

Rural Wood Fuel Consumption and Deforestation in Tanzania: A Case of Two Selected Villages in Mvomero District

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Abstract

This paper presents the results of the study which focused on rural wood fuel consumption and deforestation in two selected villages in Mvomero District. The objectives of study were to examine types and amount of wood fuel consumed by households, and to determine the extent to which wood fuel consumption cause deforestation. Stratified random sampling method was applied to select 90 households for interviews in the study area. The study established that in the year of study, the two study villages' annual fuel wood consumption was 50,838.2 m³ and 1,202.04 tons of charcoal. As a result of this rate of consumption, about 1,056.88 hectares of forest were cleared to meet the wood fuel demand in the study area. The study concludes that wood fuel consumption in the study area is very high and environmentally unsustainable in such a way that if continues unchecked, will result in devastating situation of deforestation. It recommends that immediate and long term measures should be undertaken to rescue the situation. Immediate measures include promotion of the use of wood saving stoves and use of alternative sources such as solar energy, biogas and briquettes made from biomass. The long-term measures include implementation of reforestation and rural electrification programmes.

Key words:

Deforestation, wood fuel, fuel wood, charcoal

1.0 INTRODUCTION

In Tanzania wood fuel is the most important energy source in both rural and urban areas. Wood fuels include all types of biofuels derived directly and indirectly from trees and shrubs grown in forests and non forest land, mainly fuel wood and charcoal (Malimbwi and Dhahabu 2008). The 2007 Tanzania Household Budget Survey (NBS, 2009) indicates that 90% of the country's energy needs are satisfied through the use of wood fuels of which 80 percent is consumed in rural areas (URT, 2008). According to the National Population and Housing Census (URT, 2006), in rural areas, 95.6% of the households use fuel wood as the main source of energy for cooking. This is followed by charcoal (3.6%), and electricity, kerosene, gas, and others which are used by less than one percent of households. In urban areas, charcoal is used by the majority of households (52.9%) for cooking. In these areas, other sources of energy for cooking used with percentages of households include firewood (26.7%), kerosene (15.2%), electricity (3.3%), gas and others (less than 2%). The growing population pressure on land and forest resources in rural Tanzania has resulted in excessive land degradation due to progressive removal of trees from forest without requisite regeneration. This has resulted in more pressure on the producing rural areas. Ultimately it is not only the sustainability of the environment that is at stake but the very survival of the rural people (World Bank, 2009; URT, 2008).

The estimated national annual requirement of fuel wood is 46 million m³ and 968,488 tons of charcoal. To produce this quantity by using traditional methods, the rural population has to clear the equivalent of 333.7 hectares of forest every day (Kaale, 2005). Various studies have concluded that wood fuel for the foreseeable future will remain the main energy source for the household sector (Lyimo, 2007; Kaale, 2005; FOSA, 2000). In Mvomero district, the main source of energy are fuel wood and charcoal (URT, 2007). In this district there is high consumption of fuel wood which is used in various ways, such as cooking, lighting, local beer brewing, burning bricks and fish smoking. This situation has resulted in excessive tree cutting and hence forest degradation (URT, 2007; TaTEDO, 2006; Mitinje, et al., 2007). Despite the importance and significance of wood fuel, unfortunately, wood fuel demand in Tanzania cannot be met on sustainable basis as such has caused excessive deforestation (Kaale, 2005; URT, 2008).

The Forest Act (URT, 2002) provides the legal frameworks for rural communities engaged in forest management through Participatory Forest Management (PFM). The law recognizes two types of PFM namely Community Based Forest Management (CBFM) and Joint Forest Management (JFM). The CBFM enables local communities to declare and ultimately gazette village, group, or private forest reserves. On the other hand, JFM allows communities to sign joint forest management agreements with government and other forest owners. According to MNRT (2008), by 2008, a total of 4.1 million hectares of forest land was either under local management, or in the process of being transferred. Also 2.3 million hectares of that area were under CBFM, and over 330 village forest reserves have been declared.

The National Energy Policy of 2002 (URT, 2003) provides a very comprehensive analysis of the energy supply and demand situation in Tanzania, including fuel wood and other renewable energy sources. The policy states that, fuel wood for the foreseeable future will remain the main energy source. To ensure sustainable supply of biomass fuels, the policy emphasizes that, biomass particularly fuel wood should be conserved through efficient conversion and end-use technologies which could be complemented by free growing at household level and beyond. The policy puts high emphasis on the need to sustain rural energy and in particular wood fuel supply through promotion of efficient wood fuel conservation and end-use technologies in order to save resources, reduce rate of deforestation and land degradation.

The National Environmental Policy of 1997 (URT, 1997) recognizes the importance of biomass fuel as the major source of energy to the majority of the poor in Tanzania. The policy encourages multi-sectoral cooperation in enhancing sustainable supply of biomass fuels as a component of poverty reduction efforts. The policy acknowledges a clear cause and effect relationship between poverty and environmental degradation. Environmental degradation leads to wide spread poverty which is a habitual cause of environmental degradation.

Despite the existence of policies and legal frameworks mentioned in this section which are either directly or indirectly related to conservation and management of forests and ensure efficient use of natural resources, the problem of excessive deforestation through wood fuel consumption is alarming (URT, 2008; World Bank, 2009). According to Lyimo (2007), there is no strategic energy policy



implementation strategy. Appropriate energy laws and regulations are not yet in place, making it difficult to coordinate policy implementation along with other sectors and stakeholders (Sawe, 2005).

Given this situation, concerted efforts are needed to devise viable strategies and interventions to ensure sustainable supply of forest resources to meet the needs of poor households in rural areas whose energy sources are and will continue to depend on biomass supply. As such the problem this study was set to analyze the extent to which rural energy consumption causes deforestation in the study area. The general objective of this study was to assess the effect of household wood fuel consumption on the forest cover in rural areas. Specifically, the study examined the types and amount wood fuel consumed by households, and determined the extent to which wood-fuel consumed by households cause deforestation.

2.0 METHODOLOGY

Mvomero district which was the study area was selected based on the fact that it is one of the districts in the country in which wood fuel is highly used by household (TaTEDO, 2006). The fuel is used in various ways including cooking, burning bricks, local beer brewing, and fish smoking. The district has total area of 7,325 square kilometers with 101 villages. The current population of the district is 260,525 with 129,269 females and 131,256 males. Manyiga and Lusanga (the study villages) have a total population of 7,112 and 7,210 people respectively (URT, 2006). The district experiences a bimodal type of rainfall with short rains starting from mid-October and ending in May. The lowland area receives an annual average rainfall of about 600mm while highland areas get about 100mm per year, temperature ranges between 1°C in the highlands to 30°C in the lowlands. The type of climate greatly influences the type of natural forest in a particular area and therefore availability of biomass energy resources. The main economy of the district is dominated by crop farming, livestock keeping and fishing activities (URT, 2007).

Primary and secondary data were both utilized in this study. The former was collected directly from households and key informants by using structured and semi-structured questionnaire, and observation. Key informants included extension officers, village executive officers, and the relevant heads of sectoral departments in the district

council (land, natural resources, agriculture, livestock and environment). Secondary data were collected from books and various published and unpublished reports.

Purposive sampling method was used to select Mvomero district which among five districts in Morogoro region. A multi-staged sampling method was used to select two villages, that is Manyinga and Lusanga, in the district. The main reporting unit in the questionnaire survey was a household. Systematic random sampling method was used to select 90 households from the list of households in both villages. Data on amount of fuel wood and charcoal used in the household were obtained by physical measurements of a typical bundle of fuel wood collected per week and weighing a typical weight of charcoal consumed container by household per week. Data were processed and analyzed by using the Statistical Package for Social Sciences (SPSS) software. Findings have been presented in frequency cross tables frequency.

3.0 RESULTS AND DISCUSSIONS

3.1 Types of Energy Used

Households in the study area use a mixture of various types of energy including firewood, charcoal, electricity, kerosene, solar, and crop remains. Table 2 shows the distribution of households that use various types of energy. It shows that while kerosene, firewood and charcoal are used by most households (61 to 96%), electricity, solar and crop remains are used by very few households (2 to 4%).

Table 2: Types Energy Used by Households

Type of Energy	No. of Households	Percent
Firewood	84	93.3
Charcoal	61	61.7
Electricity	4	3.5
Solar	2	2.2
Kerosene	87	96.6
Crop remains	2	1.5

Households use energy in various activities including cooking, lighting, brewing local beer and burning bricks. The study observed that most households use

firewood (93.3%) and charcoal (67.7%) for cooking. Few households (2%) use crop remains for this activity (See Table 3). The study also observed that the majority of households (96.6%) use kerosene for lighting. Firewood is also used for local beer brewing and burning bricks as reported by 24.4 and 18% of households respectively. The findings are similar to the observation by TaTEDO (2006) and URT (2006) that in rural areas of Tanzania there is high consumption of fuel wood which is used in various ways including lighting, cooking, local beer brewing and burning bricks.

Table 3: Use of Energy by Rural Households

Use	Energy Used	No. of Households	Percent (Total)
Cooking	Firewood	84	93.3
	Charcoal	61	67.7
	Crop remains	2	2.2
Lighting	Kerosene	87	96.6
	Firewood	3	3.3
Local bear brewing	Firewood	22	24.4
Burning bricks	Firewood	18	20.0

3.2 Wood Fuel Consumption by Households

In Tanzania about 92% of the total energy consumption is based on biomass, of which 80% is consumed in rural areas (URT, 2006; 2008). This study found that wood fuel which by definition includes both, fuel wood and charcoal, is consumed unsustainably, the phenomenon which has resulted in a land degradation problem.

3.3 Fuel Wood Consumption

Fuelwood is the dominant source of energy for cooking in rural areas of Tanzania compared to urban areas (URT, 2006). The study observed that in average in Lusanga village one household consumes 2 bundles per week an equivalent of 104 bundles per year. Physical observation and measurements in the field revealed that an average bundle in Lusanga village was found to be an equivalent

of 0.216 m³ which amounts to 22.464 m³ per year per households. As an average size in Lusanga village is 6.5 persons per household, this amounts to the annual per capita consumption of 3.5 m³ in this village

In Manyiga village, the measurement of an average bundle collected per household per week was found to be 0.22 m³ and the average household size is 6.4 persons. The household used 2 bundles per week an equivalent of 104 bundles per year. Based on these parameters, the annual per capita consumption was observed to be 3.6 m³. Based on the population in the two villages, the total fuel wood annual consumption was estimated to be 50,838.2 m³ (Table 4).

Table 4: Annual Fuel Wood Consumed by Households

Village	Population	Per Capita Consumption (m ³ /year)	Fuel Consumption (m ³ /year)
Lusanga	7210	3.5	25,235.0
Manyinga	7112	3.6	25,603.2
Total	14,322		50,838.2

The observation on the quantity of fuel wood consumed in the study area is more or less similar to the observation by Mwandosya and Kaale (1994) in Arusha and Zilihona et al., (2005) in Nyamilama – Kwimba district who observed the per capita consumption of 2.0 m³ and 1.8 m³ solid round wood respectively. Ishengoma (1994) estimates that in Tanzania the annual per capita fuel wood consumption varies from 1.3 m³ to 2.8 m³. This consumption quantity per capita of fuel wood in the household sector tallies with the figure observed by Nkonoki and Sørensen (1984) in 1980 which was 2.2 m³. The average consumption of fuel wood in urban areas of Tanzania was reported to be 1.12 m³ per household per month, which is low compared to the study areas probably due to diversity of energy options available in urban areas (URT, 2001). The differences could be attributed to the differences in the village average household size and tree species dominant in the respective area as there is a significant difference in calorific value between hard and soft wood. For example, miombo tree species produce denser fuel sources compared to trees of other vegetation (Malimbwi, et al. 2005).

3.4 Charcoal Consumption

In Tanzania, although charcoal is not widely used in rural areas compared to urban areas but still is an important energy source in these areas (URT, 2006). The study observed that in Lusanga village each household was found to consume average of 40 kgs of charcoal per month an equivalent of 480 kgs of charcoal per year, an equivalent of 0.074 tons per capita per year (average household size is 6.5 persons per household). In Manyinga village one household was observed to consume 50 kg of charcoal per month an equivalent of 600 kgs per year. This is equivalent to 0.094 tons per capita per year (average household size is 6.4 persons per household). This observation is more or less similar to the study by Mwampamba (2007) which revealed that the average annual per capita consumption across six urban areas in the country ranges from 0.096 to 0.180 tons of charcoal per person per year. This reflects the fact that charcoal is consumed more in urban areas than rural areas where most of households use fuel wood as the main source of energy (URT, 2006). This rate of consumption means that the amount of charcoal consumed in Lusanga and Manyinga villages is 533.54 tons and 668.5 tons per annum respectively. This amounts to a total of 1,202.04 tons per annum in both two villages.

Based on the total population in the study villages and the fact that in average 8 m³ of fuel woods from tropical woodland forest produces 1ton (Kaale, 2005), the amount of fuel wood used to produce charcoal in Lusanga and Manyinga villages per annum is 4,268.32 m³ and 5,340 m³ respectively. This amounts to a total of 9,616 m³ per annum in both villages (Table 5).

Table 5: Amount of Charcoal Consumed in the Study Area

Village	Annual Per Capita Consumption (tons/year)	Total Amount of Wood Fuel Consumed (tons/year)	Total Amount of Wood Cleared (m ³ /year) to Produce Charcoal
Lusanga	0.074	533.54 tons	4,268.32 m ³
Manyinga	0.094	668.5 tons	5,340.00 m ³
Total		1,202.04 tons	9,616.32 m³

3.5 Effect of Wood Fuel Consumption on Forest Areas

Biomass fuel use in Tanzania results in deforestation and land degradation, which is associated with non-sustainable use of land resources and environment. According to Makundi (2001) about 70% of forest loss in Tanzania is attributable to wood fuel consumption, of which 43% is due to direct removals mostly through firewood and charcoal making.

This study observed that the total amount of volume of round wood required annually for fuel wood production is 50,838.2 m³. Based on Malimbwi et al (2005), the harvestable volume of fuel wood in miombo woodland forests in average is about 65m³ of fuel wood per hectare per annum (with the range between 14 m³ and 117 m³ per hectare depending on rainfall). Therefore, a total 782.13 hectares of forest was cleared to provide fuel wood for households in the year this study was conducted in the study villages.

The amount of fuel wood used to produce charcoal in two villages was found to be 9,616.32 m³ per annum. Based on Malimbwi et al., (2005), in Eastern Tanzania, one hectare of tropical woodland forest provides an average of 35m³ of round woods for charcoal production per annum (35m³/ha/year). As such a total of 274.75 hectares of woodland forest was cleared in the year of study to provide charcoal for household use in the study villages. The findings show that a total of 1,056.88 hectares were cleared in the year of study to produce both fuel wood and charcoal. This amount of hectares of woodland forest is too large to be cleared in the single year and has resulted in a devastating state of deforestation.

4.0 CONCLUSIONS AND RECOMMENDATIONS

The study concludes that the rate of wood fuel consumption in the study area is very high and contributes to deforestation. This situation needs immediate action to be addressed, otherwise if continues unchecked, will result in excessive deforestation.

To address the situation, the study recommends that: First, efforts should be done to educate and make population in the study area aware of the importance of environmental conservation and the effect of excessive tree cutting to their



very survival and environmental sustainability. Campaigns associated with drama on the subject matter will make creation of awareness adoption of new improved technologies in the rural setting easy and quick.

Second, measures to reduce the rate of wood fuel consumption should be introduced including use of improved thermal efficiency fuel wood stoves; improved charcoal stoves; and use of improved charcoal kilns which have higher carbon conversion efficiency in charcoal making compared to commonly used earth-mound kiln.

Third, promote the use of biogas in the study area so as to reduce dependency of households on wood fuel.

Fourth, households should be encouraged to practice agro-forestry by planting trees in their farms, the factor which will shift them from depending on natural forests and forest reserves.

Lastly, diversification of rural sources of energy to modern sources should be included in the rural energy long term plans by the responsible authorities including the Ministry of Energy and Minerals in order to reverse the pace deforestation and land degradation. These include electricity, solar energy, and natural gas.

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