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Short Communication

The Social Cultural Factors Influencing the Level of Adoption of Biogas as an Alternative Energy Source in Gakawa Location, Nyeri County, Kenya

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Abstract

Objective: This study examined the socio-cultural factors influencing the adoption of biogas as an alternative energy source among the small scale farmers in Gakawa location, Nyeri County.

Methods: The study adopted a descriptive research design in order to emphasize the measurement and analysis of relationships between study variables, and to systematically describe the Social cultural factors influencing the Level of adoption of biogas as an alternative energy source in Gakawa Location, Nyeri County, Kenya. Multi stage sampling was used to sample 351 households not involved in the Biogas Technology Project (BGTP) and 71 households involved in the BGTP. Primary data was collected through a questionnaire consisting of both open ended and close ended questions. Also key informants such as the agricultural extension officers, heads of local cooperative dairy society and NGOs coordinators were interviewed to augment the results of the household respondents. Quantitative data was analyzed using Statistical Package for Social Sciences and results presented in frequency tables, while qualitative data was analysed by categorizing similar themes from the respondents and using them to augment the quantitative data.

Results: This study has shown that socio-cultural factors can influence the uptake of biogas as an alternative energy source. For instance, households with higher levels of education were found to easily adopt biogas technology. Elderly people were more established and had fixed residence compared to younger people and thus were able to invest in expensive and permanent non-transferable projects like biogas technology. Female headed households tend to adopt the biogas technology as compared to their male counterparts. Finally, the results indicate that substitution of traditional sources of cooking, to more efficient household energy for the households, particularly in developing countries has not been adequately achieved.

Conclusion: It is concluded that for the uptake of the biogas technology to be effective, social cultural factors of communities must be taken into account. Also there is need for more studies in developing countries that will generate more policies to help households to embrace more efficient technology.

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Keywords: adoption, biogas, energy, adoption potential, technology, transfer

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1 INTRODUCTION

Energy is one of the essential inputs that determine the pace and status of any country's development[1-3]. For instance energy affects all aspects of development-social, economic and environmental[4]. Biogas energy which is categorized as a clean and renewable form of energy, could augment conventional energy sources due to a number of reasons, it has the potential to mitigate the contribution of greenhouse emissions, reduce eutrophication, and eliminate drudgery for women[4]. However, the rate of biogas technology adoption varies depending on a variety of social factors. Thus a full understanding of the social culture factors that influence the adoption of biogas technology as an alternative source of energy is very important[5,6]. This is so particularly due to the fact that, the supply of sustainable, affordable, adequate, reliable energy provisions has been a major challenge in most developing countries[3]. Also, biogas technology initiatives in many developing countries are still in their infancy stages and are faced with challenges, which have beclouded the adoption level of the technology. Kileo and Akyoo[7] and Lekhanya[8], reported that some of the challenges arise from households resistance to new ideas fuelled by fear, lack of knowledge, religious and cultural beliefs, traditional practices and social influence. Mwirigi et al.[9], argue that, people consider who is close to them such as family, friends and relatives when thinking of using new technology. Thus, households learn about the benefits of new technologies by imitating their peers' decisions, or respond to their peers' experience[10]. Therefore whenever a new technology is to be integrated, its assimilation will fit more easily if its components feature well with the cultural facets of the target community[11,12].

Lauterbach and Zuckerman[13], further indicate that male extension agents for biogas technology adoption are less able to reach the female as there are cultural and social restrictions. This may result in women being left out from extension services and management decision-making regarding to biogas technology adoption[14,15]. Also the educational level, number of cattle, income level, access to credit, distance to the main fuel wood source and the number of planted trees, the level of public awareness and education, gender, age, household size and employment status determines if households can adopt the biogas technology[4,16,17].

Also, some social customs deter unrelated men and women working together, to the extent that in some communities women cannot be contacted by men in the absence of their husbands. It is thus very difficult to involve women in development interventions, public gatherings, or even meet with them. This blocks women from accessing extension information of new technologies such as biogas adoption[4]. Further, men and women from developing countries do not adopt new technologies at the same rate or benefit equally from their introduction[18]. According to the UN[19] report, women remain marginalized from decision-making processes in relation to renewable energy such as biogas, and gender-sensitive energy projects and research.

Despite these challenges, studies have indicated that a sizeable number of countries have overcome the gap of energy shortages through adoption of renewable energy source such as biogas[16,20]. Biogas technology has also been seen as one of the renewable technologies in Africa that can help to ease its energy and environmental problems[21].

Thus based on the above literature review gaps, this paper examines the social cultural factors influencing the level of adoption of biogas as an alternative energy source in Gakawa location, Nyeri County, Kenya. As already demonstrated in the literature there is a significant relationship between social cultural factors and the level of adoption of biogas as an alternative energy[1,4,10,14-17]. Even though, there is limited literature on adoption of biogas by households and their transition from traditional technologies in the Global South[22]. Also the impacts of modern technology such as biogas have been found to be more critical in a nation's sustainable economic growth[23]. This paper thus answers a significant gap in literature: How can the social cultural factors influence the level of adoption of biogas as an alternative energy source?

2 MATERIALS AND METHODS

Gakawa location is registered as County Assembly Ward No 0476. It comprises of Kahurura, Gathiuru and Githima Sub-Locations of Nyeri County with a population of approximate 26,321 persons. Gakawa sub-division is located in Kieni East Constituency in Nyeri North Sub-County on the western edge of the Mt Kenya Forest ecosystem which is one of the largest single forest blocks in Kenya. The location covers an approximate area of 251.50 Square Kilometres (Figure 1).

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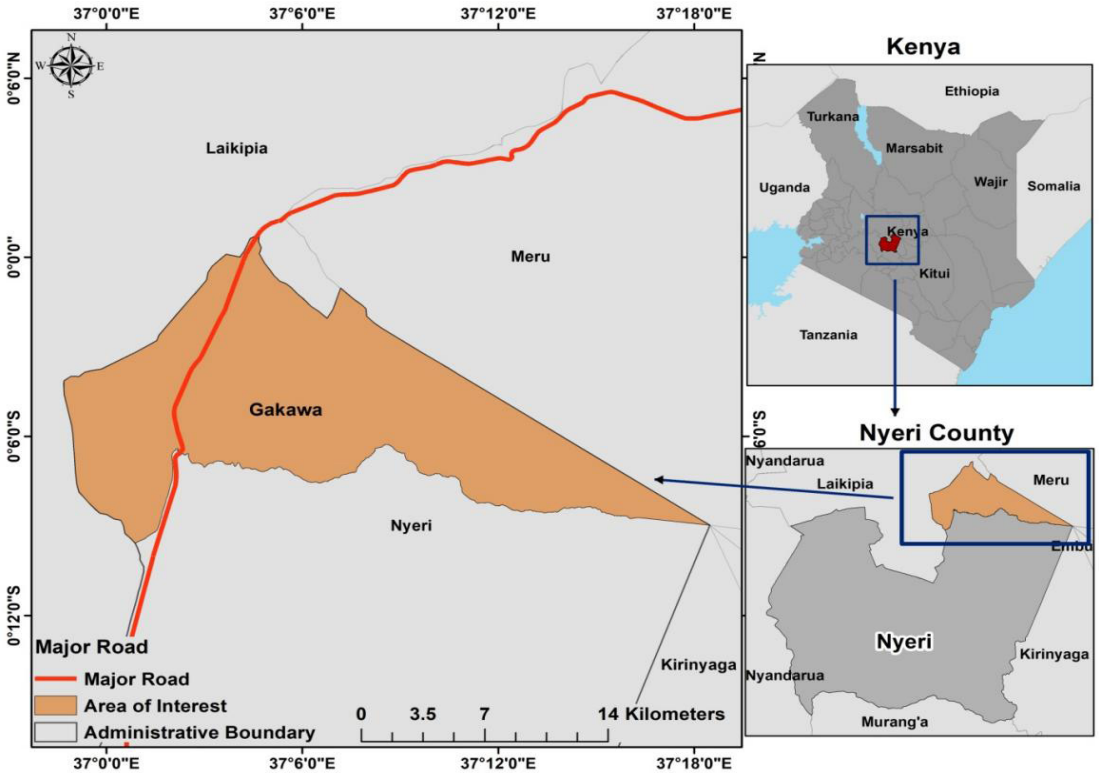

Figure 1. Location of study area.

With the instabilities that rocked the country in 1990, 1992, 1997, 2002, 2007, many internally displaced people have relocated to Gakawa Location. These efforts have either been on an individual basis, or land buying schemes and, more recently the government relocation programme[24]. Poverty data based on the Kenya Commission on Revenue Allocation shows that Gakawa location has the lowest percentage of individuals below poverty line due to the high population of immigrants and the urban population around Equator which is part of Nanyuki town[24].

The percentage of biogas users in Nyeri County, Gakawa, is negligible. The region faces amongst other weaknesses a weak human capital base due to low investment in education, poor on non-existent physical infrastructure such as roads, irrigation canals, factories, hospitals and telecommunications[25]. Traditional herds still are favoured in the form of goats and sheep that are either tethered or roam freely under close watch of some herds' boys and men. Small scale farmers grow subsistence and drought resistant crops with a mixture of horticulture and wheat farming. There is growing of maize (zea-maize), beans, and with irrigation the growing of horticultural crops, like tomato, butternuts, cabbages, kales, which mostly find their way into the local markets whilst others are being taken for sale in Nairobi and Mombasa.

This study targeted mainly household farmers' whose energy needs have been mainly wood fuel. These households have had the burden of collecting and utilizing, the ever diminishing wood fuel stocks.

Primary data was collected through a questionnaire consisting of both open ended and close ended questions to collect quantitative data from the household involved in the Biogas Technology Project (BGTP) and households not involved in the BGTP. An interview guide was used to collect qualitative data from the key informant's namely: agricultural extension officers, heads of local cooperative dairy society, and NGOs coordinators to augment data from the households. Snowballing was used to access the household involved BGTP and households not involved in the BGTP.

For the households not involved in the BGTP, the researcher adopted Fisher's formula to determine the sample size[26]:

$\mathbf{n}=\frac{n'N}{N-1+n'}$ Where, n is sample size

$n'=Z^2$ pq D/d^2, $Z^2$is the confidence level taken as 1.96 at 95%,

$\boldsymbol{p}$ is a proportion of the targeted population estimated at 0.5 confidence level at 95%,

$\boldsymbol{q}$ is1-p, $\boldsymbol{D}$ is design effect of 1 and, $\boldsymbol{d}$ is level of statistical significance taken as 0.05.

Hence, $n'= (1.96^2 *0.5*0.5*1)/0.05^2=384$

N=accessible population (in our case, Gakawa division has 8097 households).

Therefore, Sample size, n=384*8097/ {8097-1+384}=366 households not involved in the BGTP.

According to the report from Ministry of State for Planning, National Development and Vision 2030[24], the number of the household involved in the BGTP are about 180 in the whole constituency and only 71 household are involved in the BGTP in Gakawa location where the study was conducted. Thus all the 71 farmers at the study area were used to represent the household involved in the BGTP.

Quantitative data collected was presented in the form of frequency tables, pie charts, cross-tabulations, and histograms to indicate the distribution of background characteristics of respondents. All the qualitative data from the key informants and open ended questions from households were grouped into similar themes and used to support the study results[27].

3 RESULTS AND DISCUSSION

The purpose of this paper is to contribute to the existing literature by answering the question, how can the social cultural factors influence the level of adoption of biogas as an alternative energy source[1,4,10,14-17,22,23]? To respond to this gap in the current literature the results uses the social cultural factors, such as gender and age, educational levels, period of residence, marital status, and cooking energy sources as study variables. The results in response to this question are provided below:

3.1 Socio Cultural Factors Affecting Adoption of BGTP

As indicate above, the factors considered for this study included, gender, education level, period of residency and cooking energy source.

3.1.1 Gender and Age

Data collected indicated that most of the households not involved in the BGTP were male (55.4%) while 44.6% were female. Among the household involved in the BGTP, the majority (78.9%) of them were males, while 21.9% were females[18,19]. When households were qualitatively asked to explain which age bracket can accept the BGTP more easily it was found that the older people were more likely to take it up compared to the youth. For instance the following youth summed up this finding:

I cannot fathom myself collecting mounds of cow dung, certainly not me; I can't 'do it!

This was unlike among the elderly people as confirmed by GAD 11, who had this to say during the interview:

Say what!! We have no qualms handling cow dung, I mean, haven't we always been using it to plaster and smoothen our mud huts on the floors and walls? What is the fuss all about, just pick mix, with ash, and using our hands, get on!

These findings agree with Adkins et al. and Wawa and Ngcobo et al.[28-30] who report that older people are more established and have a fixed residence compared to younger people and thus are able to invest in expensive and permanent non-transferable projects like biogas technology.

3.1.2 Education Levels

The respondents were asked to provide details on the highest levels of education attained. About 66.2% of the households who were involved in the BGTP and another about 67.2% households who were not involved in the BGTP indicated that they had attained more than primary education[28-30]. Also education enables people to have the ability to understand and embrace new innovations[31]. A further interview of the households revealed that a majority of the initial households involved in the BGTP were retirees' who had invested in permanent and non-transferable enterprises like livestock farming. Muigua[32] also relates a higher level of education with adoption of biogas technology.

3.1.3 Period of Residency

The study revealed that the period of residence in an area determines the adoption rate of a BGTP. As indicated by the results about 36.4% of households not involved BGTP and another about 50.7% households involved BGTP had resided in the area for 20 year respectively (Table 1)[30].

3.1.4 Marital Status

From the data collected, 91.5% the household involved in the BGTP and another 71.4% of the households not involved in the BGTP were married. It was revealed that those divorced or widowed, were having challenges in adopting the BGTP as all household chores, decision making and financial burden were left to them[20,30,33]. For instance one widower during interviews summed up this finding KA'NAD 134:

After the death of my wife I had no one to take care of my animals, and one by one they all died leaving me with just this empty house.

However this could be argued as indicated by Kelebe et al.[20] that:

Female headed households tend more to adopt the biogas technology as compared to their male counterparts.

3.1.5 Cooking Energy Sources

The households involved in the BGTP were asked to identify the various sources of cooking energy available to them. Data collected indicated that 66% of households

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Table 1. Period of Residency of the Farmers

Period (Years)	Households not Involved in the BGTP (n=280)		Households Involved in the BGTP (n=71)	
	No. of Households	%	No. of Households	%
Less than 2	3	1.1	0	0
3-5	21	7.5	2	2.8
6-0	55	19.6	13	18.3
11-15	48	17.1	9	12.7
16-20	51	18.2	11	15.5
More than 20 years	102	36.4	36	50.7
Total		100		100

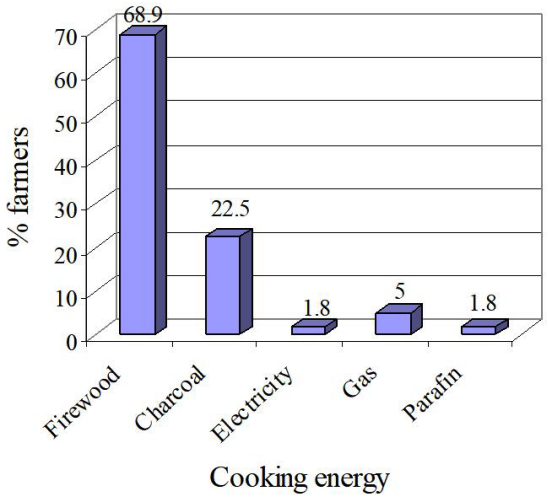

Figure 2. Cooking energy source for households not involved in the BGTP.

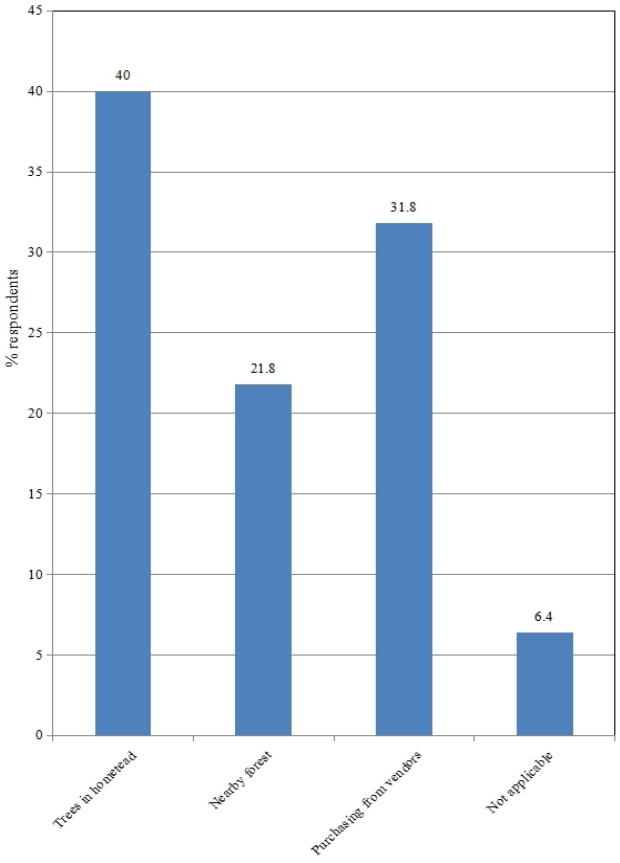

Figure 3. None- involved BGT households source of firewood. Source: Field Survey.

involved in the BGTP wholly use BGT for their cooking needs. One of the respondents GTAD4' proudly showed the researchers an abandoned pile of firewood which he had in stock before installing BGT. Other households involved in BGTP were found to have supplemented BGT with 26.8% using firewood and 7% charcoal in cooking. On the other hand, when households not involved in the BGTP were asked to identify the various sources of cooking energy that were available for them (Figure 2), about 68.9% of the respondents indicated using firewood, and another 22.5% used charcoal, while 1.8 uses electricity, 5% gas and another 1.8 paraffin respectively[34]. The use of fuel wood and charcoal is prevalent with Gakawa households due to its recognized ability to prepare *Githeri* (a mix of boiled maize and beans) fast and the notion that *Githeri* prepared using the traditional clay pot tastes much better. This agrees with Adkins et al.[28] and IEA/OECD[35] who argue that the substitution of traditional sources of cooking, to more efficient household energy for the households, particularly in developing countries is not a complete overhaul even when a household adopts BGT.

Data represented on (Figure 3) show that 40.0% of the households not involved BGTP use of broken branches, twigs, pruning and the occasional felling of mature trees in their homesteads[36]. Additionally 31.8% of the households not involved in the BGTP purchase firewood from vendors to supplement whatever little stocks they may have sourced from elsewhere[34].

Notably 21.8%, of the none-involved households in the BGT, particularly whose farms are in close proximity to Mt Kenya, visit the nearby forest to get their firewood.

4 CONCLUSION

The study examined the question on how the social

cultural factors can influence the level of adoption of biogas as an alternative energy source? Based on this question it can be concluded that social cultural factors have a significant positive relationship with biogas technology adoption. For example most elderly people were found to have adopted the technology. Also farmer's personal characteristics significantly influence biogas technology adoption in Gakawa, specifically, the probability of a household adopting biogas technology increases with age of a household and length of residence. Also marital status has a significant influence on uptake of biogas technology with women headed households more likely to take up the biogas technology compared to their male counterparts. Further, the results indicate that substitution of traditional sources of cooking, to more efficient household energy for the households, particularly in developing countries has not been adequately achieved. It is recommended that for the uptake of the biogas technology to be effective, social cultural factors of communities must be taken into account.

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Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

Author Contribution

Both authors were involved in the writing of the manuscript.

Abbreviation List

BGTP, Biogas Technology Project
BGT, Biogas technology

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