

# Impact of Woodfuel Production on The Livelihood of the People in Bagamoyo District, Tanzania

*Emmanuel Patroba Mhache*

Department of Geography  
Faculty of Arts and Social Sciences  
**The Open University of Tanzania**

E-mail: ngorora@yahoo.com; emmanuel.mhache@out.ac.tz

**Abstract:** *The study examined the impact of woodfuel production on the livelihoods of people in Saleni and Pongwe-Msungura villages in Bagamoyo district. Information used in this article was collected through documentary review, administering questionnaires, focus group discussions, interviewing key informants and direct field observations. Seventy six heads of the household were interviewed. The questions at the centre of this article are: who profits from commercial forests and how? Benefits from firewood and charcoal are derived through direct control over forest access, as well as through access to markets. The findings revealed that, woodfuel contributed to the livelihoods of the people living in rural and urban areas. Introduction of efficient kilns which make more charcoal than the conventional one, the use of efficient cooking stoves and alternative energy sources such as solar power and gas would reduce dependence on forests for woodfuel. It is recommended that, villagers and other stakeholders be encouraged and given incentives to plant fast growing trees for firewood and charcoal making. Census should be done frequently to know the number of charcoal makers, train and give them support in order to stop charcoal making and engage in alternative income generating activities. Involvement of the community in searching for alternative energy sources and alternative income generating activities is of paramount importance.*

**Keywords:** Forests, Livelihoods, Wood-fuel, Saleni and Pongwe-Msungura

## INTRODUCTION

### **An overview of wood energy**

Worldwide, about two billion people use firewood and charcoal as their main source of energy for cooking and heating their homes (CIFOR, 2009). Traditional biomass fuels (wood, agricultural wastes and animal dung) are the major source of energy in developing countries (Kilabuko and Nakai, 2007). It has been observed that wood-fuel accounts for 60-95% of total energy used in developing countries. Biomass fuels, charcoal and kerosene are the most used cooking fuels in Tanzania (ibid). In Tanzania, biomass fuels account for more than 90% of primary energy supply in the country (Kilabuko et al., 2007).

In middle income countries, wood-fuel accounts for 25% - 60% of family income and in high income industrialized countries, less than 5% depends on wood-fuel (Leach et al. 1988). More than 70% of the population in Third World countries rely on fuel wood for their energy (Hosier et al., 1993). Hosier et al. (1993) noted that increasing urban demand for fuelwood, forests in rural areas are over-harvested to produce charcoal hence contributing to deforestation. However, more than half of the people in the world rely directly on wood for their domestic energy (Wood and Baldwin, 1985). These people don't have alternative energy sources, either because there are no local supplies or because of the prohibitive costs of obtaining kerosene, gas or electricity.

In developing countries, especially in rural areas, 2.5 billion people rely on biomass -, such as fuelwood, charcoal, agricultural waste and animal dung, to meet their energy needs for cooking (Jessica, 2010). In many countries, these resources account for over 90% of household energy consumption (ibid). Therefore, energy consumption in any developing country is characterized by total dependence on fuelwood (firewood) and charcoal for domestic cooking, lighting and heating (Nkonoki, 1988). Woodfuels (firewood and charcoal) are the most important energy source in Tanzania (Tanzania Bureau of Standards, 2003). The 2007 Tanzanian Household Budget Survey indicates that 90% of the country's energy needs are satisfied through the use of woodfuels (World Bank, 2009). However, charcoal is the single largest source of household energy in urban areas, as it is considered cheap and easy to transport, distribute, and to store. Kaale and Sawe (2001) estimated that, 6.7 million urban residents in Tanzania are using charcoal. In Dar es Salaam the proportion of households depending on non-electric fuels has not gone down since 1988 (ibid).

Despite increasing investments in improving access to electricity and other energy sources - including gas, the proportion of households in the country using charcoal for cooking has increased by 7 percent since 2001 (World Bank, 2009). In urban areas such as Dar es Salaam, the figure is much higher compared to other regions. Although electricity and gas are the principal energy sources among wealthier households, these households still use considerable quantities of charcoal. Most public and private urban institutions in Tanzania (such as military outlets, bars, restaurants, schools, and hospitals) also use significant quantities of charcoal and firewood as their principal sources of energy for cooking.

### **Woodfuel production**

According to UBET (Unified Energy Terminology), wood fuels include all types of bio-fuels derived directly and indirectly from trees and shrubs grown in forests and non-forest land (FAO 2004). Woodfuels can be divided into four main types of products: charcoal, firewood, black liquor and others. This study concentrates on charcoal and firewood. The term fuelwood is used interchangeable with woodfuel in this article. In Tanzania, 91% of all energy consumed is woodfuel (CHAPOSA, 2002) with miombo woodlands being the source of 60-70% of the annual consumption (Monela et al. 2000). Miombo woodlands accounts for 97.6% of the total wood products consumed in the country (MNRT, 2001).

Charcoal is a woodfuel produced in rural areas and consumed in cities and towns. In Tanzania, households depend on woodfuels (firewood and charcoal) for virtually all of their domestic energy needs. Rural households consume firewood directly, while urban households consume charcoal, produced by the partial burning (pyrolysis) of wood. Charcoal produced in rural area is sold to merchants or charcoal traders who then sell it to the users. In most cases, charcoal makers are migrant labourers hired by a patron (merchant) to cut wood and convert it into charcoal.

However, less than 2% of energy development budget is allocated to wood energy programmes, and fuelwood is still regarded as a minor forest product with little market value (URT, 2001). Yet still, the majority of woodfuel consumers cannot afford the high investment costs associated with alternative commercial energy sources (Moyo et al., 1993). Availability, reliability of supply and cheaper prices renders woodfuels more preferable than alternative sources of energy.

### **Woodfuel and the rural livelihood strategies**

The most important use of wood in Tanzania is for providing fuel and about 95% of the country's energy supply is met by fuelwood (Iddi & Hakan, 1997). Miombo woodlands - which constitute about 90% of the total area of forests in Tanzania, are the chief source for firewood and charcoal (Luoga, 2000). Woodland trees produce a heavier and more concentrated fuel than most fast growing softwood species and trees from tropical rain forests (Gauslaa, 1988).

The contribution of forests to the livelihoods of the people and the Tanzanian national economy as a whole is significant, but is largely unrecorded and consequently unrecognized. Charcoal business support the livelihood of the rural people in the villages and is an alternative

economic activity that requires low capital and low operation costs. The local people can harvest forest products if they have a license from the district forest officer(s). But in most cases, local people illegally harvest forest products. Wood fuel enable people to eat cooked food and provide people with income and employment.

More than two thirds of the growing populations in developing countries - including Tanzania, live in rural areas. Their economies depend heavily on the natural capital-natural resources (Fellamn et al., 1990; World Bank, 2009). Mallya (1996) indicated that most forestland in Tanzania have been converted to agricultural lands, while others are used as sources of timber and woodfuel for the growing population. These woodfuels are firewood and charcoal, which are used to meet the fuel needs for rural and urban population.

In total, Tanzanians consume more than 2,650 metric tons of charcoal every day or roughly 1 million tons per year (World Bank, 2009). Apart from energy source, woodfuels are also good source of income and employment for the people living in rural areas.

People have initiated businesses of selling fuelwood (Manyatsi and Hlophe, 2010). According to World Bank (2002 in Mhache, 2004: 29) one out of four of the poor depends directly or indirectly on forests for their livelihoods. For the poor people, forests are a major source of forest products and income (ibid). Charcoal makers earn an average income of about Tshs 500,000/= per year (Mhache, 2012). This implies that most of forest resource extractions are done as commercial activities (Howell et al. 1996). The forest sector in Tanzania employs about 15 people per thousand (FAO, 2009). When driving along the major roads in Tanzania - especially those of the highways leading to Dar es Salaam city, by piles of firewood and charcoal are evidenced along the roadsides. The firewood and charcoal are sold mainly to motorists driving along those highways. Charcoal is rarely produced for rural use. It is mainly produced for sale to urban areas (Monela et al., 2000).

However, due to high rates of unemployment in Tanzania, many people are increasingly engaging in firewood cutting and charcoal making for sale as sources of income. This situation increases the demand for firewood and charcoal from the forest. The process of cutting standing trees for charcoal and fuelwood lead to deforestation. According to FAO (2007), Swaziland, for example, has a total land area of 1,736,400 ha with 624,000 ha being forest. Out of this, 463,498 ha are covered by indigenous forests and woodlands. About 201,500 ha are under

commercial forest plantation with another 25,000 ha under wattle forest (ibid).

In Tanzania, forests and woodlands cover about 34 million hectares (URT, 1998). These forests have unique environmental and biodiversity values and they also provide a wide range of products for subsistence use. The most predominant use of wood is in the form of firewood and charcoal by the majority of Tanzanians living in rural and urban areas. Charcoal is preferred in urban areas because it is smokeless, easy to store and has higher calorific value (30 MJ/kg) compared to firewood (15MJ/kg) (World Bank, 2009).

In Tanzania, households depend on wood fuels (firewood and charcoal) for all their domestic energy needs. In 1992, the total amount of charcoal consumed nationwide was estimated to be about 1.2 million tons<sup>2</sup> (FAO, 2010). About 85% of the total urban population depends on charcoal for household cooking and energy for small and medium scale enterprises (Sawe, 2004). Thus, rural households consume firewood directly, while urban households consume charcoal produced by the partial burning of wood. Dar es Salaam, Tanzania's largest city, accounts for more than 50% of all charcoal consumed in the country (Van Beukering et al., 2007). Unfortunately, the impact of wood-fuel has not been studied - both in rural and urban areas. This paper assesses the contribution of woodfuel on the livelihoods of people in Bagamoyo District in Coast Region.

The central question of this article is: Who benefit from forests and how? This article examines the woodfuel production and its impacts on the livelihoods of the people. The term woodfuel comprise charcoal and firewood used to provide energy for cooking and heating. In most of the African countries, charcoal is produced in rural areas and sold to urban residents. Firewood is the main source of energy in rural areas. Firewood is mostly obtained free from the forests.

Woodfuels play a significant role in the energy requirements of many developing countries (Herd, 2007). Fuelwood and charcoal are the commonest forms of woodfuel used widely as household power sources in rural and urban areas in developing countries. This is especially the case in Tanzania, where dependence on woodfuel is increasing due to growing urban populations and limited accessibility to alternative fuels.

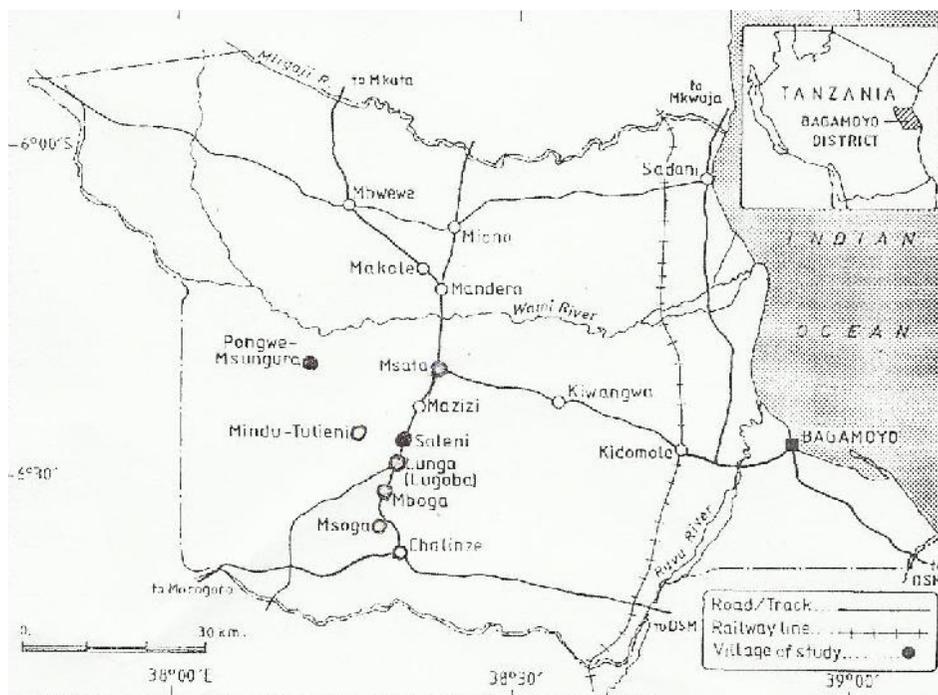
In Bagamoyo District, wood is traded informally or in the market place. The majority of users harvest it as a common property resource from forests and from scattered pockets or belts of trees at field margins or roadsides and on waste or common land. Nearly all the woodfuel

harvest is used for cooking and this use will remain the priority of most wood energy consumers. Currently woodfuel consumption is increasingly fuelled by population increase which then increases demand for woodfuel. The high demand for woodfuel has driven the unsustainable exploitation of tree resources with significant environmental and socio-economic consequences.

## METHODOLOGY

### Study area

This study was carried out in Bagamoyo district (Figure 1) in Coast region, Tanzania. The district lies between 60 and 6045'S longitude and 380 and 390E latitude covering an area of 9,842 km<sup>2</sup>, about 29.3% of the Coast region (Coast Region Socio-Economic Profile, 2007). Bagamoyo district was selected for this study for the following reasons. First, it is among the districts which supply charcoal to urban areas. Charcoal is one of the main sources of people's livelihood. Secondly, the district is reached by road all time of the year, the situation which facilitates easy movement of firewood and charcoal to urban areas. It was because of these reasons that the two villages, namely: Pongwe-Msungura and Saleni were selected for this study (Figure 1).



**Figure 1:** Location of the study villages in Bagamoyo district

### Profile of the study villages

#### *Saleni village*

Saleni is the smallest village in the Lugoba ward situated along the Chalinze-Segera highway. The village was established during the ujamaa era in the 1970s where people were settled nearby along the roads (Sitari, 1983). The village borders Mazizi village to the north, Mindukene village to the east, Lunga village to the south and Mindu-Tulieni to the north-west. The village has 133 households with a population of 589 people, 282 women and 307 men (Tanzania Bureau of Statistics, 2003). The village recorded more men than women during the 2002 census. Villagers are mainly engaged in small-scale agriculture, petty trade activities, and charcoal burning as well as working at stone quarries at a neighbouring village. All inhabitants have access to safe water from the Wami River water plant. All interviewees in the village used firewood for cooking while charcoal was mainly for sale. Only three percent of the heads of household interviewed in Saleni village had access to electricity.

The village has one primary school named Saleni Primary School which ensured all the inhabitants had access to primary education. There was no health center in the village. The villagers got treatment in Lugoba Health Center in Lunga village and other villagers got treatment at Msata Health Center in Msata village. Accessibility of health services in Saleni village had no a serious problem as the village is located between Msata and Lugoba villages whereby villagers would opt to go to Msata Health Center or Lunga Health Center.

#### *Pongwe-Msungura village*

Pongwe-Msungura is a village in Msata ward. It is also a village established following the villagisation operation in Tanzania in 1975. The village borders Pongwe-Kiona village to the north, Msata village to the east, Kinzagu village to the south and Wami-Mbiki forest reserve to the west. According to the Tanzania Bureau of Statistics, (2003) the village had 374 households with a population of 1,005 people, 495 women and 510 men. . The villagers were mainly engaged in small scale-farming, charcoal making and stone quarrying activities in a nearby village. A small number of adult residents were employed in the public sector and the others were retired workers and old people.

The village had one primary school - namely Pongwe-Msungura Primary School, which ensured children of school age had access to primary education. There was no health center in the village which forced villagers to get treatment in Msata Health Center in Msata village and sometime at Lugoba Health Center in another ward. The residents of Pongwe-Msungura village depended on both traditional deep and shallow wells for water. The wells were few and scattered, and provided

water mainly during the rainy seasons. The traditional wells were not well preserved and were therefore unhealthy for domestic use. Firewood was the main source of energy for cooking and the village was not connected to the electricity power line. Thus, no person was using electricity in the village.

### **Data collection and processing**

This study focused on wood-fuel and its impact on people’s livelihoods and hence the target population was people residing in rural areas both men and women. Heads of households were interviewed in this study. Heads of households interviewed were picked from the list available at the village’s government register. The first sample from the register was randomly picked. The other households were selected systemically by counting every sixth household from a list available at the village government register. A simple random sampling procedure was used in selecting sample used in this study. According to Kothari (2004), simple random sampling technique gives every individual in the population an equal chance to be included in the sample. In total, 76 heads of households were selected and interviewed in Saleni and Pongwe-Msungura villages (Table 1). In this study 52.6% were males and 47.4% were females.

**Table 1: Study sample by gender distribution**

Study villages	Male		Female		Total	
	Frequency	%	Frequency	%	Frequency	%
Saleni	17	22.3	20	26.3	37	48.6
Pongwe-Msungura	23	30.3	16	21.1	39	51.4
Total	40	52.6	36	47.4	76	100.0

*Source:* Field-survey, 2010

Both secondary and primary data were collected in order to address the objectives of this study. Secondary sources comprised of published and unpublished research papers; reports, internet search and other relevant sources. Secondary information was used to supplement the data collected through primary sources. Primary data collected were both quantitative and qualitative. The methods used in primary data collection involved key-informant interviews, focus group discussions, household interviews and direct field observations. Two focus group discussions were conducted in each of the two villages.

Quantitative data were edited, coded and entered in a computer programmes known as Statistical Package for Social Sciences (SPSS) software version 16 spread sheet for the data analysis. Descriptive statistics were run to give frequencies and then cross tabulation was undertaken. Multiple response questions were analysed so as to give frequencies and percentages. Tables and bar charts/graphs were used to

present different variables. Cross-tabulation allowed a comparison of different study parameters in the two study villages.

## RESULTS AND DISCUSSION

### Economic activities in the study villages

The main economic activities in Pongwe-Msungura and Saleni villages were agriculture, livestock keeping, charcoal making, and business. There were few other non-farm activities being carried out in the study villages.

Agriculture was the dominant type of land-use activity in the study villages. Farming was the major economic activity for 94.9% of the respondents in Pongwe-Msungura and 100% in Saleni villages (Table 2). Main food crops grown were maize, cassava, sweet potatoes, sorghum, millet and beans. Cotton, sesame and paddy constitute the main cash crops, although all suffered from unreliable rainfall, prolonged drought and unfavourable market outlets. In favourable years when the rains were good, the villages experienced bumper crop harvest which floods the market with a variety of cash and food crops (Mhache, 2012).

**Table 2: Proportion (%) distribution of respondents' main occupation**

Main occupation	Study villages	
	Pongwe-Msungura (n=39)	Saleni (n=37)
Farming	94.9	100
Livestock keeping	64.1	54.6
Charcoal making	53.9	48.7
Business	7.1	15.5
Others (petty business, etc)	3.1	2.5

The total adds to more than 100 because of multiple occupations.

*Source:* Field survey, 2010.

The second economic activity in the study villages was livestock keeping. In Pongwe-Msungura and Saleni villages, 64.1% and 54.6% of respondents respectively, engaged in livestock keeping. The domesticated animals included cattle, goats, sheep, pigs and chicken. All livestock keepers were also farmers and none of the respondents was keeping livestock alone. Livestock keepers earned income from the sale of animals, meat and milk.

Charcoal making ranked the third economic activity in the two study villages. Charcoal making appeared to be important to 53.9% of the respondents in Pongwe-Msungura and 48.7% in Saleni village. Petty business appeared to be of less importance in Pongwe-Msungura (7.1%) as compared to Saleni (15.5%). Some villagers engaged in a day to day labour, home-based activities and stone crushing. The differences between these two villages are caused by differences in the levels of

urbanization. Saleni is more urbanized compared to Pongwe-Msungura. Petty business opportunities are also higher in Saleni village. Saleni village is situated close to Chalinze-Segera highway while Pongwe-Msungura is very far and is about four to five km from the tarmac road. Other economic activities included selling local brew, which was common in Pongwe-Msungura and was mainly produced by women. According to the interviews, making and selling local brew had increased recently.

### Energy use in the study villages

Data on wood energy collected in Saleni and Pongwe-Msungura villages indicated that firewood consumption in the household level was the leading energy source followed by a combination of firewood, charcoal and kerosene; charcoal and firewood and finally electricity (Figure 2). Only 3% of the respondents in Saleni village were using electricity and no single person was using electricity in Pongwe-Msungura village. However, 51% and 47% of respondents in Pongwe-Msungura and Saleni villages respectively, relied on firewood as a source of energy. About 12% of respondents in the study villages used both firewood and charcoal. It was further discovered that people with stable income like school teachers, village leaders, Agricultural Extension Officer (AEO), workers in health centres and in quarrying factory used both firewood and charcoal. Charcoal was mainly used during the rain season as it was difficult to get dry wood for cooking. Lastly, 38% and 37% of the respondents in Saleni and Pongwe-Msungura villages respectively used a combination of firewood, charcoal and kerosene. Kerosene was mainly used for lighting and for small tasks like making porridge, tea and boiling water.

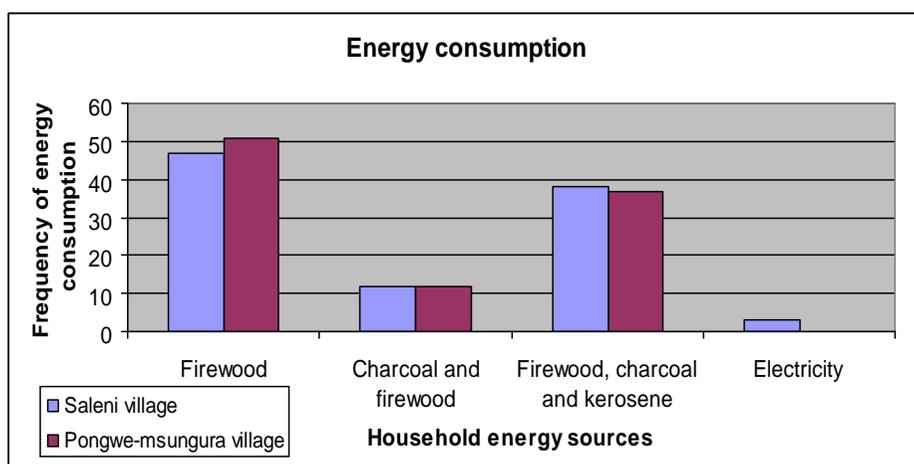


Figure 2: Comparative frequency of energy consumption by villages.

We have shown that the main energy source used for cooking meals in the villages was firewood and charcoal. It was found that in cooking, majority of the respondents (90%) in each villages relied on firewood for cooking purposes (Table 3). Only people with stable income relied on charcoal. However, 6.9% and 2.7% of the heads of households interviewed in Saleni and Pongwe-Msungura villages, respectively, used charcoal for cooking.

**Table 3: Distribution of main sources of energy used for cooking**

Energy	Villages	
	Saleni	Pongwe-Msungura
Firewood	93.1	97.3
Charcoal	6.9	2.7
Total	100.0	100.0

Source: Field Survey, 2010

### Preferred species for firewood and charcoal making

Plant species which were preferred for firewood and charcoal making are as presented in Table 4. Villagers interviewed provided different reasons for preferring some species for firewood and charcoal making. Thirty four percent prefer indigenous species because they light well even when they are not dry, while 16% said that some species when burned last long. Twenty four percent preferred some species because of their availability while 20% mentioned that they produced good and high quality charcoal.

**Table 4: Preferred trees for firewood and charcoal making**

Local name	Botanical name	Percentages	Rank
Mlama mweusi	Comberatum molle	20.6	1
Msemberere	Allophylus rubifolius	17.6	2
Mpingo	Dalbergia melanoxylon	9.9	3
Mkwaju	Tamarindus indica	8.6	4
Mkole	Grewia bicolor	8.3	5
Msosowana	Dombeya rotundifolia	6.9	6
Mkomba	Afzelia quanzensis	6.0	7
Mkambala	Acacia nigrescens	4.7	8
Mfuleta	Albizia anthelmintica	4.3	9
Miombo	Brachystegia boehmii	2.6	10
Msezi/Mseni	Brachystegia microphylla)	2.2	11
Mhande	Scrodophleous fischeri	1.6	12
Mtalawanda	Markhamia sanzibarica	1.3	13
Msosowana	Dombeya rotundifolia	1.0	14
Mkongowe	Acacia gerrardii	0.8	15
Mtondoro	Brachystegia spiciforms	0.7	16
Mkenge	Albizia petersiana	0.5	17
Msaraka	Spirostachys africana	0.4	18
Msisimisi	Albizia Harvey)	0.3	19
Other species		1.8	20

Source: Field survey, 2011

Firewood was obtained free from the forests and public lands. Other firewood was collected from individual fields mainly before and during the cultivation or farm clearing. Charcoal was a woodfuel produced in rural areas and consumed in cities and towns (Malimbwi et al., 2007). Charcoal is produced on earth mound kilns made by covering a pile of logs with earth blocks or soil, igniting the kilns and allowing carbonization under limited air supply (Figure 3). Source of labour for charcoal making activities was mainly household labour. Some big charcoal traders employed people in rural areas to make charcoal for them.



**Figure 3:** Charcoal kiln under preparation

In the study villages there were two groups of people making charcoal. There were those making charcoal for sale to merchants or any one in need of charcoal (Figure 4). The others were those employed to produce charcoal for the merchants. Predominantly urban-based merchants hired wood-cutters, gave them subsistence advances and returned after a week or two to complete the payment or buy the charcoal after the charcoal makers having informed them that charcoal was ready. The merchants hired truckers to transport the charcoal from the forests or rural areas to the cities, where it is sold and consumed. Charcoal made in remote rural areas where big trucks could not reach was transported close to the road by using bicycles (Figure 5). The charcoal merchants sometimes sold charcoal to urban wholesaler, who then distributed charcoal to the retail vendors (Figure 4). The informal interviews made with village leaders in the study villages revealed that it was difficult to get figures for migrant woodcutters, merchants, charcoal wholesalers and retail vendors because charcoal dealers were not ready to register as most of them were illegally engaging in charcoal making business.

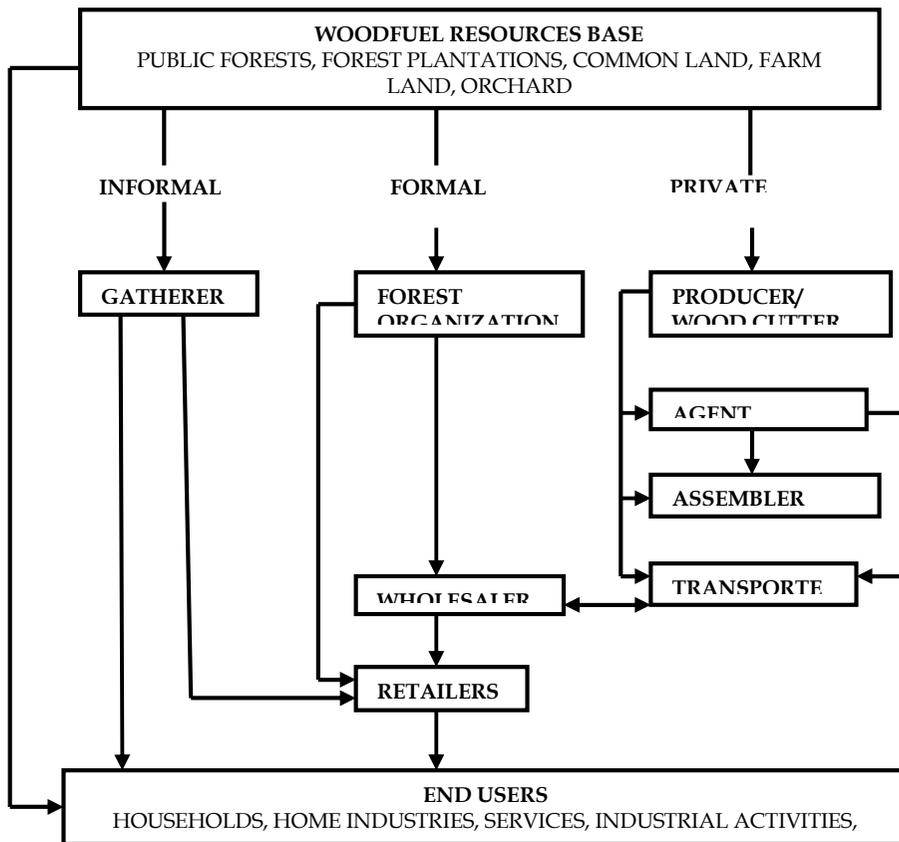


**Figure 4:** Charcoal in bags waiting for urban merchants



**Figure 5:** Bicycles is one of the means of transporting charcoal to urban areas

Figure 6 presents fuelwood flows from woodfuel resource base to the end users. Different harvesting approaches, policies and regulations affecting woodfuel flows and the trading and transport channels by which they were delivered to the consumer were observed. The flows varied, for example, fuelwood harvesting from state-owned forests (the dominant form of forest ownership) was subject to a chequered variety of regulations and customs before they were delivered to end users.



**Figure 6:** Pattern of fuelwood flows. Source: Woodfuel Flows, RWEDP (Regional Wood Energy Development Programme) (1994).

In Tanzania, all government-controlled forests destined for fuelwood or charcoal production were marked by Forest Department personnel and permits were issued to allow woodcutters to harvest the specified quantity of wood/trees. In some countries like Pakistan, the Forest Department harvested and sold woodfuels through open auctions of lots sorted into species and sizes, each with different prices (FAO, 1996). Argentina and Brazil's Forest Departments issue permits to trading organizations to remove woodfuels in certain areas, often in conjunction with timber permits or concessions (ibid). The findings showed that, unknown amount of unauthorized woodfuel extraction took place. In some countries including Tanzania, local people were allowed to collect dead wood and litter from the forest for their own use, although much of it was then sold.

Focus group discussions and questionnaire interviews indicated that charcoal was mainly produced after harvesting seasons or during the years when crop harvests were poor. As one respondent put it when answering a question on how to overcome food shortages, “I just take an axe and go to the forest”. (Farmer from Makombe village commented). The study by Toni (2011) indicated that, people were making more charcoal now than during the 1980s, because they got less produce from agriculture and needed money for buying food and other necessities. The interviews made with village leaders revealed that in the year 2011 vehicles which came in the villages had doubled because of the increased kerosene prices and electricity tariffs. The people who were using kerosene and electricity had reduced its use due to increase in kerosene prices and electricity tariffs.

### **Impacts of wood-fuel on the livelihood of people**

The term “livelihoods” refers to the capabilities, assets and strategies that people use to make a living. Forest is one of the natural asset from which people get woodfuel used for cooking and heating. Forests continue to be central to livelihood systems (Hartter and Boston, 2008). Forest resources have changed the livelihood of people living in rural areas. Charcoal production plays a very significant role in the livelihoods of the people in the study villages (Mhache, 2012). The income obtained from selling charcoal had changed the livelihood of people living in rural areas. One of the villager interviewed in Saleni village said that in 1980s his family was living in a mud-house. With charcoal business, he had managed to raise money which he used to build a brick house. Part of the money was used to buy food, furniture, pay for school fees of their children and treatment of the family as well as buying clothes. Other people engaged in charcoal business used the income for different activities such as buying bicycles, buying corrugated iron sheets and repairing their houses. Generally, making and selling charcoal had improved the livelihoods of villagers because it provided income and fuelwood for home use.

Part of the firewood collected in rural areas was used for cooking. Seventy five percent of people interviewed in Mindu-Tulieni and Saleni villages indicated that woodfuel provides them with energy for cooking. Availability of firewood assured villagers in eating cooked food.

Income was another contribution of wood-fuel. Through selling charcoal and firewood people were making money and in the process of making charcoal, employment was created. Charcoal sellers interviewed indicated that on average they got one million Tanzania shillings a year. However, studies along the Dar es Salaam-Morogoro highway showed

that the household incomes from charcoal reached the equivalent of USD 645 per year in 2002 exceeding the minimum wages of most employees in public and private sectors (Malimbwi and Zahabu, 2008: 96).

During the focus group discussion it was found that income was the major motive that encouraged people to engage in charcoal making. This was enhanced by the large number of people demanding firewood and charcoal in rural and urban areas, respectively. So the main reasons for people engaging in charcoal making were basically economic as most charcoal made was for sale. Thus, charcoal making provided villagers with additional income.

### **Woodfuel and environmental degradation**

Despite the importance of firewood and charcoal, its use led to environmental degradation. Environmental degradation was a critical problem in most countries including Tanzania. As Asha Kajiru who lives in small sub-village in Saleni village claimed that, "When I (Asha Kajiru) was a child there were many trees that provided firewood, logs for making charcoal, shade and fruit in our village. Today I can see far out into the bush as trees have disappeared". Today women and children walk a minimum of 2.5 miles a day in search of firewood. Also more time is spent on searching logs suitable for charcoal making. All these were the indications that forests had disappeared.

Majority of Tanzanians are heavily dependent on wood-based energy for cooking purposes (Kilahama, 1983; Mnzava, 1984). Ishengoma and Ngaga (2000) reported that 86% of Dar-es-Salaam residents depended on charcoal for cooking. There had been very little and deliberate national efforts to improve supply of wood-fuel either by initiating sustainable management options or by establishing forest tree plantations. Nearly 99% of charcoal used in Tanzania is from natural forests and woodlands (Mnzava, 1984) and production of charcoal is done through inefficient earth kilns (Kilahama, 1983; Songela, 2003).

### **CONCLUSION AND RECOMMENDATIONS**

Although fuelwood contributes to the livelihoods of people both in rural and urban areas alternative energy sources should be sought. This could be accomplished by reducing and controlling the costs of alternative sources of energy like kerosene, electricity and gas. There is a need to introduce improved and affordable stoves and the use of solar power in rural and urban areas. It is also important to design activities that address community's socio-economic needs in order to initiate alternative income generating activities for those who depend on forest for their livelihoods. Creating funding mechanism and initiatives that

promote tree planting programs for charcoal burners and others is of great importance in order to control deforestation at the same time ensuring a sustainable supply of charcoal and firewood.

Areas for planting trees should be identified and given priority when designing village land use plans. The government should put more emphasis on the strategy of 'cut one tree and plant three trees' a slogan which in Kiswahili is *kata mti panda mti*. The national tree planting day is a yearly event which takes place on 1st April. The event should be encouraged and sustained among charcoal burners and that a timely assessment needs to be done to know the number of trees planted per year. The government should identify and monitor charcoal burners in areas where their number is not yet known. They should be educated on environmental issues and issue them with license. This process will facilitate the management of the charcoal making activities and hence improve rural livelihoods and reduce deforestation.

Finally, there is a great need to introduce improved and efficient kilns in areas where they are not yet in use in order to reduce the amount of trees cut and consumed in charcoal production. Currently, there is a technology on improved kiln for charcoal production called Cassamance Earthmound Kiln being promoted by Tanzania Forestry Research Institute within the country. Some of the charcoal burners in Mkundi village in Morogoro have started using the improved technology. This technology can be introduced in the study villages and other areas in which it is not in use.

The results indicated intensive use of forest wood for cooking purposes in Saleni and Pongwe Msungura villages. Forests provide means of living (wealth) to many people living in close proximity to it. Agricultural Extension Officers (AEOs) should train farmers on how to practice agro-forestry. Practicing agro-forestry is like killing two birds with a single stone. There is a need for the Government to enhance implementation of the environmental laws in the country in order to conserve and protect the remaining forests.

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