The impact of Households Fuel Wood Energy Consumption to Forest Resources: A Case Study Ruangwa District

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Abstract

The purpose of this paper is to evaluate the effects of household fuel wood energy dependency on village trees in Ruangwa District. The study's specific goals were to identify energy sources in Ruangwa District, investigate the consequences of home energy dependency on trees in rural areas, and evaluate strategies to alleviate the effects of household energy dependency on forests. The study used a case study in southern Tanzania to examine the effects of household fuel wood energy dependency on forest resources. The study sample constituted 96 local forest resource stakeholders. Purposive and non-probability sampling techniques were employed in data collection. Both quantitative and qualitative methodologies were used. Closed and open-ended questionnaires were used to collect both primary and secondary data including relevant documents related to village forest resource production, sales patterns, and resource control. The study established that, charcoal and firewood were the primary sources of cooking energy. Also, lack of knowledge and household poverty had a significant impact on forest management and control. The study concluded that, poverty was the primary factor driving household reliance on charcoal and firewood compounded by forest management authorities restricting local communities from extracting essential forest products; and lack of education on the importance of conserving trees in the local environment. Recommended that, local communities should be educated on the negative fuel wood human activities to the environment specifically excessive tree cutting for fuel wood energy. Besides, villages around forest resources and forest management on authority should jointly draw regulations and supervision mechanisms sustainable use of forest resources and products.

Keywords: *Household fuel wood energy dependency, household poverty, excessive tree cutting for wood, forest management*

1.0 INTRODUCTION

In Africa, forests play a vital role in household livelihood (Razafindratsima et al., 2021). They are equally important in biodiversity protection, hydrological cycle regulation, wildlife habitat, carbon sequestration, and climate regulation, among other things (Miller et al. 2021). Food basically vegetables, fruits, and roots; medicinal plants, honey, thatching grass, fodder, firewood, charcoal, and

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construction materials, as well as cultural, spiritual, and ceremonial places, are all provided by indigenous forests to local communities (Wandago, 2002). Forests, on the other hand, play a significant role in rural household economies. Africa consumes the most fuel wood per capita in the world, 0.83 m3 per person per year. Because most of wood is used for cooking. Forests and tree systems contribute to household food security by providing cooking energy. In addition to providing household jobs and money, trees contribute to food security. Forests are also known to give non-use values to various stakeholders, such as existence, charitable, and bequest values.

According to, Gray et al. (2009) Africa has the world's biggest yearly per capita usage of fuel wood. Because the majority of wood is used for cooking, forests and tree systems contribute to household food security, employment, and income by providing cooking energy. This general alarming information on fuel wood consumption in different parts of the globe; it prompted this study to assess the situation at local level. The purpose was to establish whether rapid consumption of fuel wood in the st udy area existed at the detriment of the local forest resources; and there were intervention strategies such as alternative energy sources to ensure sustainable use of forest resources.

2.0 LITERATURE REVIEW

Many researchinstitutions including United States Department of Agriculture (USDA 2007) and the National Research Council (2008), have discovered that rural poor people rely on forest resources for income and other forest resources. As a result, several experts concluded that one factor contributing to deforestation was a lack of alternative energy sources, as their high profit margins are dependent on the availability and sale of fuel wood. In Tanzania, the gap between biomass fuel output and consumption is widening. Biomass consumption and sustainable supply predictions show a 22 percent shortage by 2020; which if combined with population expansion, might compel more people to rely on forests for their fuel needs (FAOSTAT, 2004).

The majority of African households rely on traditional fuels to meet their daily energy needs, and this is projected to continue for many years (Mwampamba, 2007). Wood is extremely significant in Sub-Saharan Africa as a household cooking fuel and for any other form of domestic use. (SSA) (Erakhrumen, 2008 cited in Erakhrumen, Ogunsanwo and Blomley, *et al* 2010). More than 90% of Africans use firewood or charcoal for cooking and other heat-related activities, according to available estimates. Similarly, wood fuel dominates Tanzania's energy supply, accounting for more than 90% of the country's energy mix (UTR,

2003). In Tanzania, charcoal is the most common source of energy for both rural and urban communities.

The number of homes who rely on wood fuel to meet their daily energy demands is expected to rise steadily (Rude *et al*, 2010). On the other side, a study by Mwampamba (2007) found that as African cities grow, more charcoal will be consumed with a 14 percent increase in charcoal consumption for every 1 percent rise in urbanization. Furthermore, according to Msuya et al. (2011), Tanzania loses 150,433 hectares of forest per year, or around 5.8% of the total forest, due to fuel wood usage. Erakhrumen (2010) attributes the expected future increases in fuel wood use to demographic and socioeconomic changes, as well as unpredictably fluctuating fuel costs (such as kerosene, liquefied petroleum gas (LPG), and others).

The above figures highlight the importance of charcoal as a residential and commercial fuel in Sub-Saharan Africa, particularly Tanzania. The energy use is dominated by biomass-based fuels particularly fuel-wood (charcoal and firewood), which are the main source of energy to both urban and rural areas. Biomass-based fuel accounts for more than 90% of primary energy supply (Msuya *et al,* 2011). Commercial energy sources such as petroleum and electricity, account for about 8% and 1.2%, respectively, of the primary energy used (Mwampamba, 2007)). Coal, solar and wind account for less than 1% of energy used. Tanzania has a forested area of about 35.5 million hectares of which, around 80,000 hectares are plantation forests, and 70,000 hectares are privately owned (URT, 2003).

According to URT (2003), the National Energy Policy of 2003 was established to assure the availability of reliable and inexpensive energy supplies, as well as their logical and sustainable usage in support of national development goals. As a result, the national energy strategy aspires to build environmentally sound and sustainable energy production, procurement, transportation, distribution, and end-use systems. The 1997 National Environmental Policy establishes the environmental foundation for a variety of industries, including energy.

Sustainability, security, and equitable use of resources to meet the basic requirements of present and future generations without jeopardizing health and safety are among the goals of the National Environmental Policy. As a result, the goal of this study was to examine the impact of household

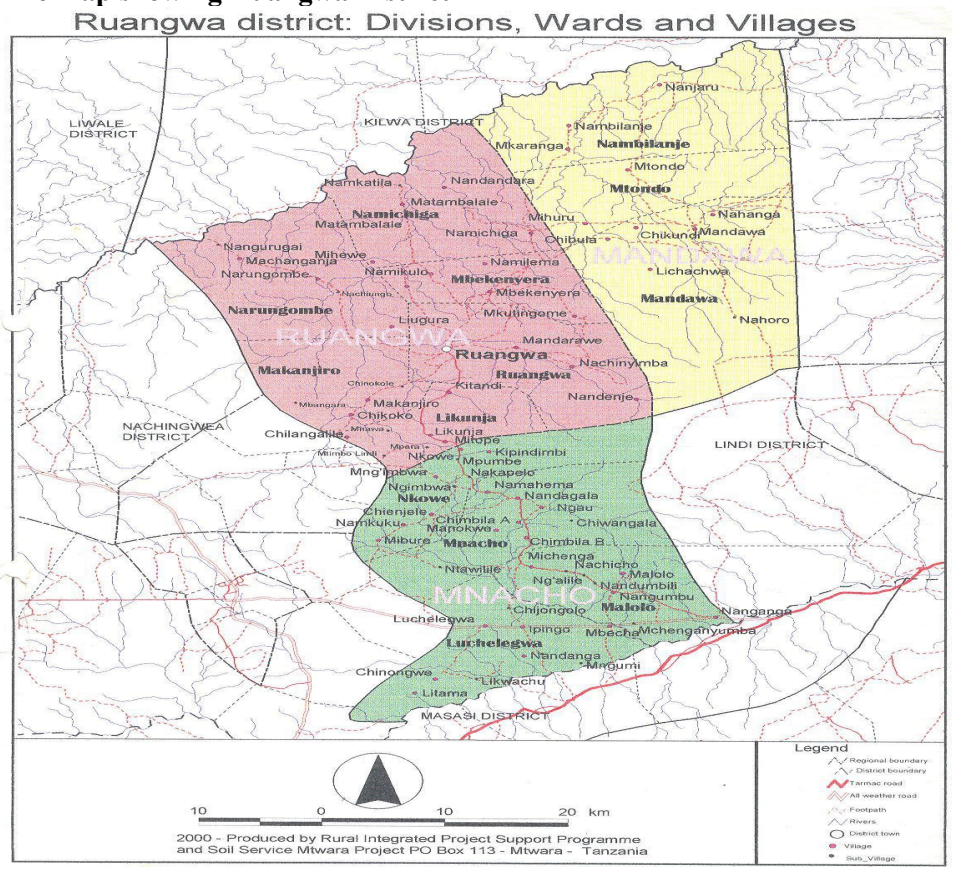
energy consumption and reliance on firewood and charcoal forest resources on village forest conservation. This paper intended to address three issues: to identify main sources of energy used for cooking at home; examine effects of dependence on village forest for charcoal and firewood; and respective measures taken to mitigate the effects of household energy dependency on forest.

3.0 MATERIALS AND METHODS

3.1 The Study Area

The research was carried out in Ruangwa District, Lindi Region, Tanzania. The district is divided into 22 administrative wards. According to 2012 National Census, the district had a total land area of 2,515.6 km^2 and a population of 184,899 people made up of 89195 male (48.24%) and 95704 females (51.76%). The district has seven villages with community forests namely: - Kipindimbi, Lichwachwa, Nahanga, Ng'au, Kitandi, Chingumbwa and Nandenje.

The map showing Ruangwa District



3.2 Research design

This research assumed a case study. The justification is that; according to Denscombe (2000), a case study provides more comprehensive results rather than generic responses to how and why concerns.

3.3 Sampling Frame

The sampling frame for this study was obtained from the national censual (NBS, 2012) covering the population of seven villages which form community forest villages. They were purposely selected for this study. All seven villages had a total of 14040 people as shown in Table 3.1.

Table 3.1: Population of the study

Population category	Population	Percent (%) in total population
Kipindindimbi	2018	14.4
Lichwachwa	444	3.2
Nahanga	2565	12.2
Ng'au	2965	18.2
Kitandi	3145	22.4
Chingumbwa	1264	9.0
Nandenje	1639	11.6
Total population	14040	100.0

Source: National Bureau of Statistics 2012

3.4 Sampling Techniques.

Foremost, the household was the unit of analysis. It included heads of households. By virtue of being leaders their respective households were assumed to know even practice tree cutting in fuel wood processing for livelihood; thus, they were chosen for interview. Simple random sampling technique was employed to get a sample of 96 respondents from the population for interview. Random sampling was employed because it increased probability of selecting charcoal harvesters, charcoal traders, and charcoal consumers from the population who in one way or the other were involved in using forest resources. The random selection was carried out in such a way that, heads of households in the study area were asked count numbers 1, 2 up to 3. Then, those who counted 3 were selected to form the study sample for interview. In this way, the sample of 96 heads of households randomly included charcoal harvesters, charcoal traders; and charcoal consumers.

3.5 Data Collection Methods

Data were collected using both primary and secondary data. Primary data are those data which are freshly gathered while Secondary data are those

data which already existed in other sources of data (Kotler, 2007). Questionnaires, interview and documentary reviews were the tools for data collection. Primary information was collected through respondents, while secondary data were collected through documentary review from various scholars who had gone through various studies relating to this study.

3.6 Data Analysis and Presentation

The information collected using questionnaires, interviews and observation was coded and analyzed. Quantitative data collected were analyzed using Statistical Package for Social Sciences (SPSS) version 16 where simple descriptive statistics were computed and presented in frequencies, percentages, tables and in figures. Qualitative data were analyzed using content analysis where the results were presented in narratives to meet the specific objectives of the study.

4.0 RESULTS AND DISCUSSION

4.1 Demographic Characteristics of Respondents

4.1.1 Age and Gender

Male respondents accounted for 48, or 50 percent of the total number of respondents, while female respondents numbered 48 or 50 percent of the study sampled population (see Table 4.1). To avoid gender bias, the male and female numbers were equal. The justification for selecting more or less balanced gender for the interview was that, both female and male they use and sell surplus forest products in the form of fuel wood, therefore, in either case they cut down forest resources for livelihood.

Furthermore, it was found that 67 of the respondents were 20-30 years old (69.8%), 14 were in the age of 31-40 years (14.6%) , 11 respondents were 41-50 years old (11.5%) , and 4 were 20-30 years old (4.2%). This was done to get critical results especially in agricultural sector and other production sector in rural villages

Table 4.1. Age of respondents

	Variables	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	20-30 years	67	69.8	69.8	69.8
	31-49 years	14	14.6	14.6	84.4
	41-50 years	11	11.5	11.5	95.8
	51 and above years	4	4.2	4.2	100.0
	Total	**96**	**100.0**	**100.0**	

Source: Field survey, 2017

4.1.2 Education Level of Respondents

Table 3.2 shows different levels of education achievements of respondents. They ranged from primary school education to university education levels as follows: primary 44 (45.8%). ordinary 36(27.6%), advanced 8 (8.3%), diploma 4 (4.2%); and university 4 (4.2%) levels. These data suggest that the research involved respondents with different levels of education. The purpose of analyzing levels of education was to establish whether different levels of education achievement have impact on sustainable/haphazard use of forest resources in the study area.

Table 4.2: Respondents education level

	Variables	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Primary level	44	45.8	45.8	45.8
	Form four	36	37.5	37.5	83.3
	Form six	8	8.3	8.3	91.7
	Diploma level	4	4.2	4.2	95.8
	University graduate	4	4.2	4.2	100.0
	Total	**96**	**100.0**	**100.0**	

Source: Field survey, 2017

4.2 Charcoal and Firewood: Main Sources for Cooking at Home

Table 4.3 stipulates that among 96 respondents who answered the question on whether charcoal/ firewood or bothe were the main sources of cooking energy. It shows that, 50 (52.1%) strongly agreed, 32 (33.3%) just agreed to the statement, 9 ((9.4%) disagreed, 3 strongly disagreed; and 2 were not decided. It means that, several respondents said that charcoal and firewood were the main sources of cooking energy in their localities. Besides, it implied that Ruangwa rural households depended much on charcoal and firewood as the major source of energy for cooking and commercial purposes.

Table 4.3: The opinions over charcoal and firewood as the energy sources for cooking at home

	Variables	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	50	52.1	52.1	52.1
	Agree	32	33.3	33.3	85.4
	Neutral	2	2.1	2.1	87.5
	Disagree	9	9.4	9.4	96.9
	Strongly disagree	3	3.1	3.1	100.0
	Total	**96**	**100.0**	**100.0**	

Source: Field Survey, 2017

These results were similar to those reported in Uganda where 80% of rural communities used charcoal and firewood as their main source for cooking at home around Nakasongola where community livelihoods relied on **firewood** and **charcoal** burning and selling (Mwaura, 2014).

Plate 4.1: Firewood and Charcoal sales in Nandenje village in Ruangwa district

Source: Field Survey, 2017

Plate 4.2: Charcoal and firewood sales along Ng'au-Mkowe Road. By the time this research was conducted, the prices for a bag of charcoal and proportionate pieces of firewood were Tshs. 8,000 and 1,000 respectively.

Source: Field Survey, 2017

4.3 Effects of Use of Charcoal and Firewood to the Village Forest

Table 4.4 presents the number of respondents and their opinions ranging from those who stated that the cutting of trees for charcoal and firewood had negative effects to no effects to the village forest resources. They were categorized into two main different groups. That is, those who strongly agreed that excessive tree cutting for various uses had no effect to community forests as compared to those who strongly disagreed with the statement. It implied that, generally the use of charcoal and firewood have strong negative effect to the village forest resources.

Table 4.4: Respondents' opinions on the use of charcoal and firewood whether it had no effect/effect to community forests

	Variables	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	7	7.3	7.3	7.3
	Agree	13	13.5	13.5	20.8
	Neutral	1	1.0	1.0	21.9
	Disagree	44	45.8	45.8	67.7
	Strongly disagree	31	32.3	32.3	100.0
	Total	**96**	**100.0**	**100.0**	

Source: Field Survey, 2017

These study findings tally with those of Tscharntke et al., (2012). Therefore, such excessive use of fuel wood for cooking has large-scale effects to tropical biodiversity such as habitat loss and forest fragmentation. It is partly explained by the general lack of knowledge on the overall impact of fuel wood harvesting at micro scale (Maennig, 2011). Quite often, many e studies report on the potential impacts of fuel wood harvesting on tropical forests are anecdotal or come from studies aiming at assessing poverty and/or energy issues that do not assess the biodiversity status of the forests that provide this ecosystem service (May-Tobin, 2011). Alternatively, if several micro spatial scaled studies on the dynamics of fuel wood harvesting are to be conducted in various areas focused on the socioeconomic drivers for excessive tree cutting for fuel wood; they can in aggregative form basis for preparing information at macro levels. Plate 3 presents such areas which had been distracted by farmers in Kipindimbi village forest in Ruangwa district.

Plate 4.3: Areas with forest distracted by farmers in Kipindimbi village forest

Source: Field Survey, 20174.4 Assessment on Villagers be Given Permission to Access and Control Village Forest Products

Table 4.5 shows different responses on whether villagers be permitted to access and control village forests products as follows, 57(59.4%) disagreed; 23(24.0%) strongly disagreed, 10 (10.4%) were neutral, 5 (5.2%) agreed; and 1(1.0%) strongly agreed. Overwhelmingly, respondents disagreed for for villager entirely to be granted permission to access and control village forest products alone. It is partly because some might misuse that chance by overusing the forest resources beyond sustainable levels. There should be checks and balances for effective use and control of such forest resources by involving both the community and government stakeholders to oversee sustainable use of the forest resources for the benefit of both parties.

Table 4.5: Respondents' opinions on every villager should be given permission to access and control village forest products

Variables	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly agree	1	1.0	1.0	1.0
Agree	5	5.2	5.2	6.2
Neutral	10	10.4	10.4	16.7
Disagree	57	59.4	59.4	76.0
Strongly disagree	23	24.0	24.0	100.0
Total	**96**	**100.0**	**100.0**	

Source; Field Data (2017)

These findings are contrary to (Kistler, 2010) who stated that under Community Based Forest Management (CBFM) villagers take full ownership and management responsibility over an area of forest within their vicinity. They gain the right to harvest forest products and timber, retain and collect forest royalties, undertake patrols including arresting and fining offenders. Furthermore, they are exempted from Local Government (LG) taxes on forest products and they are not obliged to remit any of their royalties to the central government. This study argues that, CBFM is at an advanced stage whereby local communities through capacity building had full knowledge and experience in self-managing forest resources at sustainable levels. But communities in the study are still at the initial stage towards achieving sustainable forest resource management. They need a second party to enhance checks and balances in managing forest resources and sharing benefits in a win-win situation as observed by Blomley&Ramadhani (2004). Under this situation, villagers become more inclined to protect forests in their vicinity in order to gain economic benefits as a result both forest conservation and improved livelihoods are achieved simultaneously.

5.0 CONCLUSIONS AND RECOMMENDATIONS

According to the findings, charcoal and firewood are the primary sources of energy for cooking in various communities endowed with forest resources. Likewise, the majority of the Ruangwa rural home community relies on wood fuel energy for livelihood. The main actors are charcoal and firewood harvesters. On one side, they are responsible for the village forest degradation. It is partly explained by the fact that, residents are not involved in decision making or given access to village forests to use forest production. Village forestry units, on the other hand, are unable to prevent residents from harvesting firewood at levels that exceed sustainable output. As a result, village forests are overexploited by largely villagers as they lack a sense of ownership of the forest resources.

Lack of knowledge on exploitation of charcoal and firewood for livelihood compounded by poverty among households; also have impact on village forest resources control and management. These findings demonstrated the need for rural communities to be educated on sustainable use of forest resources for fuel wood energy while given alternative energy as opposed to total reliance on fuel wood coupled with excessive tree cutting which is environmentally unfriendly. Further, public awareness campaigns can be conducted to enlighten the community about the benefits of forests and potential for establishing

alternative economic activities, such as beekeeping, in forest reserve areas. These efforts can lead to poverty reduction which was reported as the primary driver of household reliance on charcoal and firewood as a source of energy in the study.

The study recommended the following. That education on access and control of village forest reserves should be encouraged so that as the majority of the community members become aware of the existing rules and management of the village forest resource. Besides, proper procedures and permission to cut trees for sustainable production of charcoal and firewood by producers should be put in place under participatory supervision of villages and responsible government authorities. Further, authorities charged with setting rules and regulations for registration and utilization of various forest resources such as beekeeping, harvesting of poles and thatching material should be known for consultations and enforcement of forest resources regulations. Furthermore, villagers should be regarded as stakeholders in the management and utilization of forest resources, therefore, they have equal rights and benefits in safeguarding and utilization of forest products before the law. They should actively participate both in protecting the forest resources against offenders; and getting forest benefits ranging from sustainable production of charcoal, fi rewood, timber to retention of a certain percentage of collect forest royalties for the Ahrends, A., N. Dcommunity welfare.

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