Fuelwood Consumption in Brick Making: A Case of Morogoro Municipality, Tanzania

Magembe, K. S.[1*], Makonda, F. B. S.[2] and Masanja M. M[3]

[1] Department of Mass Education, Institute of Adult Education, P. O. Box 20679, Dar es Salaam, Tanzania

[2] Department of Wood Utilization, Sokoine University of Agriculture, P .O. Box 3014, Morogoro, Tanzania

[3] Department of Community Development, Local Government Training Institute, P.O. Box 1125, Dodoma, Tanzania

Abstract

The study aimed at determination of the annual fuel wood consumption caused by brick making activities in Morogoro municipality, Tanzania. The collected and analyzed data were based on field survey and quantitative measurements. Field survey based on interviews with group leaders dealing with brick making activities as the main focus was conducted. Data were collected from brick maker's survey as well as from some relevant secondary sources. The study revealed that almost all brick makers in the municipal used fuelwood as the major energy sources. The average annual fuelwood consumption for brick making was 8,610 m^3. In order to reduce heavy dependency of fuelwood in the area, use of alternative energy sources in brick making such as rice husks, maize cobs and baggasse are recommended. The study also recommends the establishment of woodlots in all wards, establishment of agro-forestry systems and intensive afforestation and reforestation programmes to be undertaken by the municipality for more sustainable fuelwood use.

Keywords**:** Fuelwood, consumption, brick making, Tanzania

* Corresponding author: Tel.: +255 784 805466

E-mail address: stevenkmagembe2001@gmail.com

1.0 Introduction

According to UBET (Unified Bioenergy Terminology) wood fuels include all types of biofuels derived directly and indirectly from trees and shrubs grown in forests and non-forest land (FAO, 2004). Wood fuels can be divided into four main types of products: charcoal, fuelwood, black liquor and other. Fuelwood is not therefore synonymous with wood fuel as often regarded (Johnsen, 1999). Wood fuel constitutes a major source of energy in most countries, both developing and developed, and its contribution is expected to grow in the future as a result of the application of stricter environmental regulations and the use of more competitive sources of locally-available energy. Wood fuel is the world's fourth largest energy source providing about 13% of the total world's energy consumption (Alam, 2006). The other energy sources are electricity, 36%, petroleum 34% and coal 26% (EIA 2004, EIA 2007).The World Commission and Sustainable Development (WCSFD, 1999) estimated that demand for fuelwood would grow from 3000 million by 2050. In developing countries, it is the most important source of energy reaching 33% of the total energy use. Nearly 2 billion people in developing countries depend on traditional fuels, which are wood, dung and crop residues (Hall et al. 1999, WMO, 2001 Anderson 1996, Alam 2006). Deforestation and increasing demand for fuelwood have resulted in a looming fuelwood shortage crisis in many areas (Heltberg et al. 2000, Macht et al. 2007).The International Energy Agency (2002) and WHO (2006) stated that, the number of people relying on biomass for cooking and heating in developing countries in the year 2030 is projected to be as follows: China (645 million), India (632 million), Other Asia (456 million), Africa (832 million), Latin America (72 millions). In Tanzania, around 91% of all energy consumed is wood fuel (CHAPOSA, 2002), Miombo woodland being the source of 60-70% of the annual consumption (Monela et al. 2000). It accounts for 97.6% of the total wood products consumed in the country (MNRT, 2001). The estimated national annual wood fuel consumption in Tanzania is 44.8 million m^3 (Kaale, 2005).

Major fuelwood consumers are household domestic purposes, and small-scale industries related to agriculture such as tobacco and tea curing, brick burning fish smocking, etc. Fuelwood constitutes 96.6% and 4.2%, of cooking and lighting fuel respectively in rural areas in Tanzania. Given that 75% of the Tanzanian population (34,443,603) lives in the rural areas, the domestic fuelwood requirement is more than 25, 832,702 m^3/year. Most of the wood fuel comes from forests, mainly wood and charcoal. Many exotic trees have been introduced to Africa in the attempt to find quickly growing alternatives to native species (Evans, 1982). Usually wood with higher density is better suited as fuelwood because it has high calorific value. In 1995, about 3,350,000m^3 of wood were harvested worldwide, of which 63% was used for energy production (FAO, 2000).

Though the government has drawn attention of insisting people to conserve their environment such as planting trees in their areas for fuelwood and other needs, still people are continuing cutting trees from the nearby forests for many purposes (MNRT, 1983). These forests are

increasingly threatened by fuel wood collection, a rapidly expanding population, commercial felling of timber, and expanding agriculture. Deforestation rates between 1990 and 2005 were estimated at 412,000 ha per annum, equivalent to about 1.1% of the total forest area (Blomley and Iddi, 2009). Indiscriminate use of many indigenous trees from natural forests or woodlands has a significant impact to the environment. Such uses may include charcoal making, brick burning, drying of tobacco, smoking fish and use of large amounts of indigenous trees as wood fuel in public service institutions such as restaurants, training institutions, hospitals and prisons (Kilian and Scharpenberg, 1993).

In most cases methods used to extract wood energy are not sustainable, leading to land degradation. Wood energy production has therefore direct consequences on the environment. Other entities that affect production and availability of wood energy are socio-economic, cultural, institutional and legal aspects. Unsustainable use of forests has resulted in severe environmental problems, especially land degradation which is manifested by soil erosion, desertification and general loss of productive potential in rural areas. Soil degradation has been the cause of stagnating or declining yields in parts of many countries especially on fragile lands from which the poorest farmers attempt to wrest a living (World Bank, 1992). Deforestation has also affected water catchment areas and destroyed watersheds, affecting the quantity and quality of the water supplies they contain. In some cases, deforestation has resulted in unprecedented floods and loss of life. Scarcity of fuelwood caused by deforestation has also been a major problem to the majority of people, who, poor as they are cannot afford to use alternative sources of fuel. African women have been forced to walk farther for fuelwood, reducing the amount of time they would spend on other productive activities. All these problems are eroding the potential for sustainable development. Thus most developing countries are caught up in a vicious cycle of poverty and underdevelopment. Their efforts to disentangle themselves from this cyclic phenomenon are thwarted by the international world order with imbalances of trade and the debt crisis which forces developing countries to over-exploit their natural resources to meet their obligations at the expense of their own development. Furthermore, the large fuelwood consumption in brick making has strong public health implications as brick kilns emit toxic fumes containing suspended particulate matters rich in carbon particles and high concentration of carbon monoxides and oxides of sulphur (SOx) that are harmful to eye, lungs, throat and also stunt the mental and physical growth of children (SOS-Arsenic. net, 2015).

The intention of this research was to determine the annual consumption of fuelwood in brick making in Morogoro Municipality, Tanzania. Results from this study are used as a base to monitor forest threats, ecological changes and hence develop forest management strategies, solutions and options for the benefit of people in the area and the nation as a whole.

2.0 Material and Methods

2.1 Description of the study area

Morogoro Municipality is located in the eastern zone of mainland Tanzania. It lies between 5^0 to 7^0 latitudes South of the Equator and 37^0 to 38^0 longitudes East of Greenwich Meridian. It is about 195 kilometres to the west of Dar es Salaam and is situated on the lower slopes of Uluguru Mountains whose peak is about 488 metres above sea level. It is divided administratively into 19 wards, of which 7 wards were purposively selected for the present study namely Mazimbu, Kihonda, Mwembesongo, Kichangani and Kilakala. Others are Bigwa and Mzinga.

2.2 Sampling Plan

A multi-stage random sampling method was employed to draw the sample for the survey. Brick makers who make use of fuelwood in making bricks in the selected 7 wards of Morogoro municipality constituted the sampling frame. From each ward, 5 brick making groups were selected randomly (giving a total of thirty five groups). Specific wards selected in Morogoro Municipality were as follows: Kichangani, Kihonda, Mwembesongo, and Mazimbu. Others were; Bigwa, Kilakala and Mzinga. The sampling units were all areas where bricks were made at large scale which accounted to 100 percent sampling. Sampling was in such a way that the sampling fraction was greater than 5% as recommended by Boyd et al. (1981).

2.3 Data collection

The diameters of tree species used as fuelwood were measured by using caliper and the length using measuring tape. Finally, log sections from each tree were also measured for base, mid, top diameter and length. The Newton's formula was then used to estimate volume of individual log sections and hence volume of each tree as the sum of individual log sections and hence volume of each tree as the sum of individual log sections volumes. Volumes were then determined by using Newton's formula given below:

$$V = \frac{3.14\left(d_b{}^2 + 4d_m{}^2 + d_t{}^2\right)L}{24}$$

Where: d_b and d_t =diameter at base and top of log respectively, cm
d_m =diameter at mid-length of log, cm
L=length of log, m
V=volume of log, m^3

The local tree species names were later translated into botanical names using available checklists (Mbuya et al. 1994). From the collected data, the following parameters were computed. Diameters of logs (m) and volume of fuelwood consumed per year (m^3/year).

2.4 Data analysis

Microsoft Excel and Statistical Package for Social Science (SPS) Computer programs were used

to analyze the data. Quantitative data collected were summarized to ensure that they could be in the form suitable for addressing both research questions and the method of analysis used. This was done while ensuring that original meanings of the statements made by respondents were maintained. The summarized data were then coded and used for subsequent statistical analysis. Descriptive statistics were used to summarize the data in frequency tables and percentages.

3. Results and Discussion

3.1 Amount of fuelwood used in brick making in Morogoro municipality, Tanzania

The study revealed that the total annual quantity of fuelwood consumed in brick making in Morogoro Municipality is 8,610 m^3. The value of total fuelwood consumption in Morogoro Municipality is given in Table 1. Based on own field survey, about 10,000 clay bricks are required to construct a three bedroom house, using 10 m^3 of firewood.

3.2 Types of fuel used in brick making in Morogoro Municipality

It was observed that, the major source of energy for brick making in Morogoro Municipality was fuelwood. Majority of brick makers (97.9%) have shown to benefit from fuelwood and few of them managed to use other energy. Only one alternative energy source used by brick makers was rice husks, which accounts 2.1% of the total energy consumption on brick making in Morogoro Municipality (Figure.1)

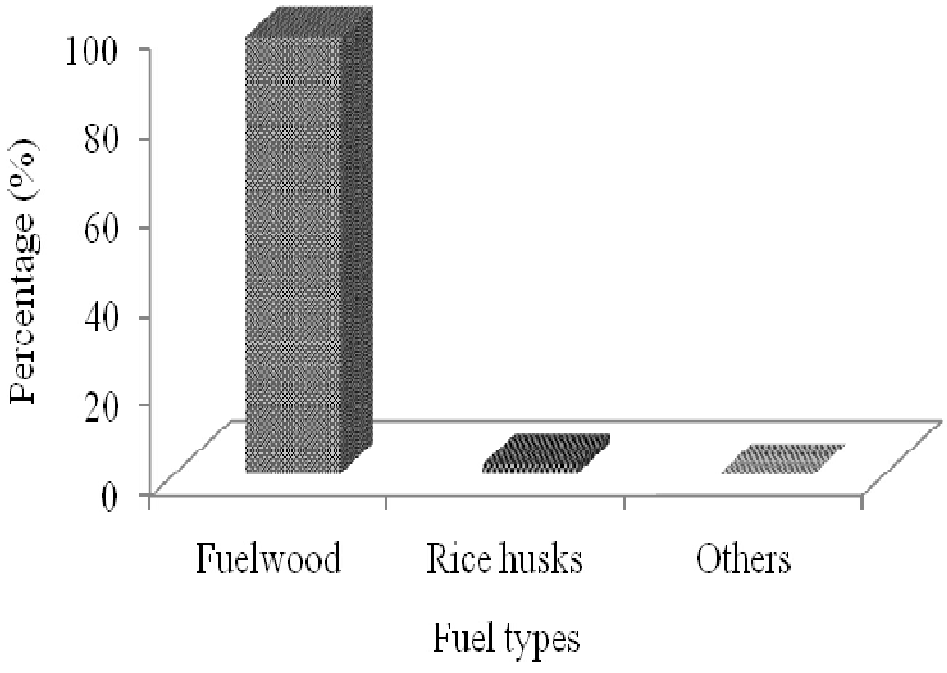

Figure 1: Types of fuel used in brick making in Morogoro Municipality, Tanzania

Table 1: Consumption of fuelwood in Morogoro Municipality for the seven (7) wards ranked in descending order

S/N	Ward name	Species names	Volume by species (m^3)	Percentage (%) by species
1.	Kichangani	*Senna spectabilis*	465	16.6
		Burkea Africana	1,331	47.5
		Eulycaptus spp	100	3.6
		Combretum molle	205	7.3
		Azadirachta indica	315	11.3
		Mangifera indica	385	13.8
		Sub-total	**2,800**	**100**
2.	Kihonda	*Senna spectabilis*	127	5.8
		Pithecellobium dulce	60	2.7
		Senna siamea	169	7.7
		Burkea africana	1,195	54.3
		Azadirachta indica	549	25.0
		Mangifera indica	100	4.6
		Sub-total	**2,220**	**100**
3.	Mwembesongo	*Senna siamea*	20	1.5
		Burkea africana	829	60.8
		Combretum molle	396	29.0
		Azadirachta indica	119	8.7
		Sub-total	**1,364**	**100**
4.	Mazimbu	*Senna spectabilis*	50	6.2
		Senna siamea	110	13.6
		Burkea africana	377	46.5
		Combretum molle	170	21.0
		Azadirachta indica	104	12.8
		Sub-total	**811**	**100**
5.	Bigwa	*Senna spectabilis*	57	8.7
		Senna siamea	32	4.9
		Burkea africana	239	36.5
		Combretum molle	97	14.8
		Azadirachta indica	88	13.4
		Mangifera indica	142	21.7
		Sub-total	**655**	**100**
6.	Kilakala	*Senna spectabilis*	213	38
		Pithecellobium dulce	10	1.8
		Delonix regia	23	4.1
		Senna siamea	42	7.5
		Burkea africana	20	3.6
		Combretum molle	45	8.0
		Azadirachta indica	22	4.0
		Mangifera indica	186	33.2
		Sub-total	**561**	**100**
7.	Mzinga	*Senna spectabilis*	21	9.6
		Burkea africana	87	39.6
		Eulycaptus spp	19	8.6
		Combretum molle	19	8.6
		Azadirachta indica	15	6.8
		Mangifera indica	59	26.8
		Sub-total	**220**	**100**
		GRAND TOTAL	**8,610**	

Discussions

The findings in Table 1 indicate that, fuelwood consumption varied very greatly between the different wards surveyed depending on the frequency of making bricks in a year, number of burns possessed and availability of firewood to the brick makers centre. However, fuelwood user in both surveys generally showed a distinct preference for particular species, which is similar to other findings done by Tietema et al. (1991), Shackleton (1993) and Tabuti *et al*. (2003). Similarly, Alam (2006) found out that, due to the consumption of fuelwood in the brick making industries of Sudan the amount of wood lost from the total growing stock of wood in forests and trees is 1,466,000 m^3 per year. The implications for the heavy fuelwood consumption in different countries in the world is that, if recent consumption trends continue, both the loss of forest productive capacity and, the loss of key services that forests provide could disrupt local economies in some countries (Lester, 2001).

From these results, it is clear that rice husks as an alternative energy source are used in insignificantly amount as compared to fuelwood use in brick making. Similar studies have reported that, a considerable number of people in Tanzania do not use other energy sources than wood fuel for cooking (URT, 1998). The reason for this, include the unavailability of affordable and reliable alternative energy sources (MEM, 2004). According to FAO (1985), Over two-thirds of people in developing countries depend mainly on wood for their households and sustained rural industries. Likewise, about 90% of the people of Africa rely upon fuelwood (Barnes, 1990 cited by UN, 1994) and that excessive harvesting of fuelwood is a second major (after clearing land for agriculture) cause of deforestation throughout the developing world whereas in certain mountains and/or arid regions of Sub-Sahara Africa, fuelwood extraction is the leading cause of deforestation. In some African countries, Burkina Faso, Chad, Ethiopia, Malawi, Mali, Somalia and Tanzania, for example wood energy accounts for more than 90% of national energy consumption (Irene and Joan, 1988). Even in oil-rich countries like Nigeria and Saudi-Arabia, wood accounts for over 80% of energy consumption.

Conclusion and Recommendations

On the basis of the study findings, the estimate annual consumption of fuelwood in brick making in seven wards visited in Morogoro Municipality was 8,610 m^3 per year. This means huge quantities of fuelwood (8,610 m^3) are used annually for brick making and accordingly forest resources are extensively exploited for this purpose. The limitation of using alternative sources of energy to be used in brick making has created a high demand for fuelwood in Morogoro Municipality.In other words, obviously brick making activities are acting as a serious agent of deforestation in Morogoro Municipality, and this sector could be considered as one of the contributory factors that seriously affecting the environment. Consumption of fuelwood imposes increasing potentially negative consequences for regional and global environmental problems (e.g. greenhouse gas emissions) and for local residents.

This study recommends the use of alternative energy sources in brick making such as rice husks, groundnut hulls, cotton stalks, maize cobs and baggasse (BENS, 1996) and others. The use of rice husks and bagasse are easily available in Morogoro Municipality and are also environmental friends. However, the much talked of solar energy could be given a closer look, as the reports are encouraging from many developing countries, both in Asia and in Africa. Additionally, Morogoro Municipality should create additional woodfuel resources through plantations and farm forestry, intensive afforestation and reforestation programmes for more sustainable fuelwood use.

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Conflicts of Interest
The authors declare no conflict of interest.

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