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GENDER AND ENERGY NEXUS: SERVICE DEMANDS AND ACCESS TO VARIOUS ENERGY SOURCES IN SUB-SAHARA AFRICAN COUNTRIES

A Case of Nambala and Manyire Villages in Arumeru District,-Tanzania

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Abstract

Gender roles and challenges to service demands and access to various energy sources in Tanzania are not well understood, particularly in rural areas. The study examined gender disaggregated survey on energy demands and access to various energy sources. Documentary review was employed for secondary data collection while self-administered questionnaire and focus group discussions were employed for primary data collection. The most used energy sources include firewood, plant residues and charcoal. Challenges and opportunities in usage of firewood include long distance to the collection point, accidents and decrease in biomass. Collection of firewood is done by females and children. Most of the households use local energy stoves. Most families using firewood are low income earners and therefore clean energy is affordable to few individuals with high or medium income.

Keywords: Energy nexus, Gender, Nambala, Manyire

1.0 INTRODUCTION

1.1 Background Information

Satisfying energy needs is crucial in the wider sustainable socio-economic development (Fatona *et al*., 2013). As such, energy sustainability is a key part in poverty alleviation projects in many developing countries (Clancy *et al*., 2002). Because of its importance, energy poverty is increasingly being one of the key poverty indicators (Clancy *et al.*, 2002; Fatona et al., 2013). It is already know that the way energy is generated, distributed and consumed has direct economic implications (Fatona et al., 2013). In Tanzania for instance, availability of electricity has resulted in mushrooming of small scale businesses such as fish selling and groceries. Equally important, power outages in the country have incurred significant losses to these small scale businesses that are important for local livelihood. Thus, energy security is an issue that must be addressed within development vision as it determines many other development slots, including the sustainable development goals (SDGs) (Clancy et al., 2002; Fatona et al., 2013; Reddy et al., 2000)

In addition, the fact that the total cost of energy in typical food processing is between 20-25% of the total food cost (Clancy et al., 2002), improvements in accessibility and efficiency of energy in poor countries could play a key role in the overall livelihood support system. Thus, improvements in energy access and efficiency could help many women and children who are mostly charged with collection and processing of household energy mixes (Clancy et al., 2002). Studies have shown that within the rural settings in many developing cou*ntries availability of enough biomass for family use and local food vendors would make significant* impacts to the local livelihood (Clancy et al., 2002).

Energy use characteristics, availability, control and management, are important in rural Tanzania and are characterized by sharp gender and income dimensions (URT, 2011). In Tanzania, where 80% of the total energy mix comes from biomass, women and children play central roles in collection, processing and using the biomass (Mwandosya and Luhanga, 1993). While fulfilling these ends, severe health concerns have been reported. For instance, women have been murdered because of the red eyes as a direct consequence of

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continued use of biomass energy, (URT, 2011). In addition, rape cases to both women and children have also been reported in many areas in rural Tanzania (URT, 2011).

Within the country, availability of energy is especially important because of the high dependency on the biomass energy and the pace at which massive forest resources are being degraded, (URT, 2011). The continued use of charcoal in many urban areas has not been sustainable primarily because of the poor return rate efficiency in making charcoal (URT, 2011). In addition, because of poor availability of sustainable energy options and awareness, the majority of rural populations continue to heavily depend on biomass for their energy use (URT, 2011).

Tanzania is located in the Sub-Saharan Africa, a region that is characterized by high dependency of non-renewable energy to facilitate social and economic development. It covers an area of 940,000 square kilometres rich in natural resources that can be used as energy sources. Rapid population increase and economic development in the country are considered to be the main factors contributing to the increase in demand for energy to support different development initiatives. According to Rwiza (2009), the dependency on biomass-based energy in most developing countries accounts for more than 90% of the total household energy consumption. However, its use is associated with health problems that cause death of about 1.6 million people per year in poorly ventilated houses. Therefore, there is need to understand gender disaggregated roles, demands and access to energy sources so as to determine the energy related challenges, thus enhance informed decision in the country (Rwiza, 2009). In addition, there are fears of climate alterations due to increasing release of greenhouse gases from biomass burning (Fatona et al., 2013). Thus, there is need for understanding the types of energy stoves mostly used in various areas - especially rural areas - and the impediment factors to the use of improved energy stoves. This will help to develop appropriate strategies that could influence the reduction of hazardous gases in the atmosphere that adversely affect the climate system.

1.2 Statement of the Problem/Issues

Economic development and population increase have exerted more pressure on the use and availability of energy in Sub-Sahara African countries, including Tanzania. The extreme use of non-renewable energy, viz. fuel wood and charcoal, plays a great role in degrading the environment through massive deforestation and the attendant release of greenhouse gases which in turn alter the natural state of the environment. While availability of energy has generally continued to be challenging within the country, energy needs, uses and characteristics are variable between men and women, particularly in rural areas. Specifically, socio-economic impacts associated with gathering, processing and use of particular forms of energy in the national energy nexus are known to be very variable across the country. Irrespective of this importance however, gender and energy nexus characteristics within the country are not well studied to portray the existing situation on energy demands, users, access; and the associated challenges and opportunities on the existing energy sources used. In addition, because the main source of energy in the country is being collected at zero cost, mostly by women and children, there is need to carry out a detailed energy survey to understand its socio-economic implications and how energy governance is practiced at a household level. Therefore, this study intends to undertake gender desegregation in energy service demands and access to various energy sources in the villages, and assign correct monetary values to the energy collected by women and children. This will help to improve understanding and interpretation of existing policies and guidelines in the energy sector, thus reducing energy associated challenges and improve standards of living in Tanzania.

1.3 Study objectives

The study intends to examine gender and socio-economic differences in energy service demands and access to various energy sources in the study villages. Specifically the study intends to;

i. Undertake the gender disaggregated survey on demands for and access to energy sources
ii. Identify and analyze the most used energy source vis-a-vis the income level of the users
iii. Analyze challenges and consequences related to the use of a particular energy source
iv. Analyze different initiatives from different energy stakeholders in improving access to socio-economic and environment friendly energy sources in the country

1.4 Organization of the Manuscript

This paper is presented in five main sections, namely, introduction, literature review, study findings and discussions, and conclusion and recommendations.

2.0 LITERATURE REVIEW

2.1 Energy characteristics in Tanzania

The major energy mixtures in Tanzania are not very different from those in many other African countries. According to the National Energy Policy, biomass is the main energy source for the nation, accounting for up to 80% of the total energy used in the country (UTR, 2012). The preference of biomass as the main source of energy doesn't come without its costs. Massive forests degradations have been reported across the country (MEWM, 1992, UTR, 2012). The declining forests resources could have a three-fold negative implication for the country. Forest degradation adversely affects the agriculture sector, decrease in biomass, loss of catchment areas for hydro-power generation and finally loss of carbon sink (MEWM, 1992, UTR, 2012). The policy document puts it clear that rural Tanzanians mostly use biomass in the form of firewood, crop residues, animal droppings and combination of these sources whilst their urban counterparts use mostly charcoal - all of which are detrimental to forest resources. However, studies have shown that energy sources and mixture across the country are highly variable (UTR, 2012). In addition, energy scarcity in the country has brought various energy combinations in the day to day use. For instance, coconut residues have widely been used in the coastal city of Tanga whilst forest litter is a common source of energy in central Tanzania (Sida, 2003).

Furthermore, the energy infrastructural development in Tanzania is not matching the growing population of the nation. As such, energy shortage is pronounced as the key factor hindering rapid development in Tanzania (URT, 2012). Recent survey on energy and development indices showed that because of energy unreliability, the nation ranks the 60th out of 64 developing countries in terms of development. Such a poor performance could repel many potential investors into the nation (URT, 2012). Within the Sub-Saharan Africa, Tanzania has the most power outages per month leading to comparable trend in the firms receiving electricity from own generators (WB, Enterprise Survey 2006). In addition, the nation has very low proportions of access to modern energy sources both in rural and urban localities. Statistically, slightly above 14% of total households in Tanzania mainland have electricity connectivity (TDHS, 2010). Worth noting, there are huge disparities in electricity coverage between urban and rural areas with respectively 45.4% and 3.4% (PHDR, 2011). Implication of the low electricity connectivity within the country could take many challenging forms, key among them being degradation of forest resources to cover up for the energy needs via fuel wood and charcoal production.

One key challenge in energy use in Tanzania is the use of traditional wood-burning stoves (URT, 2012) that have repeatedly shown to have major social-environmental problems (Clancy et al., 2002). The country is performing poorly in the conservation of biomass energy in which the traditional three stones stoves (the most stoves used in rural areas) have thermal efficiency of less than 10% but are widely used (URT, 2011). Similarly, the most used source of energy in urban area, charcoal, is not efficient either (Grant Axén, 2012). The charcoal that is produced in the rural area and transported to urban centres is made from traditional kilns that have efficiency of 15% recovery rate (URT, 2012).

Like in other developing countries, the highly advocated alternative has been the use of fuel saving stoves (Rwiza, M., 2009). Studies in Mexico showed that, the fuel saving stoves were more efficient and used less fuel to deliver more energy. The study showed that the improved stoves saved up to 67% of the fuel wood load (Berrueta et al., 2008). In the local setting, this good news has not been well tapped as studies have shown that fuel serving stoves have not been widely disseminated in Tanzania. Some of the reasons attached to the poor application of the stoves include poor awareness and knowhow (Kusekwa, 2011).

Similarly, irrespective of the presence of huge opportunities for the use of renewable energies viz solar, mini-hydropower, biomass co-generation and wind energies, not many people are using the clean energy sources in Tanzania (Kusekwa, 2011). Similarly, not many people are using biogas irrespective of the presence of many livestock in the country (Sida, 2003).

In addition, recent discoveries of huge reserves of non-renewable petroleum products could help the nation to surpass its energy deficiencies and characteristic power outages. Already 13200 $X10^6$ tonnes of coal have been located 0.04% out of which is tapped annually. Similarly, the country has 5 trillion ft^3 of proved natural gas and more gas deposits have been discovered recently. However, such huge developments would require significant development of the local human capacity and improve governance in the energy sector, all of which are not well set (URT, 2011). These discoveries, if well tapped, could provide huge balances in the energy mixture of the country and particularly in the rural settings and hence reduce dependence on biomass.

2.2 Gender disaggregated survey on demands and access to energy source

Because of the nature of job descriptions in many African countries, consideration of gender dimensions is important (Fatona et al., 2013; Leach and Mearns, 1988). Energy poverty in many developing countries affects the women and children more who are often charged with the tasks of collection and processing of the energy sources (MEWM, 1992, UTR, 2011) (Clancy et al., 2002; Reddy et al., 2000). Because of the increasing shortages of energy, women have been spending longer hours fetching fuel wood (Reddy et al., 2000). Similarly, long school hours are lost by students while collecting fuel wood in more and more remote areas following depletion of biomass around the homestead. To be specific, women and children spend between 3 to 8 hours to collect biomass and animal dropping daily (Fatona et al., 2013). In addition, studies have shown that, at times of energy shortage, girl children would most likely miss school hours in order to collect energy for the family, leaving their boys counterparts in schools. Statistically, women make up 70% of the 1.3 billion people living below energy poverty line (Fatona et al., 2013). Specifically, women lead the majority of the 2/3 of people lacking access to modern energies (Fatona et al., 2013).

2.3 Energy source used in relation to the income level of the users

Studies have shown that energy sources, use and characteristics are important poverty indicators (Reddy et al., 2000; Reddy and Assenza, 2012). For instances, statistics show that there are over two billion people who are still using traditional energy sources namely biomass, animal droppings, agricultural residues and forest litter (Fatona et al., 2013). Poor people are particularly associated with the use of biomass energy (Clancy et al., 2002; Reddy et al., 2000). In addition, studies have quantified that poor people spent more time collecting needed energy as compared to their wealthy counterparts (Reddy et al., 2000). Studies conducted in Tanzania showed that rural people who characteristically have lower GDP mostly use fuel wood whilst urban people with correspondingly higher GDP prefer the use of charcoal and other modern sources of energy (MEWM, 1992, UTR, 2011).

Economic growth of any sort is characterised by increased energy use (Kaygusuz and Toklu, 2012; Reddy and Assenza, 2012). Such energy use must be sustainable so as to be environment friendly, hence calling for increased energy efficiency (Kaygusuz and Toklu, 2012; Reddy and Assenza, 2012). Because of its importance, energy supply is a geo-strategic issue that has continued to shape global politics (Kaygusuz and Toklu, 2012). This therefore shows how important energy demarcates living standards (Kaygusuz and Toklu, 2012).

2.4 Challenges and consequences related to the use of particular energy sources

Biomass as a main energy source for the poor (Clancy et al., 2002) is known to have many setbacks. It has low calorific value and severe health concerns are associated with it. In Tanzania nthe health impacts include respiratory complications and red eyes resulting from continued exposure to smoke and particulate matter. The latter are of particular concern because many women with this condition have been associated with witches, on many occasions costing them their lives (UTR, 2011). In addition, many long hours are spent by women and children to collect a few kilograms of fuel wood - the time that would otherwise have been spent on other activities (UTR, 2011). According to Barnette, 2000, biomass will continue to be the main source of energy for the poor for many years to come. Furthermore, burning of biomass, has a climate change dimension; it is also associated with premature deaths of women and children in poor countries (Fatona et al., 2013).

2.5 Initiatives from different energy stakeholders in improving access to socio-economic and environment friendly energy sources

There have been various initiatives advocated in addressing energy poverty across the world - namely, rural electrification, improving biomass availability and the use of fuel serving stoves (Clancy et al., 2002). These options however have proved to have major limitations in rural Tanzania where land shortages have prevented people from establishing their own wood lots. In addition, rural electrification is still far from being realized as only 3.4 % of rural Tanzania is electrified (PHDR, 2011). On the other hand, although fuel saving stoves have been around for some two decades, such simple technologies have not been disseminated sufficiently in the rural setting and, where available, the technology is still very expensive for the local people who are perennially struggling to provide enough food for their families (Rwiza, M., 2009).

3.0 METHODOLOGY

3.1 Description of the study area

The study was conducted in Nambala and Manyire villages located in Arusha region, north-east of Tanzania. The climate of the area is bimodal, receiving about 1609-1825mm and 425-745mm of rainfall during the wet seasons (February-June and October-December) and the dry season (July-September) respectively. The average temperature in the area ranges from 13°C to 30°C. The selection of the study area was based on the fact that it represents typical energy challenges in rural Tanzania that could offer meaningful results with much wider implications for the country.

3.2 Methods

The study employed a case study research design involving Nambala and Manyire villages. This approach exposed the researchers to the reality of what currently exists in the field as a basis for collecting rich data to realize the study objectives. The sample population involved is households in all villages. The sample taken was 82 and 55 for Nambala and Manyire respectively; that amounts to 137 households. According to Bailey (1994), a sample of 30 respondents is the bare minimum for studies in which statistical analysis can be done regardless of the population size. A random sampling technique was employed to get such a sample size. This accounts for the fact that all households in the area use different energy sources which is vital information for this study.

The study collected both primary and secondary data. The primary data included types of energy sources, main economic activities of the households, gender desegregation and associated challenges in the collection, processing and use of the energy sources; strategies to counterfeit the experienced challenges; and key energy stakeholders including their roles in the villages. These data were collected through self-administered semi-structured questionnaire consisting of open and close ended questions. The study also employed focus group discussion for primary data collection where in each village a group of 15 people was formed to complement the information gathered through questionnaire. In addition, self-observation techniques were employed where necessary. On the other hand, secondary data were collected using documentary reviews of district socio-economic profile, Tanzania National Energy Policy and different research reports that were found to be pertinent to this study.

Both qualitative and quantitative data were analyzed. Qualitative data were analyzed through content analysis throughout the research process. Quantitative data were analyzed using computer based statistical software (i.e. SPSS Version 20) in order to generate descriptive statistics that were used as the basis for study discussions. Cross tabulations were performed so as to draw the linkage between study variables. The analyzed data are presented in pie charts, histograms and tables for ease of interpretation.

4.0 FINDINGS AND DISCUSSIONS

This section presents the results and discusses the findings of the study that examines gender and socio-economic differences in energy service demands and access to various energy sources in the study villages, namely, Nambala and Manyire. The findings of the survey largely highlight the socio-economic implications of the energy situation in the area as discussed hereunder.

4.1 Respondents typology

The surveyed demographic characteristics of respondents include age, sex, household size, sex of the household head, education levels and main economic activities of the families. It was important to determine these variables because they have implications on the use and challenges of energy sources in the villages. The study found that the sample size composed of 82 (60%) and 55 (40%), females and males respectively. The fact that there were more female respondents than males was to the advantage of this study since traditionally females are the ones responsible for fetching, collecting and using locally available energy sources. The females would therefore be in a position to give the true picture of energy availability and challenges in their areas. The study found that, 92 (67%) and 45 (33%) of the household heads are males and females respectively. Age characteristics of the area indicate that most household heads are within the working class (Table 1), hence potential for more meaningful assistance to their counterparts in collection and processing of energy sources for their households.

Table 1: Age of household head

Age	Frequency	Percent
18-35	39	28.5
36-55	66	48.2
55-70	26	19
71-85	6	4.4
Total	137	100

Source: Field survey, 2015

In addition, this study found that farming is the most economic activity practised in the study villages. According to the findings, of the 137 respondents, 80 (58%) and 19 (21%) practise farming and wage employment respectively (figure 1). This implies that, crop residues can be a significant contribution as a source of energy for a large number of people. This could help to reduce pressure on the forest resources though it can lead to soil infertility due to reduced biomass content of the soils and hence poor agricultural produce. Indeed many households were found to use crop residues. However, one key setback in the area is the fact that the majority of farm plots were not big enough; they ranged between 0.5 to 2 acres.

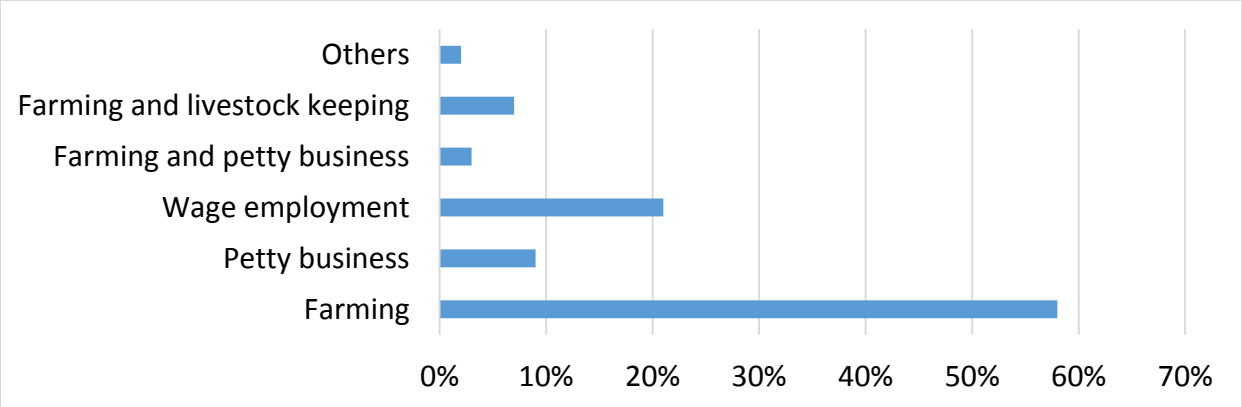

Figure 1: Respondents' main economic activities
Source: Field survey, 2015

Furthermore, the study found that out of 137 households 78 (53%), 58 (42%) and 6 (4%) have family members in the order of 5-8, 1-4 and 9-11 individuals respectively. The findings indicate that most of the household size in the study area is greater than 4.8 the national average household size (URT, 2013). The higher number of family members implies higher demand of energy sources in these households. On the other hand, the large number of individuals could help with family chores, including energy collections. This would therefore require the family hold to resort to either planting more trees or turning to alternative energy sources like solar and biogas to satisfy their energy needs.

Assessment of the education characteristics revealed that of the 137 respondents, 100 (72%), 20 (15%) have primary and secondary education respectively (Figure 2). This implies that, the majority of the study dwellers have basic education that can assist them to control their environment and make a better living. It was important to determine the education level because it has significant impact on the uses of improved energy stoves that save the biomass and therefore reducing the emissions rate of black carbon to the atmosphere. Moreover, education plays a great role in environmental conservation and management through the use of energy sources that are environment friendly (example biogas and solar power). Individuals with education are therefore well placed to receive further training in the management and efficient use of alternative energy sources.

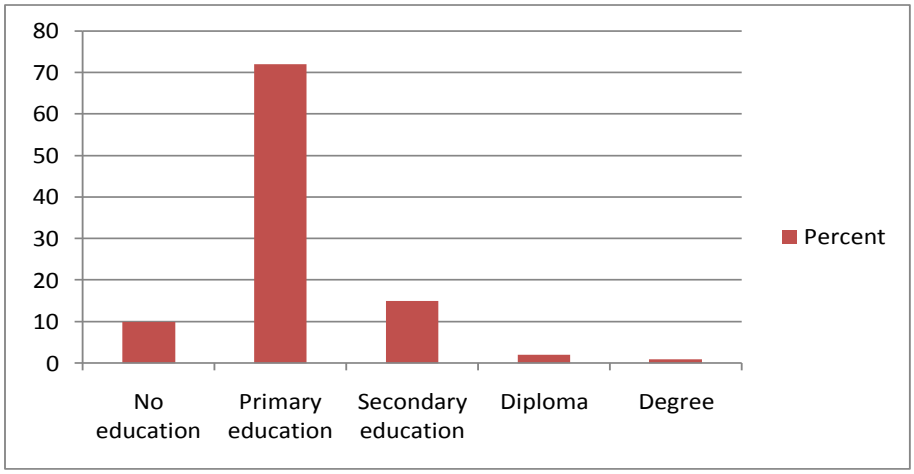

Figure 2: Respondents education level
Source: Field survey, 2015

4.2 Gender disaggregated survey on demands and access to energy sources

The finding of this study shows that several energy sources are used in the study villages where a combination of more than one source is common. Specifically, out of the 137 respondents, 29%, 23%, 15%, 15% use firewood, kerosene, charcoal and crop residues respectively as their main source of energy (Table 2 multiple response). The reported high fuel wood demands indicate that, as the population continues to increase there will be a corresponding demand increase in firewood. Thus, forest degradation is inextricably linked to increased use of fuel wood in the study area. This trend will be catastrophic if there will be no appropriate strategies to reduce the demand of firewood by introducing alternative options that could reduce the extreme burning of biomass. Respondents reiterated that they normally use firewood, charcoal, crop residues and kerosene because they are easily available (42.3%), less costly (44.5), and convenient (10.5%). One key finding of this study was that the alternative sources of clean energy, particularly biogas and solar power, were not widely used. This is the case irrespective of a few success stories on the use of the same in both villages. The adaptation of the technology doesn't seem to trickle down well. Adoption of environment friendly technologies like solar power and biogas will succeed only if the cost will be affordable to most of the villagers. The current cost of the average size solar system is around 500,000Tzs to 1,800,000 Tzs whilst biogas system is at around 1,200,000 Tzs. The end use of the mainly used energy source is for cooking (51.5%), lighting (45.8%) and heating (2.7%). Therefore, introducing efficient energy stoves will save much of the biomass used for cooking.

It is worth noting that out of the 137 respondents, 111 (81%), declared that biomass has been decreasing in the study area due to its massive use as a source of energy. Following the decrease in fuel wood, it is not surprising that many villagers use crop residues as one of the key energy sources in the area. The crop residues, mostly remains of maize cobs, are however seasonal and would not solve the problems of household energy on a sustainable basis. In addition, villagers complain that the crop residues have the disadvantage of producing more smoke which could have more detrimental effect on the health of the users. This indicates that, carbon sink (trees) will be greatly degraded in the absence of alternative and environment friendly energy sources. Such degradation will further contribute to failure in reduction of harmful greenhouse gases concentration. The latter would be a setback in the global campaign to control global

warming and its harmful impact on livelihoods - particularly rural dwellers in Sub-Saharan countries. This is due to the fact that they are less able to diversify their livelihood activities because of limited resources and, therefore, become more vulnerable to the impacts of climate change.

Table 2: Energy sources

Source of energy	Responses	
	Frequency	**Percent**
Electricity from national grid	9	2
Solar power	33	8
Kerosene	99	23
Biogas	3	1
Candles	14	3
Charcoal	64	15
Firewood	123	29
Animal droppings	5	1
Crop residuals (grainless maize cob and maize stalks)	65	15
LPG	12	3
Total	427	100

Source: Field survey 2015

Figure 3: Fuel wood and wheat residues used for burning bricks

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Figure 4: A: A woman cooking using crop residues B: Local energy stove using crop residues
Source: Field Survey 2015

In a bid to understand gender issues in the study area, gender roles and perspectives in the energy issues were considered. The findings indicated that, women and children are the ones most responsible in the collection of firewood compared to other groups (Figure 5). Of the 137 respondents, 34 % and 33% reported wife; and wife and children to be the responsible groups in collecting firewood for household use respectively. Men appeared to be less involved in firewood collection. This is due to the traditional ties in the area in which firewood collection is done by women and children. This trend is not any different from many other African societies (Clancy et al., 2002). This study also found that most of the children involved in firewood collection are students. However, it was clear that their involvement in fuel wood collection is done outside school hours. Worth noting, it remains to be found if the long hours and energy spent affects the academic performance of these students compared to their peers who do not collect fuel wood for their families.

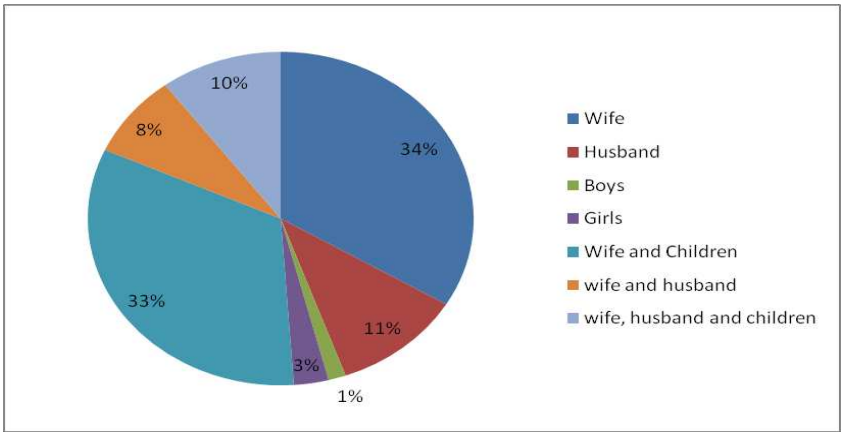

Figure 5: Responsible person for firewood collection
Source: Field survey 2015

Furthermore, this study found that respondents have different sources of firewood, namely, woodlots, along river banks in the village, village land, own farms, buying from firewood sellers and encroaching the nearby forests (LITI Tengeru). The findings show that, the majority of the village dwellers depend on woodlots (44.5%) and along the river banks (28.5%) to collect their firewood for household consumption (Table 3.) This trend is common among many other rural Tanzania societies (Rwiza and Brogaard, 2009). According to Rwiza, (2009), collecting firewood from woodlots ensures availability of firewood due to sustainable harvesting of trees; however more efforts on sensitization should be made to make sure that each person in the village has own woodlot for firewood. One key setback for this would be the shortage of land within the area. It is necessary to underscores the point that collecting firewood along the river banks could have significant drawbacks to the environment (Tanzania and Madini, 2003). This is due to the fact that, removing land cover contributes to the loss of water to the atmosphere through evaporation. Equally harmful is clearing of trees along the river banks as it will result in erosion of the river banks that may contribute to poor water quality through sedimentation process.

Table 3. Sources for firewood collection

	Frequency	Percent
Woodlot	61	44.5
Along river banks (Mtoni)	39	28.5
Village land	8	5.8
Woodlot and own farm	4	2.9
Buying	13	9.5
LITI Tengeru forest	12	8.8
Total	**137**	**100.0**

Source: Field survey 2015

4.3 Identification and quantification of widely used energy sources versus the income level of the users

Both local and improved energy stoves were found to be used in the study area. Statistically, of the 137 respondents, 109 (80%) and 28 (20%) were found to use local and improved energy stoves respectively. Respondents argued that, the majority use local energy stoves because they are cheap (40.4%), efficiency (18.3%), locally available (12.8%) and respondent have traditional ties to the stoves (20.2%) (Table 4). This implies that, more biomass is lost through the use of local energy stoves (Berrueta et al. 2008). The findings of this study fall within the national trend that shows that the traditional three stones stoves are widely used (Sida, 2003). Studies have proved that, improved energy stove saves about 67% of the biomass used in local energy stove (Berrueta et al. 2008). Therefore, there is need to increase awareness on the use of improved energy stoves in the study villages so as to reduce the pressure exerted on forest resources for generating energy resource. This has a multiplier effect, both environmentally and economically; and therefore it will contribute significantly towards attaining sustainable development.

Table 4. Use of energy stoves

	Frequency	Percent
Cheap	44	40.4
Efficiency	20	18.3
Local availability	14	12.8
Traditional ties	22	20.2
Cheap and traditional ties	9	8.3
Total	**109**	**100.0**

Source: Fieldwork 2015

Moreover, respondents argued that, improved stoves are not widely used because they are expensive (40.9%). In addition, poor sensitization on the use of improved energy stoves by energy stakeholders was also found to be a key limitation to the use of improved stoves (19.7%) (Table 5). These results are similar to results by (Kusekwa, 2011; Ringia and Massawe, 2009). This signifies that, there is need of increasing

awareness in the study villages and other villages on the use of improved energy stoves. This will help to reduce the volume of biomass required as a source of energy in order to gain both economic and environmental benefits. Economically, it will reduce the frequency of collecting firewood and, therefore, the time saved could be spent on other economic activities. Environmentally, it reduces the rate of emissions of greenhouse gases to the atmosphere that contribute to the changes of the global climate. Furthermore, conservation of forests for wildlife habitat will be improved and therefore enhance ecosystem restoration in the areas. Similarly, a few respondents were found to be using biogas from livestock droppings (Figure 6). Such a positive initiative, if well adopted could reduce dependency on biomass and relief women and children of the tedious work of collecting fuel wood.

Figure 6: C: Biogas **D: Energy efficient stove**
Source: Field Survey 2015

Table 5. Reasons why the improved ones not mostly used

	Frequency	Percent
Expensive	56	40.9
Not efficient	5	3.6
Poor sensitization	27	19.7
Poor availability	10	7.3
Poor availability, poor sensitization and expensive	18	13.1
I don't know	21	15.0
Total	137	100.0

Source: Fieldwork 2015

What is more, this study sought to find out how far were the villagers located from the firewood collection points. The findings showed that out of the 137 respondents, 128 (93.4%), 3 (2.2%), 6 (4.4) collect firewood at a distance of 0-2 km, 3-5 km and more than 5km respectively. However, this figure could give a wrong perception that there is plenty of fuel wood within and around the villages. The close proximity to the fuel wood collection point actually reflects the land ownership in the area which does not allow people to collect fire wood in areas owned by other people. Thus villagers are left with only the option of collecting fire wood in their own areas or from their friends and families. In addition, there isn't much firewood in areas beyond the villages as the area is closed surrounded by big institutions and commercial farms. Therefore, efforts of conserving the existing forests in the villages are important. There is need to have effective by-laws in the study villages that prohibit unsustainable use of forests resources. This will help to tune the minds of people who are still using the local energy stoves that consume more biomass and leads to environmental degradation.

This study also sought to find out the way fire wood is carried to respective homes and who is responsible for that. The findings showed that several means of ferrying firewood to homes were used in the study area - including, own body, ox-carts, vehicles and bicycles by 131 (96%), 2 (1.5%), 2 (1.5%) of the respondents respectively. Interestingly however, 51% of the households reported that fuel wood collection is often done by all members of the family. It is worth noting that collection of firewood using own body has economic disadvantages because more time is spent for firewood collection that could have been devoted to other economic activities. This is due to the fact that, through own body collection individuals do afford to carry small bundles that can be consumed within a short time before going to field again. On the other hand, financial constraints are limiting people from using motorized engines that would carry more pieces of fire wood per trip.

In addition, collection of firewood was found to be associated with many problems, namely long distance to the collection point, poor availability of firewood and injury inflicting accidents by 33 (34.1%), 32 (23.4%) and 37(27%) of the respondents respectively (Table 6). It is worth noting that only a few villagers collect firewood from their own woodlots and farms while majority walk long distances to collect firewood. Therefore, there is need to encourage implementation of woodlot farming by each household in the study area so as to reduce the distance to the firewood collection point. This will ensure availability of firewood; it will also improve ecosystem services. However, as already discussed, land shortages and ownership are the major impediments for the farmers to have their own woodlots. Moreover, respondents argued that there are problems associated with firewood collection, including accidents, the long time taken to process fire wood, and inability to process the firewood due to old ages and poor health of the respondents in the orders of 58 (42.3%), 12 (8.8%), and 11 (8%) respectively. However, 56 (40.8%) respondents said there were no problems associated with firewood processing in the study area.

Table 6. Problems of firewood collection

	Frequency	**Percent**
Long distance to the collection point	33	34.1
Poor availability	32	23.4
High transportation cost	1	.7
Spending more time in collection	7	5.1
Accidents	37	27.0
Accidents and time consuming	5	3.6
Poor availability and poor processing tools for hard woods	3	2.2
Accidents and conflicts	6	4.4
None	13	9.5
Total	**137**	**100.0**

Source: Fieldwork 2015

The use of firewood was also found to have severe problems, specifically those relating to health. According to the findings, most biomass and animal dropping users were complaining of severe eyes and chest complications. This could threaten the wellbeing of most villagers due to high dependency on firewood as a source of energy. The latter has the potential of lowering the labour force of the country and hence reduces poverty. Most importantly, respondents argued that the most affected groups were both females (74%) and males (3%). The huge difference in the statistics originates from the fact that, traditionally females are responsible for cooking and therefore, spend more time in the kitchen where they become more exposed to smoke and particulate matters (Figure 6, C&D). In accounting for the energy challenges in the area, villagers have developed several strategies to counteract the energy problems, namely establishing own woodlots, use of biogas, solar power and use of fuel serving stoves. However, as discussed before, these efforts are limited and it would be helpful to replicate them in many more villagers.

Figure 6: C: A woman cooking using crop residues D: Local energy stove using firewood
Source: Field Survey 2015

Furthermore, the study found that there were no specific group who collected and processed firewood in the study area. Both groups (youth and adults) at the households are responsible for collecting firewood to serve as energy source (Table 7). This implies that, there is collective approach for gathering firewood and therefore the activity becomes simplified.

Table 7. Family members responsible for collecting firewood at the household level

	Frequency	Percent
Children	2	1.5
Youth	2	1.5
Adults	42	30.7
Both	51	37.2
Adults and Youth	7	5.1
None	33	24.1
Total	**137**	**100.0**

Source: Fieldwork 2015

The study observed that, each household is responsible for the implementation of the strategies for counteracting the challenges. Of the 137 respondents, 80 (58.4%) reiterated that the most actor for implementation of the strategies is the household, but 51 (37.3) respondents showed that, they don't know the responsible actor. The greater number of the respondents who don't know the responsible actors implies that, there is poor sensitization on the efforts of overcoming the challenges in the energy sector. Therefore, more efforts should be made to increase awareness on overcoming the energy challenges at the household level, which is the direct consumer of the energy. Moreover, the study observed that there were local institutions/by-laws responsible for ensuring effective managing forest resources in the study area. The findings showed that, the local institutions/by-laws were effective to attain the intended goals by 80.3 %. Therefore, this should be emphasized and be adopted by other villages around the study area so that forest resources are safe from degradation as a mechanism to enhance the existing ecosystem.

Existence of energy stakeholders in the study village is not well known to most of the respondents. The study findings show that, 57 (42%) respondents don't know any stakeholders in the village. However, government ranked as the main stakeholder in the study villages by 32% (Table 8). This implies that there was poor sensitization by the energy stakeholders in creating awareness on the appropriate energy technology. This will have significant negative impact in the future on the adoption of improved energy stoves which are environment friendly.

Table 8. Energy stakeholders in the study area

	Frequency	Percent
Private companies	8	5.8
Government	44	32.1
CAMATEC	11	8.0
NGOs, CBOs, FBOs	17	12.4
None	57	42.0
Total	**137**	**100.0**

Source: Fieldwork 2015

The study observed that, energy stakeholder play some limited roles in the study area. Of the 137 respondents, 36 (26.3%) and 24 (17.5) reported to have received some form of environmental awareness and sensitization on the use of improved energy stoves from the major energy stakeholders in the area respectively (Table 9). However, 61 (44.5%) respondents reported that they have not seen any active involvement of the energy stakeholders in the area. This implies that awareness building on the use of improved energy stoves has not been done effectively, hence a danger of more biomass consumed in the future. Several benefits accrued from energy stakeholders, including education on improved energy stoves, installation of bio-gas systems and education on environmental education. Moreover, it was important to determine the performance of energy stakeholders in the study area. Of the 137 interviewee, 27 (19.7%), 27 (19.7%), 29 (21.2%) ranked the performance of stakeholders poor, very poor and good respectively. However, 49 (35.8) failed to rank the performance of the energy stakeholders due to the reason that they are not sure of their existence in the study area. The government has made some efforts on improving energy services in the study area through installation of hydropower electric lines and training on the use of energy efficiency stoves.

Table 9. Roles of energy stakeholders

Roles	Frequency	Percent
Sensitization on the use of improved energy stoves	24	17.5
Supply improved energy stoves	5	3.6
Awareness on environmental conservation	36	26.3
Making available of alternative energy source	5	3.6
Empowerment on biogas use	3	2.2
Supply of solar panels on loan basis	3	2.2
None	61	44.5
Total	**137**	**100.0**

Source: Fieldwork 2013

Within the study area the level of income can be indicated by individual's assets. For instance, of the 137 respondents, only 7 (5.1%) own motor bicycles. Therefore, the proportion of people using petroleum energy source is very low. This indicates that the level of income of most village dwellers is low. It is worth noting that all owners of the motorized means of transport are men.

5.0 CONCLUSION AND RECOMMENDATION

Integration of gender issues in energy sufficiency in the area should be handled as key policy issue because it is central to many livelihoods. In addition, it is clear that availability of energy in the village has been worsening and energy collection and processing have particularly consumed a lot of time, the time that would otherwise have been spent on other economic activities. Gender biasness is very clear in the study villages

when it comes to who is most affected by challenges brought by energy issues. Within the study villages it is very clear that women, and to some extent children, play key roles in the collection and processing of firewood.

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