of biogas on forest conservation in Meru District.

RESEARCH METHODOLOGY

The study adopted mixed research design both qualitative and quantitative paradigms; where by farmers were sampled using random sampling to obtain sample size of 10%. The study was conducted at Sing'isi village, Poli village and Kimundo village. The primary rationale behind the selection of this study is proximity with the forest that make easier to get genuine information about usage of biogas, climate change mitigation and forest conservation. The secondary rationale is the areas were characterized with the deforestation due to the use of both firewood and charcoal before the installation of the biogas plants. This study used questionnaires for the biogas users, interview guides for the local leaders and biogas experts, observation guides and

document analysis guides were also used as instruments for data collection. Furthermore statistical package for social sciences (SPSS) software was used in data analysis and data presented using pie charts, tables and histogram.

STUDY FINDINGS AND DISCUSSION

Social demographic characteristics of respondents

The study sampled 3 villages in Meru district, where by 70 households with biogas plants were consulted. The demographic characteristics of respondents are based on sex, age, occupation and marital status.

Sex and age of respondents

Table 1: Respondents' distribution by Age and Sex (n=70)

Sex of respondents		Age			Total
		18-45	45-60	60>	
Sex	Male	11	18	15	44
	Female	2	13	11	26
Total		13	31	26	70

***Source*: Field survey, (Feb 2016)**

The sample of the respondents surveyed comprised of 62.9% men and 37.1% women which is equivalent to 44 and 26 people respectively as indicated in table 1 above. Males were many due to the social system of people in the study area with regard to household leaders. Also findings from the study revealed that male and females of the age group between 45-60 years owned and use biogas energy compared with others. So majority of participants were in economically productive age also capable of affording the installation cost and undestanding the needs of use alternatives energy in comparison to ipacts resulted from non renewable energy use.

Occupation

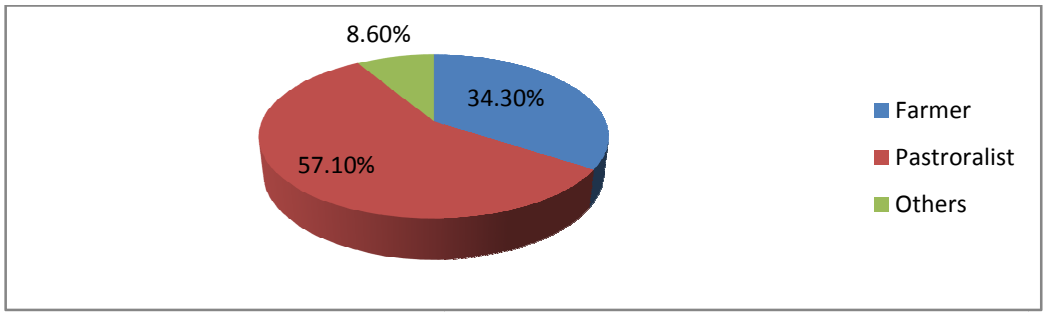

Figure 1: Occupations of the respondents

***Source*: Field survey, (Feb 2016)**

Figure 1 above indicates that majority (57.1%) of the respondents were pastoralist. This implies that large number of pastoralist adapted and implementing biogas program since they have cattles enable them to obtain animal dung necessary for production of biogas.Similar findings were obtained by Adhikari (2002), in Nepal where by biogas program dominated among pastoral societies.

Source of energy sources used by respondents before installation of biogas plant

Table 3: Source of energy used by respondents before the installation of biogas in Meru dstrict (n = 70)

Energy sources	Frequency	Percent
Firewood	45	64.3
Charcoal	18	25.7
Electricity	6	8.6
All above sources	1	1.4
Total	70	100.0

***Source*: Field survey, (Feb 2016).**

Results in table 3 above depict that 64.3% their were using firewood and 25.7% used charcoal before the introduction and installation of biogas program in Arumeru district. This has contribution on deforestation and forest degradation. Upon observation it was revealed that the

forest along mount Meru was degraded due to intensive exploitation and unsustainable use. Also upon interview with village leaders it was established that areas covered by village forest it was dense in the past however current there are few and scattered trees. These findings are in line with Kauzen and Sawe (1995), URT (2003), UN (1993), and Kilahama (2004), who found out that between 85% to 90% of rural energy consumption was a biomas energy, and dominant energy source for both rural and urban due to lack of alternatives sources of energy.

Challenges of using biogas

The findings from the study indicated that 55.7% of the respondents facing the challenges in the utilization of biogas as the source of energy for cooking and lighting. Compared with 38.6% said that there is no challenge in the use of biogas.Upon interview with key informants it was realized that water stress, shortage of pastures, floods, death of cattle, population growth, attitude of the people, poverty, nature of the landscape, and lack of awareness among the people were the main challenges. A study carried out by Wargert (2009), indicates that lack of financial capabilities to invest in biogas plants among poor farmers in rural areas, lack of animal waste and technical problems due to cold temperatures were main challenges.

Effectiveness of biogas energy program

The following were responces with regard to question of effectiveness of biogas program.

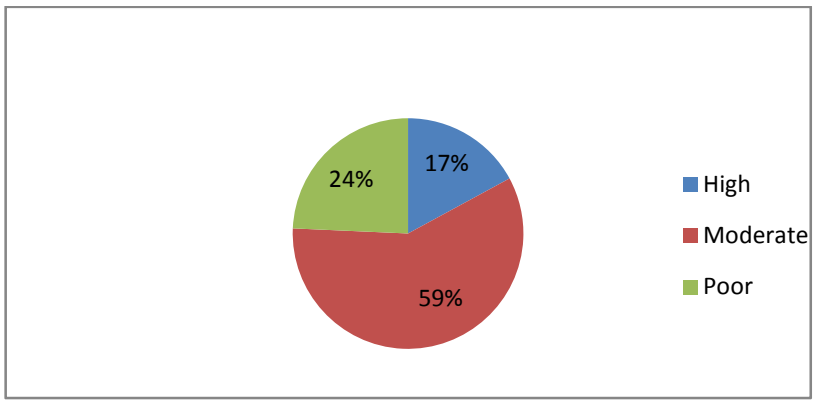

Figure 1.2 showing the effectiveness of biogas program

***Source*: Field survey, (Feb 2016).**

Study findings indicate that 59% of respondents said tefficient of the program is moderate, 24% said it was poor and 17% reported that there was high efficiency. Majority said it is moderate

since it doesnot fulfil the needs of energy three times a day (morning, afternoon and evening). Additionally, interview with the key informants it was revealed that biogas plant is highly efficient if well managed. Similarly the study carried out by EESI (2009), conformed that if biogas is operated well can be effective and affordable to reduce greenhouse gas emissions. Study carried out by Samson and Stamler (2009), argued that biogas stoves have maximum efficiency of 60% and it replaced energy from burning wood.

Uses of biogas per day

Table 4: The uses of biogas energy per day (n = 70)

Biogas Uses /day	Frequency	Percent
Once per day	23	32.9
Twice per day	35	50.0
Three times per day	12	17.1
Total	70	100.0

***Source*: Field survey, (Feb 2016)**

As it is indicated in table 5 above 50% of the participants responded that they use biogas twice a day while 32.9% once per day and mnority 17.1% three times per day.This shows that most people in the study area are stll using frewood as source of energy.Upon interview with key informants about most of them believed that biogas saves charcoal and firewood but due to its inefficient they have to use firewood.

Energy used when biogas is not effective

Upon interview with key informants they said sometimes biogas is not effective and this obliged people to find another sources of energy. The results revealed that 62.9% of respondents use firewood when biogas is not functioning followed by charcoal 25.7%, this implies that the effectiveness of biogas alone cannot demise the need of firewood and charcoal in Meru District, rather than reducing the amount of fire wood and charcoal. Furthermore the study concured with those of Kauzeni and Sawe (1995), and URT (2003) where by it was revealed that 85% of the total energy consumed in the rural areas was from biomas.

Table 5: Awareness of the respondents about the climate change mitigation (n = 70)

Awareness	Frequency	Percent
Yes	16	22.9
No	45	64.3
I don't know	9	12.9
Total	70	100.0

***Source*: Field survey, (Feb 2016)**

The result presented in table 6 above revelaed that 64.3% of the respondents said that they were not aware about climate change mitigation, while only 22.9% were aware about it.Upon interview local communities it was revealed that those who were not aware of climate change and climate change mitigation were still destroying forest for charcoal and firewood selling. The reseacher observe bundles of firewood collected near households. The study carried out by Wargert (2009), and Adhikari (2002), emphasize the needs of providing education about climate change and its mitigation to enhance awareness.

Results of impacts of climate change to the implementation of biogas program

41.4% of respondents said that climate change have the negative impacts to the implementation of biogas program in the study area compared to 21.4% who believe that there is no impacts. Upon interview with key informative it was revealed that impacts of climate change like water stress, drought, flooding shortage of pastures and outbreak of different diseases to the animal has the direct impacts to the implementation of biogas program. Upon observation at Sing'isi village people failed to operate the biogas plants due to shortage of pasure to feeding animals, outbreak of diseases and water stress. The study carried out by Rajendran et al (2012), realised that the remain problem and challenges of climate change to the production of biogas is weather changes like low temperature effects to the biodigester whereby biogas production increases by tenfold upon increasing the temperature from 10°C to 25 °C. People living in mountain valleys or outside tropical regions suffer from low digestion rates during the winter season when the

temperature drops below 15 °C. Further more study carried out by Adhikari (2002), reported that weather changes and climate change have impacts in the biogas production and utilization where by the optimum temperature for biogas production is 30^0C.

Amount of firewood reduced by biogas

The data indicated that 85.7% of respondent said biogas energy reduced firewood from 2 to 1 bundle per week compared to 5.7% reduced firewood utilization from 1 to 0 bundle of firewood per week. This implies that the biogas energy reduce the use of firewood. Upon interview with key informatives it was realised that they were using more fire wood before biogas introduction.The result of the present study agreed with those of Meggyes (2012), Mohan (2012), and Samson and Stamler (2009) that the use of biogas energy reduce the firewood forest destruction and climate change mitigation.

The relationship of biogas program and climate change mitigation

The data indicated that 52.9% of respondents said that there is positive relationship between the biogas program and climate change mitigation, Upon interview with key infomant it was revealed that there is relation ship between the biogas and climate change mitigation due to low cost energy for cooking and lighting. This is supported by TDBC (2008), that the use of biogas or alternative sources of energy reduce the green house gases by sequestrating carbon from the atmosphere.These results also concured with Adhikar (2002), and Samson and Stamler (2009).

Perception of people on the use of biogas energy

Findings revealed that majority 62.9% of respondents perceived biogas as good source of energy while 31.4% perceived use of biogas as source of forest conservation. Upon interview with key informants it was realised that biogas saves allot of money compared to firewood or charcoal.

Current status of the forest

The findings indicated that 65.7% of respondents said there is improved forest conservation. Furthermore interview with key informants it was realized that introduction of biogas program in the area lead to few people going in the forest to colect firewood.This was supported by one of the villager living in Poli village saying

"though biogas is not so much effective but still it can assist his family and village forest".

Relationship between perception of people and uses of biogas/day.

Table 6: ANOVA summary results for the relationship between the understanding of the peoples and the uses of biogas /day

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.157	1	.157	.669	.416
Within Groups	15.915	68	.234		
Total	16.071	69			

***Source*: Field survey, (Feb 2016)**

Table 6 show the relaationship between the uses of biogas per day and perception of the people about the biogas energy, yielded at p statistic of 0.416 > 0.05 which was found to be statistically significant at 95% confidence level. This implies that there is no relationship between the two. Therefore the use of biogas was not influenced by the perception of the people.

Conclusion

The findings in this study shown that efectiveness of the biogas is moderate compared to the other sources of energy, this implies that still the biogas program does not meet the needs of energy for cooking and lighting, temperature change, usage of biogas for whole day, type and time of cooking food remain the big challenges to the biogas efficient.

Furthermore it was observed that there was a positive relationship between the biogas program and climate change mitigation, since biogas provides low cost energy for cooking and lighting reduced firewood use and reduction of emission of green house gases.

Generally it was observed that there was positive effect of biogas energy program on people's socio-economic well being and forest resources conservation.

Recommendations

Basing on the presented results, discussion and conculusion the following recommendations were made in order to promote and improving the biogas energy program and archive climate change mitigation and forest conservation.

Poverty reductions should be given priority since is the underlying causes for the deforestation and climate change.

Furthemore conduction of awareness and training programs about advantages and disadvantages of biogas plants.

Initiate integrated program in livestock improvement, plantation and promotion of community forestry, income generating activities.

The researcher recommends that further studies should be conducted to find out the main factors for poor efficiency and uneffective operation and management of biogas.

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