IMPACT OF INCREASED CHARCOAL CONSUMPTION TO FORESTS AND WOODLANDS IN TANZANIA

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Abstract

Wood or biomass is the major source of energy for domestic uses on Tanzania mainland especially for cooking meals. This survey about charcoal production and utilization has shown that majority of households are dependent on woodenergy more than other sources of energy. Observations within the City of Dar es Salaam and adjacent areas including some rural areas particularly between Kibaha and Chalinze as well as some other areas in the Coast and Morogoro Regions have shown that sources of woodenergy supply are increasingly becoming critical. Degradation of Miombo Woodlands within the 2 km distance on either side along the Dar es Salaam-Morogoro; Chalinze-Segera and Tanga-Arusha roads suggests that woodenergy shortages are obviously becoming serious and could result in energy for cooking both in the rural and urban areas being more problematic than the case may be for food supply. This is most likely to happen due to inadequate strategies and capacity to produce and utilize woodenergy on a sustainable basis. Where woodenergy shortage becomes obvious, the tendency is for the prices to shoot-up as a result of long distances that are involved to ferry charcoal to consumers. The survey conducted along the Segera-Chalinze stretch showed that charcoal brought to Dar es Salaam involves transportation distance of more than 250 km. This definitely increases the price of charcoal to consumers. Despite this situation charcoal is still a dependable source of energy for cooking because majority of urban dwellers consider it easier to use than firewood and also charcoal is considered to be easily available, easy to store, and still affordable (purchased in small quantities).

Random surveys in the Cities of Dar es Salaam and Tanga as well as the Municipality of Morogoro, indicated that many households are still using traditional charcoal cooking stove. Furthermore, production of charcoal in the rural areas is mainly done through the earth kilns. Thus, use of woodenergy for cooking purposes is shown to be very inefficient in terms of methods of production (in the field) and utilization (at the household level and within the informal sector). Efforts initiated since the 1990s to improve earth kilns' efficiency and also to produce and distribute improved charcoal cooking stoves through the private sector, have not produced intended impact. On the other hand, many households are not using electricity as their main source of energy to cook food. Electricity is mainly used for lighting, refrigeration and Television services. A slight increase in electricity tariffs definitely adds a burden to users and at the same time causing more pressure on forests and woodlands due to increased demand for charcoal, which in turn leads to increased environmental degradation.

Two decades ago charcoal production was considered to be sustainable in terms of production and forest/woodland resources management. The situation has changed rapidly because amount of charcoal being used in urban areas increased drastically for the last decade. A survey conducted between Mikese and Chalinze along the Dare-es-Salaam Morogoro highway, on five roadside charcoal collection sites, counted a total of 505 bags of charcoal. Another survey conducted on a 30 km stretch between ***Chuma cha pua*** *of and* ***Kitumbi*** *villages, along the Chalinze-Segera highway. Charcoal bags on 22 collection sites were counted and 1214 bags were record. The owners informed that they were awaiting transportation to take the charcoal to Dar es Salaam. Records from the Forestry and Beekeeping Division (FBD) in the Ministry of Natural Resources and Tourism (MNRT) show that on average the City of Dar-es-salaam is using more than 60% of charcoal produced on the mainland or more than 7000 bags of charcoal day^{-1}*

In this paper options to produce and supply wood-energy on a sustainable basis are suggested. These include encouraging people to invest in energy production plantations. The Ruvu woodenergy production initiative has demonstrated that as long as local communities are committed and through good planning, it can be done. Furthermore, the importance of alternative sources of domestic energy cannot be overemphasized. The urgent need to reduce pressure on the forests and woodlands through introduction of affordable alternative sources such as electricity, LPG, natural gas and new and renewable energies for cooking purposes is equally important. This can be achieved if Tanzania mainland would adopt policies that encourage and promote wide-use of alternative sources for domestic energy purposes. The government subsidies e.g. on electricity tariffs can promote increased conservation of forests and woodlands on the mainland through reduced demand for woodfuels..

BACKGROUND

Tanzania mainland occupies about 88 million hectares (ha) of land including water bodies and mountainous landscapes. There are no reliable data in relation to the exact amount of forests and woodlands on the mainland. This is because there have been variations in reported data, which raises doubts about the correctness of the data. For instance, the forests and woodlands on the mainland amount to about 38.5 million ha (FAO, 2002). This represents about 44% of the total mainland area. Other records (Hurskainen in Malimbwi *et al*., 2003) refer to 34 million ha and FAO 1992 indicated that Tanzania mainland possessed forests and woodlands of about 33.5 million ha (the same figure is quoted by URT, 1998). What this implies is that for the period of 1992 and 2002 the forests and woodlands on the mainland have increased by 5 million ha. On the other hand, the deforestation rate in early 1990s was estimated to be between 130,000 to 500,000 ha^{-1} $annum^{-1}$ (URT, 1998). This rate of deforestation has been reported to decline to about 92,000 ha^{-1} $annum^{-1}$ (FAO, 2002). This probably could be the reason for the alleged increased mainland forests and woodlands cover. The main reasons for deforestation outlined in the Tanzania Forestry Action Plan (TFAP) 1989 to 2007/08 and the National Forest Policy that was adopted by the Government in 1998 are: clearing for agriculture, overgrazing, wildlife, production of charcoal and over-exploitation of wood resources for timber and poles. The challenge is how to ascertain increased forests and woodlands cover while it is apparently known that population has drastically increased thereby fueling an increase in human activities. The impact being increased clearing of forests and woodlands for farming and livestock keeping. Also tree-cutting rate for charcoal making is observed to increase over the last decade. Despite such uncertainty about the reliability of the existing information about the total area occupied by forests/woodlands as well as the subsequent deforestation rate: the 2002 figures are the only documented and available estimates that can be used for planning and management purposes as far as the forestry sub-sector on the mainland is concerned.

The problems faced as a result of deforestation are further compounded by high population pressure and poverty. When Tanzania attained her independence in December 1961 the population was less than 10 million people. Majority of the families at that time were using more firewood than charcoal. Thus, the rate of deforestation was insignificant because the pressure on trees was low. According to the 2002 population census report, Tanzania has more that 34 million people (99%) of these being on the mainland. With such a population, the deforestation rate can be significantly felt due to increased demands on the use of forest and woodland resources for the majority to gain livelihoods. Experiences show that 99% of Tanzanians living in rural and about 90% of urban dwellers are heavily dependent on wood-energy for cooking and for house warming in colder highland areas.

Wood-energy dominates the household budgets in Tanzania and other countries south of the Sahara. In some countries including some parts of Tanzania wood-energy is the only physically and economically available source of domestic and cottage industrial use (Mnzava, 1991). Incorporation of wood-energy use in the developing and poor countries of Africa is about 90% of primary energy sources (Mnzava 1991). It is estimated that about 25% (about 8 million) of the population found on Tanzania Mainland live in urban areas (towns and cities). It is further assumed that 95% of these (about 7 million) are

depending solely on charcoal and firewood. Inevitably degradation of forests and woodlands on Tanzania mainland is to some extent, related to increasing demand for wood-energy particularly charcoal. This is because charcoal is reliable and majority can afford it (Malimbwi *et al*. 2003) however prices do not reflect its real cost. Charcoal has high calorific value of twice that of firewood (Hamza and Kiwira 2003; Sawe, 2004). According to trends, the true cost of charcoal is not the modest amount paid for a day's supply of cooking fuel. What this implies is that the price paid does not fully embed the value of the benefits forgone. Such benefits include environmental values: carbon sequestration, habitat to wildlife, soil and water conservation, conservation of climate, and conservation of water sources, biodiversity. Degradation of forests and woodlands as a result of increased charcoaling activities has widespread social and economic consequences (Nkonoki, 1983) and with negative effects to the environment (Eckholm, 1975; Mnzava, 1994). Most of these activities are taking place in general lands but also in some Forest reserves, affects rainwater infiltration hence reducing the ability of the environment to sustain water supply in streams and rivers especially during the dry season. This makes Tanzania exchange cheap fuel for expensive water and environmental management. The costs to rehabilitate seriously degraded forests and woodlands are usually high and in most cases difficult to afford for a poor country like Tanzania.

The benefits forgone due to deforestation and degradation of woodlands as a consequence of cheap fuel especially charcoal is estimated to be equivalent to at least 2% of Gross Domestic Products (GDP). Charcoal is nowadays hauled from very far distances more than 300 km (Mnzava 1994), which is not an ideal situation for attaining sustainable conservation and development. Lack of appropriate mechanisms including adequate infrastructure to allow many households in the urban areas to use conventional sources of energy, leaves them with charcoal as their main household source of energy for cooking. For the past 40 years Tanzanians have experienced a situation of prices of kerosene, Liquid Petroleum Gas (LPG) and electricity being on the increase while in real terms incomes declining. This affects the ability of the majority of urban dwellers to afford and use conventioned sources of energy therefore, no other options except to depend heavily on wood-energy. Furthermore, use of charcoal in urban areas is mostly preferred compared to firewood because of its comparative advantages. Unlike firewood, charcoal is relatively clean (almost smokeless and does not contain sulphur) hence making it ideal to use in closed doors and congested settlements. It is also easy to distribute charcoal and reasonable storage space cab be easily secured compared to firewood.

In May 2004 the Management of the Tanzania National Electricity Supply Company (TANESCO) announced increase in electricity tariffs. Before the increase the minimum subsidized rate was up to 100 units of power use. But these have now been reduced to 50 units. Thus, the increase in electricity tariffs is more targeted to the middle consumers. What impact will this have in terms of households' energy budgets and general domestic energy consumption trends? The majority of low-income group that benefit from subsidies does not use electricity for cooking but mainly for lighting and probably some refrigeration and to some extent operating Television or music instruments. The households most likely to use electricity for cooking, pressing and boiling liquids are those targeted for increased electricity tariffs. The assumption is that as the electricity tariffs shoot-up, there will definitely be a fuel switches from using electricity for cooking or boiling water to using other alternatives and in this case charcoal and firewood. Other options may include using Liquid Petroleum Gas (LPG), natural gas, kerosene, solar and

biogas. To what extent these latter options are viable and could benefit many households is still a challenge. This is because the prices of these are also not affordable to most households. This leaves wood-energy as the only viable option for the majority of people on Tanzania mainland. Thus, increased pressure on forests and woodlands as a result of increased charcoaling activities to meet increasing demand for the commodity is highly anticipated.

Experiences show that there are immense pressures and rate of deforestation of forests and woodlands on the mainland is alarming. In the early 1990's the Government deliberately adopted a national energy policy that aimed at encouraging more households in the urban areas to use electricity and LGP. Through that policy the Government enabled the power sector to control electricity tariffs and also encouraged use of a alternative energy sources by subsidizing prices for electrical appliances (e.g. cookers) and those for using LGP and solar energy. Despite that move, the situation has remained unchanged because the majority of the households in the urban areas are still depending heavily on wood-energy to meet their cooking requirements. Experience further show that there has been an increasing dependency on charcoal for cooking and other household applications compared to using electricity and LPG. Why? Because a number of factors account including low income (poverty) and globalization initiatives that are taking place all`ver the world. This paper examines increasing use of charcoal in urban areas and what will be the implications of increased electricity tariffs to the mainland's forests and woodlands if the situation remains unchanged?

STUDY AREA

Tanzania mainland is geographically organized into 21 administrative Regions and 114 Districts. The mainland socio-economic activities are carried out in both the rural and urban sectors. The latter is composed of two cities, seven municipalities, 12 regional towns, 114 District Urban Centers (townships) including a number of growing peri-urban areas and more than 8400 villages. This study focused on three urban centres covering limited sites in Dar es Salaam, Morogoro and Tanga (Figure 1). Also some data was obtained from the City of Mwanza, which is situated south of Lake Victoria.

Reasons for concentrating on these few urban areas are:

(a) More than half of the urban dwellers are found within the study areas; and

(b) Increasing electricity tariffs will seriously affect livelihoods of low-income[1] and middle-income[2] households majority of them being in the study areas.

[1] Low-income household earning less than Tshs. 50,000/= or equivalent USD 50 per month.

[2] Middle income households earning less that TShs 300,000 or USD 300 per month

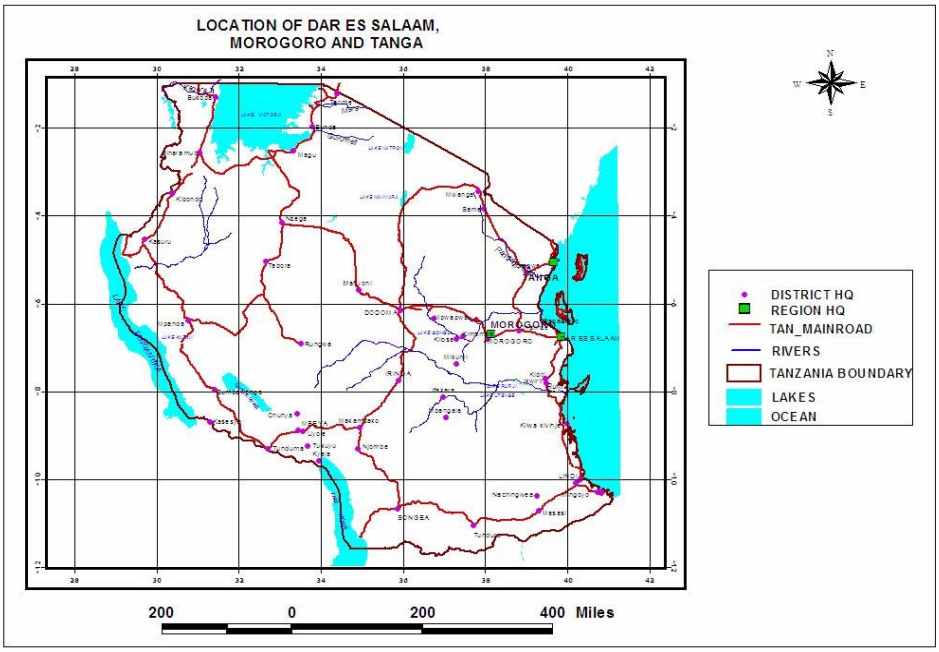


Fig. 1: Location of Main Study Areas-Dar-es-Salaam, Morogoro and Tanga

METHODOLOGY

The primary objectives of this article are to examine the effect of increased charcoal consumption to Tanzania's forests and woodlands and with the view that wood-energy is the most likely alternative to electricity especially for cooking purposes. Also a subsidiary aim was to assess the amount of wood-energy being used in the study areas particularly in the City of Dar es Salaam although some assessments were also conducted in the cities of Mwanza and Tanga as well as the Municipality of Morogoro.

Charcoal Brought into the Market

Data on charcoal for cooking bought into the urban areas was collected in two ways:

(a) Firstly, from daily records kept at the checkpoints at Kibaha (Maili Moja); Mbagala and Vikindu along the Kilwa Road and along Bagamoyo; and

(b) Secondly, through random observations between Dar es Salaam and Morogoro regions. In most cases the number of vehicles (trucks, pick-ups, Bases etc) and bicycles carrying one or more bags of charcoal were counted and recorded. Furthermore, roadside charcoal collection sites were noted and number charcoal bag present at time of visit counted.

Charcoal Consumption

Data on charcoal consumption in the study areas was obtained through structured and semi-structured interviews. A limited number of households (about 195 in Dar es Salaam, 129 in Morogoro and 100 in Tanga) were randomly interviewed and questionnaires used to administer their responses.

Charcoal Prices

A random survey regarding charcoal price was conducted mainly through the collection and selling centres along the Dar es Salaam-Morogoro and the Chalinze-Segera roads. A further survey of charcoal prices was conducted in Dar es Salaam especially in Kimara, Magomeni and Tabata areas covering those selling bags (sacks) weighing, on average, 50kg (57kg reported by Ishengoma and Ngaga (2000) and those selling in small quantities (in tins popularly known as "Kopo").

Charcoal Selling Sites

Charcoal selling sites are both located at the source in the rural areas from where charcoal production takes place and along the road as well as at various localities in the urban area such as "Kimara Mwisho" in Dar es Salaam. In most cases charcoal is stored in open space and very few vendors are using reliable storage sheds. It was noted that quite a few charcoal sellers are using small room adjacent to their homes to store few bags.

Electricity Tariffs

Data on electricity tariffs was obtained from the Tanzania Electricity Supply Company (TANESCO) Head office, which is located at Ubungo, along the Morogoro road in Dar es Salaam. The data on tariffs covered a period of between 1980 and 2004.

RESULTS

Data on wood energy collected in the cities of Dar-Es-salaam and Tanga indicates that charcoal consumption in the household sector is leading followed by a combination of charcoal and kerosene, charcoal and firewood and finally electricity (Figure 2).

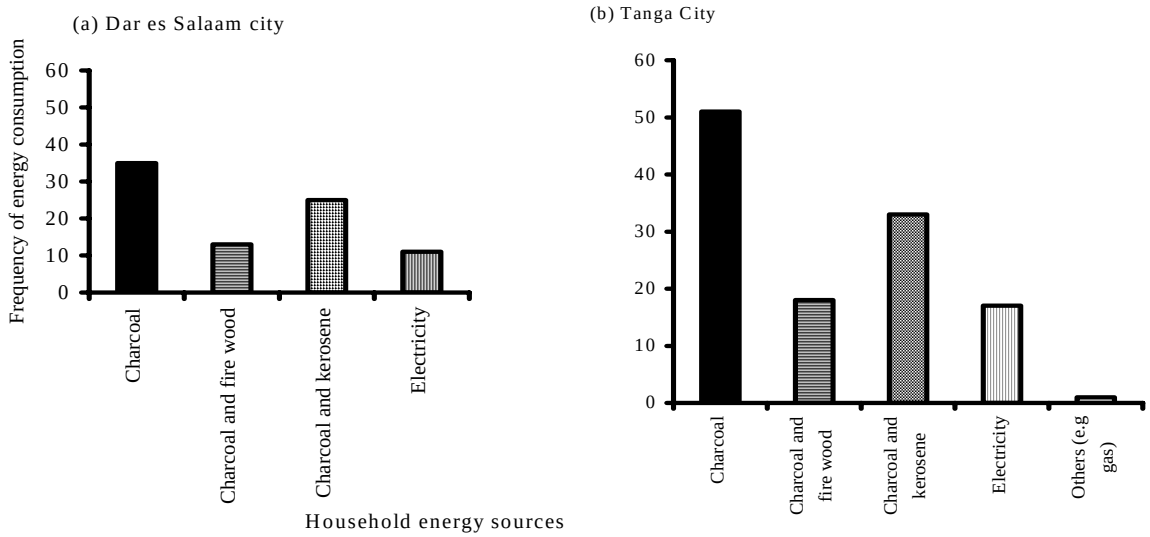


Figure 2: Frequency of energy consumption by category in Dar es Salaam and Tanga, Tanzania

Charcoal Brought into the Market

Charcoal traders were observed to collect charcoal from the sources that are either on the roadside (highway collection centers) or from the kiln where charcoal has been produced (ex-kiln collection). In most cases charcoal is transported to consumers using very old truck. This was observed as the main mode of transporting charcoal from the producers to consumers. Records at the checkpoints show that more than 120 vehicles day^{-1} (over 3800 vehicles $month^{-1}$) supply charcoal to consumers in the city of Dar-es-Salaam (Tables 1a and 1b).

Table 1a: Daily records of trucks carrying charcoal, number of bags and the value of Charcoal delivered to Dar es Salaam from June to August 2004

Month	Number of trucks per day	Number of bags per day	Value in '000' Tshs per day
June	34* (11)	2577(588)	1312.80(259.09)
July	44 (9)	3074 (634)	1776.50 (401.35)
August	49 (7)	1876 (396)	1083.50 (139.90)
Overall	**127 (17)**	**2604 (861)**	**1316.40 (655.90)**

*Values in blackest are standard deviation

Table 1b: Summary of Charcoal Brought into DSM and Recorded at Checkpoints for June-August 2004.

Check point	Kibaha		Mbagala		Mbezi		Boko		Vikindu		Total	
Month	Trucks	Bags	Trucks	Bags	Trucks	Bags	Trucks	Bags	Trucks	Bags	Trucks	Bags
June	790	42702	457	26474	878	43898	184	6336	760	38217	3069	157627
July	838	46684	806	46438	645	42230	195	7799	1250	61564	3914	205715
Aug	922	52034	1637	59851	997	49860	217	7930	1280	64015	4448	233680
Total	2550	142420	2296	132763	2720	135978	596	22065	3270	163796	11431	597022
Ave. Month	850	47473	765	44254	907	45326	198	7355	1090	54598	3810	199007

Source: Forestry and Beekeeping Division, MNRT

The survey further showed that not many trucks are able to go very far into the woodlands. Use of bicycles for relatively short distances i.e. not more than five kilometers and tractor/trailer for longer distances of up to 20 km away as well as head-carry to roadsides or closer to the points where trucks can easily load the commodity was observed to be popular practices (Table 2).

Table 2: Unchecked Number of Charcoal Bags Brought into Dar-es-Salaam by Various Means of Transport: June-September 2004

Number of bags of charcoal and means of transport (daily averages)									Overall number of bags
Using Bicycles		Number of bags (Daily average) carried by min-buses and various trucks					Cars (private and public)		
No. of bicycles	No. of bags carried by bicycles	Min buses (roof rack)	Tankers (roof rack)	Tankers (sides)	Trucks (between cabin/body)	Trucks (top of goods)	Roof rack	Pick up	
28 (7.53)*	57 (15.06)	6 (3.01)	6 (3.01)	3 (1.74)	3 (1.74)	6 (5.35)	4 (1.58)	5(1.85)	66 (22.70)

*Values in blackest are standard deviation

It was also noted that other forms of transport are being used. For instance, using bicycles, private and some public vehicles. Observations have shown that use of bicycles in Dar es Salaam (DSM), Morogoro, Mwanza and Tanga is becoming popular and the vendors transport charcoal directly to consumers. Use of bicycles to transport charcoal has been reported as being done by self-employed cyclists (MEM 1988). Through this study an average of 28 bicycles day^{-1} were observed (in one hour) carrying two bags of charcoal for short transits in Dar es Salaam mainly between Kibaha Maili Moja and Kimara (Table 2) but also a good number of bicycles are used along the Kilwa road and from Pugu/Kazimzumbwi areas to Ukonga and adjacent areas. That means in DSM alone more than 100 bicycles day^{-1} are used (within one hour). In the city of Mwanza between 70 and 90 bicycles day^{-1} are used while in Morogoro and Tanga bicycles are increasingly being used to supply charcoal to customers. Semi-trailers with or without containers, oil tankers; buses and minibuses, private and public cars especially those with roof racks are also used. It was observed that oils tankers coming from up-country are regularly carrying bags of charcoal either on the sides or roof racks (Table 2). Not only those, but also some buses and mini-buses are used either by carrying bags of charcoal together with other passengers' belongings on roof racks or within the boots (underneath) of ordinary (large) buses. About to 2 to 10 bags of charcoal vehicle^{-1} are transported through such means (Table 2). This is increasingly becoming a common practice and many of them do not pay royalties to the Government. In some cases the charcoal transported is for home use but where large quantities are involved: Drivers of oil tankers and big trucks bring the charcoal to urban areas to sell in order to earn extra income. The trucks ferrying charcoal were observed during early hours of the day and late evening hours and indicate an increasing trend.

Charcoal Consumption

How much charcoal and Firewood are consumed in urban areas on Tanzania mainland is indeed, an indication of how crucial wood energy is to the well being of Tanzanians? The surveys have shown that a lot of charcoal is used on Tanzania mainland. Majority of the households sampled (56.4%) of sample reported cooking three meals daily (Table 3a) in the city of Dar-es-Salaam and on average, are using 2 kg of charcoal day^{-1} or about 2 bags of charcoal month^{-1}. This means a large proportion of the sample use 2kgs (40%) and

3kgs (32.2%). This situation is for Dar-es-Salaam alone but demonstrates what could be the situation in other urban areas.

Table 3a: Responses on Number of Meals cooked per day in the City of Dar-es-Salaam

	Cha'be	Ka'koo	Keko	Ki'mba	Kilu're	Kimara	Kitunda	K'sini	Mag'ni	Mbezi	Mmala	Sinza	T'dika	Te'ke	Total	% Total
Three	11	6	13	12	8	14	4	7	7	2	8	5	10	3	110	56.4
Two	0	5	1	8	6	5	2	2	1	1	2	3	3	3	42	21.6
One	0	0	1	3	2	3	0	1	2	0	0	0	3	1	16	8.2
> Three	2	1	1	2	1	0	9	0	0	5	1	0	4	1	27	13.8
No of HH	**13**	**12**	**16**	**25**	**17**	**22**	**15**	**10**	**10**	**8**	**11**	**8**	**20**	**8**	**195**	**100**

Table 3b: Responses on the Amount of charcoal Used per^{-1} (Kgs) in the City of Dar-es Salaam

	Cha'be	Ka'koo	Keko	Ki'mba	Kilu're	Kimara	Kitunda	K'sini	Mag'ni	Mbezi	Mmala	Sinza	T'dika	Te'ke	Total	% Total
No of HH	**13**	**12**	**16**	**25**	**17**	**22**	**15**	**10**	**10**	**8**	**11**	**8**	**20**	**8**	**195**	**100**
One	3	2	3	8	4	4	3	2	2		1	2	5	3	42	21.2
Two	4	5	2	10	6	10	3	3	4	6	3	4	12	4	76	40
Three	6	5	9	5	4	8	8	5	3	2	3	2	3	1	64	32.2
Four	0	0	2	2	3	0	1	0	1	0	4	0	0	0	13	6.6
Ave.bags/ month	2.3	1	2	2	2	2	1	2	2	2	1.5	2	1.5	2	25.3	1.8 bags

This means a consumption of about 26 bags of charcoal month^{-1}. Results (Tables 1a&b) based on three months data collection: indicate that the rate of consumption of charcoal in the city of Dar-es-Salaam is increasing utilizing more than 200,000 bags month^{-1} or more than 2.4 million year^{-1} (Figure 3).

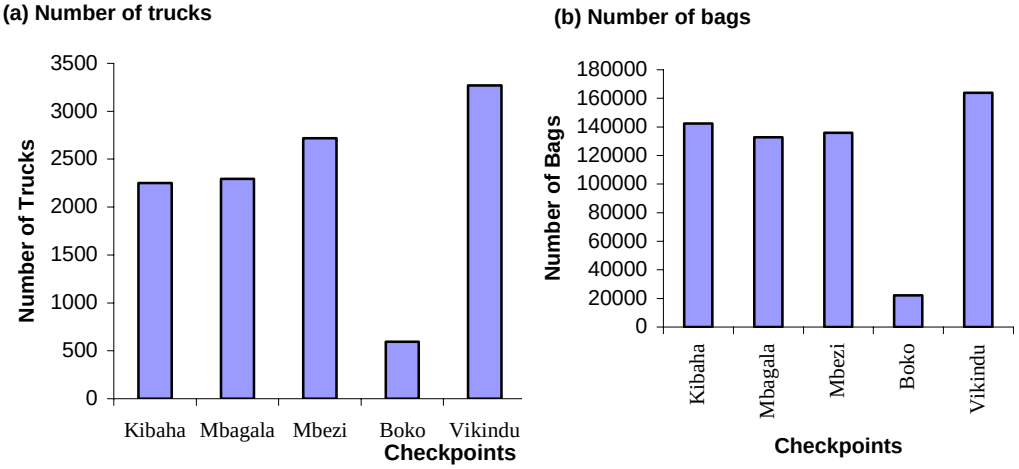


Figure 3: Trucks carrying charcoal and bags brought to Dar es Salaam city from June to August 2004

Ishengoma and Ngaga (2000) reported 86% of Dar-es-Salaam residents to depend on Charcoal for cooking purposes. For the municipal of Tanga highest quantities of charcoal used were recorded for the period of 2000/01 (136,646 bags of charcoal) and more firewood consumed in year 2001/02 (20,625 m^3). For the past five years (July1999 to

June 2004) Tanga consumed a total of 556,306 bags of charcoal (an average of 111,261 bags year^{-1}. In the city of Mwanza, records indicate that between 1997 and 2002, about 323,948 bags of charcoal were used (Figure 4).

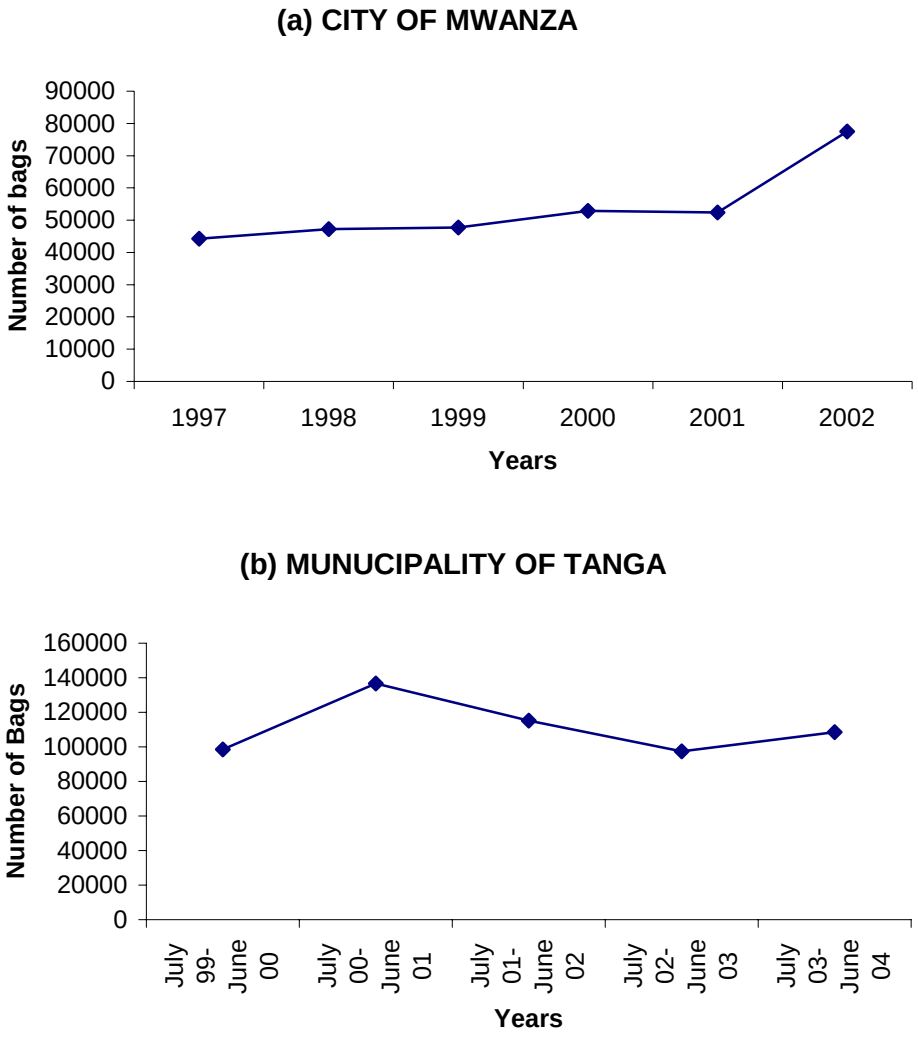


Figure 4. Charcoal Brought into Mwanza and Tanga: 1997-2004

Charcoal Prices

Charcoal prices are varied depending on where one gets it. In the villages from where it is produced (ex-kiln) prices were reported to be between Tshs. 1500.00 and Tshs. 2000 bag^{-1} of charcoal with an average weight of about 50 kgs compared to 28 kgs stipulated in the forest Rules and Regulations. When the same bag of charcoal reaches the final destination (consumers) the price is relatively high but also differentiated depending on locations. For instance, a bag of charcoal sells at Tshs. 6,000/= in Kimara (October 2004) and over Tshs. 10,000/= (April 2005). In other areas like Tabata the price was Tshs 6,500 - 6,700/= per bag of charcoal.

The small-scale retailers were observed to sell charcoal in small tins whose prices range from Tshs 150/=, 200/= 250/= and 300/=. On average the small filled with charcoal weighed about 1 kg and sold Tshs. 150/= whereas other tins (about 1.25 kg) charcoal were sold at 200/= and 250/= in Kimara and Oysterbay/Masaki areas respectively. The price of larges tins of about 2.5 kgs of charcoal was reported to be Tshs. 300/= per tin in the Municipality of Tanga. In some other areas (Mikanjuni and Sahare A&B also in Tanga) retailers use small baskets made from palm leaves and others selling charcoal in "mafungu" (small heaps) whose weight was noted to be almost the same as that of small and medium size tins (1 and 1.5 kgs respectively) depending on the size of the heaps.

Charcoal Collection/Selling Points

Results of interviews and observations show that substantial amount of charcoal is collected and sold along the highway: Dar es Salaam–Chalinze–Segera and Chalinze–Morogoro. The information indicates that the distance between charcoal selling points along the road and production sites is increasing. From Tables 4a and 4b a range of between 3 to 30 km was reported: the average being 10 km. This implies a drastic depletion of sources of wood within 2 km either side of the highways. This forces charcoal markers to move further inland where they can obtain wood for making good quality charcoal. Also transportation costs from the kilns to selling points are also increasing: ranging from Tshs. 200/= to 1200/= bag^{-1} the average is Tshs. 700/= bag^{-1}. This rendered the average buying and selling prices bag^{-1} of charcoal (average weight 50kg) to be Tshs. 1,300/= (kiln site) and Tshs. 4,000/= (roadside selling points).

Table 4a: Charcoal Business At Roadsides Between Chuma Cha Pua And Katumbi-Segera-Chalinze, Coast Region

Location	Number of bags		Price (TShs Bag^{-1})		Distance to sources (km)*	Means of transport[1]	Operation costs (TShs Bag^{-1})		Profit (TShs Bag^{-1})	Profit margin (%)
	Holding capacity	Found in stock	Buying	Selling			Transport[1]	Packaging Unloading		
Kwalugenge		150	1500	3500	25	3	1200	200	600	20.7
Kwedukwazu		63	1500	3000	5.5	1, 2	550	200	750	33.3
Bakule		33	1500	3200	7	2	800	200	700	28.0
Kisaza		78	1800	2700	3	1	200	150	550	25.6
Kwamachalima		137	1200	2500	4	2	500	200	600	31.6
Komkenga I		237	1500	3000	6	2	800	300	400	15.4
Kwamgao		244	1500	3500	20	3	700	200	1100	45.8
Kitumbi		148	1500	3000	3	1	500	200	800	36.4
Total		**1090**	**12000**	**24400**	**73.5**	**-**	**5250**	**1650**	**5500**	**-**
Average		136.3	1500	3050	9.2	-	656.3	206.3	687.5	29.6
S.d[2]		77.0	160.4	350.5	8.4	-	294.5	41.7	208.3	9.5
CV[3] (%)		56.5	10.7	11.5	91.9	-	44.9	20.2	30.3	32.0

[1]Means of transport: 1 = Head carry, 2 = Bicycle, and 3 = Tractor (30 Bags/trip), S.d[2] = Standard deviation; [3]CV =Coefficient of variation

Table 4b: Summary Of Charcoal Business: Sub-Whole Sellers In The Municipality Tanga

Location	Number of bags		Price (TShs Bag^{-1})		Distance to sources*	Operation costs (TShs Bag^{-1})			Profit (TShs Bag^{-1})	Profit margin (%)	Remarks
	Holding capacity	Found in stock	Buying	Selling		Transport[1]	Loading	Unloading			
Chumbageni	60	36	1000	4500	90	1500	100	100	1800	66.7	Can sell 9 to 10 bags day^{-1}
Sahare A	150	30	3500	4300	120	1200	50	50	-500	-10.4	
	50	9.5	3800	4500	Spd	NA	NA	NA	700	18.4	
	15	7	2000	4200	Spd	NA	100	NA	2100	100.0	
Sahare B	120	23	1550	3900	150	1000	100	100	1150	41.8	
Makorora	100	20	1300	4400	110	1200	100	100	1700	63.0	
	120	70	1300	4500	160	1400	100	100	1600	55.2	
Mikanjuni	200	13	1250	4200	120	1300	100	100	1450	52.7	
Total	**815**	**208.5**	**15700**	**34500**	-	-	-		**10000**	**387.4**	
Average	101.9	26.1	1962.5	4312.5	125	1266.7	92.9	91.7	1250	48.4	
S.d[2]	59.3	20.4	1083.9	210.0	25.9	175.1	18.9	20.4	825.1	33.1	
CV (%)	58.2	78.1	55.2	4.9	20.7	13.8	20.4	22.3	66.0	68.4	

*Spd = Supplied by dealers; NA = Not available; S.d[2] = Standard deviation

NOTE: Firewood is sold in pieces or bundles. A fire wood piece and bundle are sold at TShs 200 and TShs 400 respectively. The firewood traders purchase 3 pieces for TShs 100, and a bundle for TShs 100. This makes profit margins of 500% and 300% for pieces and bundles respectively. This is actually a super profit.

Charcoal and other Sources of Domestic Energy

Some households in the City of Dar-es-Salaam are using Charcoal but in combination with other sources of energy. Many respondents indicated that they use charcoal and kerosene (26%) while another 25% reported using charcoal, firewood and electricity (Table 5a). Use of charcoal and electricity was reported by about 13% of the respondents and only 1.5% of sample is using electricity. On the other hand, Table 5b shows responses on the use of single energy source. In this case charcoal is the critical and most used source of domestic energy by majority of users (81%) of sample followed by firewood and kerosene (9.2%) and (7.3%) of the sample respectively.

Consumption of Firewood

Some firewood is used in urban areas especially by several restaurants, Mama Lishe groups, Bakeries and in public utilities like Schools, Hospitals and Armed forces (mainly in the barracks and prisons. Also some households are using firewood (9.2%) of respondents Dar es Salaam (Table 5a) and (4%) in Morogoro (Table 5b). Ishengoma and Ngaga (2000) reported 27% of residents in Dar-es-Salaam to use firewood. For the past five year the Municipality of Tanga used over 20,000m^3 of firewood.

Responses on type of Energy Source which is Mostly used in Dar-es-Salaam

	Cha'be	Ka'koo	Keko	Ki'mba	Kilu're	Kimara	Kitunda	K'sini	Mag'ni	Mbezi	Mmala	Sinza	T'dika	Te'ke	Total	% Total
No of HH	**13**	**12**	**16**	**25**	**17**	**22**	**15**	**10**	**10**	**8**	**11**	**8**	**20**	**8**	**195**	**100**
Charcoal	1	2	0	3	2	6	0	0	0	0	1	0	1	3	19	9.7
ch/fw	0	0	1	8	2	4	0	1	0	0	1	0	1	0	18	9.2
ch/elec	3	3	3	2	0	2	2	0	2	2	1	0	5	1	26	13.3
ch/fw/ker	0	0	0	0	0	4	0	0	2	0	1	0	0	0	7	3.5
ch/fw/kr/elc	0	5	11	4	0	0	12	0	1	4	0	0	10	2	49	25
ch/fw/ker	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ch/elec/ker	3	0	1	0	0	0	0	3	0	0	4	4	0	0	15	7.6
ch/fw/elec	1	0	0	0	0	6	0	1	0	0	0	0	0	0	8	4.1
ch/ker	6	2	0	8	11	0	1	5	5	1	3	4	3	2	51	26.1
Electricity	0	0	0	0	2	0	0	0	0	1	0	0	0	0	3	1.5

Responses on type of Energy Source which is Mostly used in Dar-es-Salaam

	Cha'be	Ka'koo	Keko	Ki'mba	Kilu're	Kimara	Kitunda	K'sini	Mag'ni	Mbezi	Mmala	Sinza	T'dika	Te'ke	Total	% Total
No of HH	**13**	**12**	**16**	**25**	**17**	**22**	**15**	**10**	**10**	**8**	**11**	**8**	**20**	**8**	**195**	**100**
Charcoal	13	9	16	16	13	12	11	9	9	6	9	8	20	7	158	81
Kerosene	0	1	0	4	2	3	2	0	1	0	0	0	0	1	14	7.3
Firewood	0	2	0	3	2	6	1	1	0	1	2	0	0	0	18	9.2
Electricity	0	0	0	1	0	1	1	0	0	0	0	0	0	0	3	1.5
LPG	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0.5
Others	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0.5

Table 5a: Responses on Using Various Sources of Energy for Cooking in the City of Dar-es-Salaam

Description	Location										
	Kilakala	Kihonda	Misufini	Mazimbu	Mji Mpya	Forest Hill	Sabasaba	Mji Mkuu	Kigurunye mbe	Grand total	Overall %
Energy sources preference											
Mostly using charcoal	14	16	14	13	9	12	12	15	14	119	**93**
Mostly using fire wood		1	1	1	1	0	2	0	0	5	**4**
Frequency of cooking and other uses of energy											
Cooking 3 times a day	13	11	15	13	9	14	11	12	15	113	**88**
Boiling water	12	16	15	11	9	15	11	14	15	118	**92**
Ironing clothes	11	8	8	9	6	2	7	11	13	75	**58**
Information on energy consumption											
Charcoal (2 or 3 tins a day)	14	16	15	12	10	16	14	14	15	125	**97.6**
Kerosene (2 or 3 cans)	10	14	7	9	10	13	8	11	13	95	**74**
Buying charcoal	14	15	14	13	10	15	15	14	14	124	**96.8**
Type of charcoal stove used											
Improved stove	10	3	7	5	3	9	9	8	8	62	**48.4**
Traditional stove	3	0	5	4	3	2	4	6	5	32	**25**
Both improved and traditional stoves	0	11	4	4	4	4	2	0	2	31	**24**
Reason for using charcoal											
Charcoal is easy to get	13	14	14	14	9	12	14	14	15	119	93
Number of households surveyed	**14**	**16**	**15**	**14**	**10**	**15**	**15**	**14**	**15**	**128**	**100**

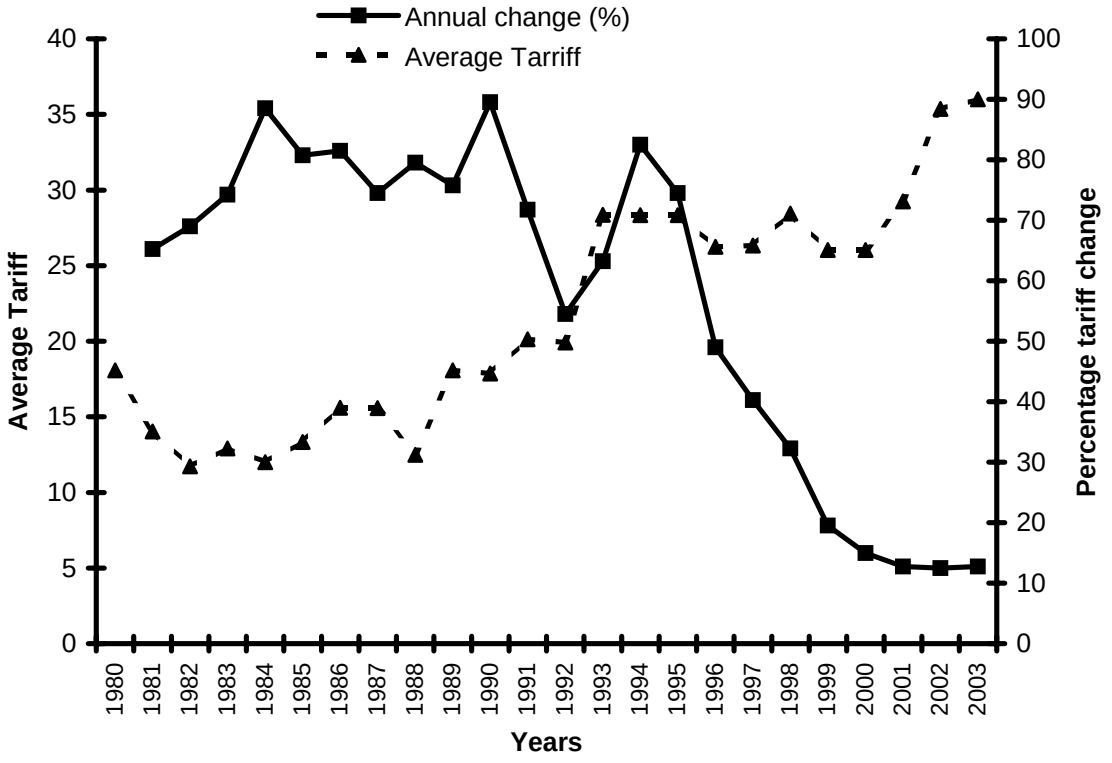
Table 5b: Frequencies of Responses on the Types of Energy used, Number of Meals Cooked day^{-1}, and Reasons for Using Charcoal by Households in the Municipality of Morogoro

Most of the households in the rural sector are using mainly firewood for meeting their domestic energy needs including house warming in some colder parts of Tanzania. Mainly employees such as teachers, medical staff, police, primary court magistrates or other professional/technical cadres working at the Divisional and Ward levels use small quantities of charcoal. Experience indicates that women usually collect firewood and in most cases go for dead wood and branches hence their impact to woodlands is marginal. On the other hand, large quantities of firewood are used by some rural industries like fish smoking, brick making, tobacco curing, lime production and salt making. In tobacco growing areas such as Tabora Region or other places where tobacco is cultivated substantial amounts of firewood are used hence causing deforestation in the respective areas. For instance, a farmer needs about 35m^3 of wood to cure one tone of tobacco. This means with 1000 tones of tobacco nearly the same amount of hectares of Miombo woodland would be cleared to obtain required.

Effects of Increased Electricity Tariffs

Experiences show that majority of the households use electricity for lighting purposes. However some families use electricity for cooking, boiling liquids, ironing, and refrigeration as well as operating radios, TVs and music systems. Surveys conducted in the study areas show that not many households are using electricity for cooking. High electricity tariffs coupled with difficulties to acquire necessary appliances like electric cookers/burners and others like electric kettle or rice cookers render it impossible for low-income households to use electricity for cooking and boiling liquids.

Electricity tariffs (Figure 5) indicate an increasing trend over the years. This has a negative effect on the households' budgets especially for cooking purposes. Some residents in the city of Dar es Salaam expressed their concern that the tariffs imposed by TANESCO since June 2004 is a threat to sound forests and woodlands conservation. Monthly electricity bills have doubled and for that reason they cannot afford to TANESCO monthly bills. Hence such customers will switch to using more charcoal than electricity. Thus, will add stress to the already increased demand for charcoal and therefore, more pressure on woodlands with negative impact to the environment.



(Source: TANESCO, Dar-es-Salaam**)**

Figure 5: Electricity Tariff for the Period 1980-2004

DISCUSSION

This survey has demonstrated that the market for charcoal is enormous and majority of the households on the mainland are heavily dependent on this source of energy to cook food and perform other households' applications. Sufficient data and literature about wood energy production and utilization in Tanzania and Southern African region is available (Mnzava 1980, 1984, 1991; Kilahama 1983, 1986; Eckholm 1975; Juma 1982; FAO 1971, 1980, 1981; Openshaw 1978; Serenje *et al*., 1994; CHAPOSA 2003; Ishengoma 1982; Ishengoma and Ngaga 2000; Kaale 1984; Kiwale, 1994; Makundi 1984; Nkonoki 1983; Mascarenhas 1984; Emrich and Mwihava (1989); Skutch 1983; Kikula and Nilsson 1982; Songela, 2003; Temu, 1979). The literatures available also include information on efficiency of cook stoves (Songela 2003) and that of kilns (Malimbwi *et al.*, 2003; Hamza and Kiwera 2003). Despite such tremendous amount of information about wood energy production and utilization particularly charcoal and firewood and including efficiencies of kilns and cooking stoves: Tanzania mainland has not been able to attain sustainable management of forests and woodlands, which are the main source of these critical commodities. While majority of Tanzanians are heavily dependent on wood-based energy for cooking purposes (Kilahama 1983; Mnzava 1984; FAO 1981; Openshaw 1978) there has been very little and deliberate national efforts to improve supply of woodfuel either by initiating sustainable management options or by establishing energy plantations. Nearly 99% of charcoal used in Tanzania is from natural forests and woodlands (Mnzava, 1994) and production of charcoal is done through inefficient earth kilns (Emrich and Mwihava 1989); Kaale, 1984; Kilahama, 1983; Songela, 2003) and also woodcutting for charcoal making is not controlled.

The charcoal makers usually enter general woodlands and cut wood in the way they like provided they have the labour to do so. According to Serenje *et al*., 1994 charcoal production in the African context involves minimum investments with no foreign exchange requirements. Basing on the fact that many rural households do not have reliable sources of income, many people in villages adjacent to woodlands are engaged in charcoal making activities. Under the existing socio–economic conditions, charcoal production and marketing becomes the largest employer in terms of number of people involved in production, transportation, distribution and retailing compared to other aspects of the energy industry in Tanzania. According to Sawe, 2004 charcoal is a big industry on Tanzania mainland whereby its contribution to people's livelihood security is enormous: estimated a value of over Tshs. 20 billions (Sawe, 2004). Despite such enormous value, uncontrolled woodcutting for making charcoal is nowadays widespread thereby causing serious degradation of forests and woodland. Loss of biodiversity and their habitats in different parts of the country especially in the Coast, Morogoro, Lindi and Tanga Regions has occurred as an outcome of uncontrolled tree cutting not only for charcoal but for other income generation such timber and logs for export and local markets. This eventually leads to serious consequences to the environment.

Although Serenje *et al;* 1994 argue that charcoal production may actually enhance woodland regeneration and biodiversity and further stated that deep soil moisture storage and rate of aquifer recharge are also enhanced through reduction of evapotranspiration, the opposite of such a hypothesis could occur. Unless charcoal making activities are well organized and done in a manner that will reduce loss of biodiversity: reduced water supply becomes inevitable due to widespread deforestation and therefore increased surface rainwater run-ff rate. The situation described by Serenje *et al.*, 1994 could be possible if wood cutting for charcoal production is

done on selective cutting basis: a factor dictated upon by low demand. For Tanzania mainland, demand for charcoal has constantly increased and prices rising (Mnzava 1984). This is due to (i) population increase especially for the number of households living in urban and peri-urban areas where charcoal is used most and (ii) high prices of alternative domestic sources of energy like electricity, LPG, Solar or kerosene. According to Eckholm (1975) population increase usually aggregates problems related to increased demand for woodfuels. But also an increase in prices of one or more alternative energy sources lead to shift in demand to cheaper sources in this case: Charcoal and firewood. Experiences in Tanzania show that prices of kerosene, LPG, solar and electricity have never been favourable to low-income households. For instance, prices of petroleum products increased substantially in 1980s (Mnzava 1994) but the situation in 2004 has not significantly changes because majority of the urban households cannot afford to cook meals using electricity, LPG or solar energy. Thus, majorities depend heavily on charcoal and firewood as their main source of domestic fuels for cooking (FAO 1981; Juma 1982; Eckholm 1975). In such a situation of increased demand for charcoal, selective tree cutting cannot be practiced because of enormous pressure on the woodlands.

Woodenergy and Deforestation

This study has once more confirmed that households in urban areas on Tanzania mainland are depending heavily on charcoal and firewood to meet domestic energy requirements. If 7 million people are using charcoal and firewood and assuming that about 4 million are solely using charcoal that means a substantial amount of wood would be cut in order to meet the needs. Information collected in Dar es Salaam, Tanga and Morogoro suggests that per capital consumption of charcoal day^{-1} is about 0.2 kgs. This means a family of 6 will use 1.2 kgs of charcoal day^{-1} but also this amount depends on the type of food, number of meals cooked day^{-1} and the efficiency of cooking stove. Majority of the households are using inefficient stoves, thereby utilizing about 10% of the energy value. This demonstrates a consumption rate of about 2 bags of charcoal $month^{-1}$. Assuming about 1.2 million households on the mainland are depending on charcoal to cook their food: that implies more than 28 million bags of charcoal are used $year^{-1}$ or about 2.4 million bags or about 120,000 tones of charcoal $month^{-1}$ or 1.44 million tones of charcoal $year^{-1}$. This estimated amount does not take into account the use of charcoal for roasting and cooking food in business centers like restaurant, bars and hotels as well as in public services like schools, hospitals and armed forces (prisons, police TPDF or JKT). It is important to take into account such uses in order to obtain good estimation of amount of wood being used in Tanzania. To produce one tone of charcoal, about 10 tones of wood are required because inefficient technology (mostly earth kilns) is used. Thus, more than 14 million tones of wood are used annually, which means cutting tree for making charcoal from an estimated area of between 250-300,000 ha. of Miombo Woodland.

On the other hand, increasing demand for charcoal means cutting more trees to get wood for charcoal making. Related studies (O'ktingati 1984; Ishengoma 1982 and Mulokozi (undated) indicated that a large forest area is cleared because is considered the most efficient and affordable source of cooking fuel for the majority of urban dwellers. Ishengoma (1982) noted that 6-8m^3 of wood produce one metric tone of charcoal. This is equivalent to about ten tones of wood yielding one tone of charcoal. Through such inefficient charcoal making methods widespread loss of tree cover in many parts of the mainland is observed. According to Eckholm (1975) the consequences include spread of ecologically disastrous and potentially irreversible treeless landscapes. Devres (1980) reported that land within 70km around Niamey and Ouagadougou in Niger and Burkina

Faso (former Upper Volta) respectively was strip and devastated in an effort to supply fuelwood to consumers. Nkonoki (1983) observed that widespread loss of trees has serious social and economic consequences. This is because extensive deforestation processes such as increased rate of soil erosion, poor infiltration and retention of rainwater and eventual worsening microclimate conditions lead to socio-economic hardships. Yet high dependence on woodenergy especially charcoal by the majority of the urban dwellers is hard to avoid. Furthermore, distances from charcoal sources to the markets are increasing for instance, more than 200km whereas in 1986 the distance was less than 120km (Kilahama 1986). As the charcoal supply distances continue to increase the prices are also significantly increasing.

Since TANESCO has increased tariffs especially for those consuming over 50 kWh per month (2005 tariff rate of Tshs. 115 per kWh) under the high-energy charge per kWh category will have to adjust their electricity consumption habits. Although the low rate consumers (customers using 50 or less kWh per month) their tariff is Tshs. 38 per kWh majority still find it high due to lack of reliable and sufficient incomes. This means that those households that were using charcoal partially (in combination with kerosene, LGP or electricity) or those who were fully using electricity for cooking will start using charcoal as a response to increased electricity tariffs. This will further increase demand for charcoal and firewood hence expand negative effects to forest and woodland conservation because more and more trees will be cut compare to those planted. The deforestation rate will then rise to more than 92,000 ha annum^{-1} probably to more than 100,000 ha while tree planting has remaining at about 25,000 ha year^{-1}. Therefore, the impact of TANESCO's increased tariffs is a challenge to the forest and beekeeping sector and the environment as a whole.

One of the mitigation measures would be increased tree planting but this will not be a solution in the foreseeable future. Use of alternative sources of energy like kerosene, LPG or solar power have some limitations basing on the fact that income for majority of the households is low and therefore forcing them to depend heavily on wood fuels as the main source of energy.

Cooking Fuel and Household Income/Expenditure

The proportion of expenditure of households on basic commodities including charcoal or other domestic fuels was not easy to establish. Basically, most families in urban area budget for food, house rent, cooking fuel, clothes (the later not on monthly basis) and utilities like water and electricity or medical care. When asked how the monthly income is distributed in relation to the household budgets most of the respondents were hesitant to discuss the issue. Firstly, they were not willing to reveal what they earn and secondly how income is spent was considered a sensitive and personal issue. Overall assessment suggests that for the majority of households, priority is purchase food and payment of house rents. Regarding cooking fuel, some respondents in Dar es Salaam, Morogoro and Tanga expressed their opinion that for many years, they did not consider cooking fuel as a burning issue within their families' obligations. Although they mostly use charcoal and/or firewood for cooking and considered these as important commodities but felt that charcoal was easily obtained on a daily basis. For instance, with Tshs. 200/= or 300/= a family could purchase charcoal required to cook a day's food for the family members hence not considered a constraint to the family's expenditure.

Under normal conditions high-income households use electricity and/or LPG while the low-income families depend heavily on basic sources of energy such as firewood and charcoal

(Serenje *et al.,* 1994). When disparities in income levels and the dependence of low-income households on woodenergy are taken into account, it is observed that the low-income households spend a large proportion of their income on woodenergy. Results of the surveys (Table-) show that nowadays low-income households are spending more on cooking fuel (between Tshs. 500/= and 1000/= day^{-1}), which accounts for more than 30% of the household income. For instance, a family using 3 kg of charcoal day^{-1} for cooking means a household expenditure of Tshs. 600/= day^{-1}. Assuming a family income of Tshs 60,000/= $month^{-1}$ this means about 30% of household income is spent on fuel for cooking. This compares well with similar studies elsewhere for instance, Devres in 1980 reported that 30% of income of the poorest classes in Ouagadougou, Upper Volta and 25% in Niamey, Niger were spent on fuelwood. Previous studies in Tanzania (Nkonoki, 1983) indicated that poor households in urban area spend between 28% and 34% of their households' income on cooking fuel and lighting respectively while Kaale 1984 reported 30% expenditure. Nkonoki (*op. cit.*) further projected increased use of kerosene for cooking purposes whereby households in urban areas could have used less charcoal over the years. Despite the fact that kerosene is available on the market but wide application for cooking has been hampered by high prices compared to the majority's low levels of incomes to use kerosene for cooking. Thus, Nkonoki's assumption of many households switching from using charcoal to kerosene was based on the anticipation that, over the years, the purchasing power for many households in the urban sector, would increase but this has turned out not to be the case. Instead, the majorities of households are still depending on charcoal and demand for the commodity increasing. This demonstrates the importance of wood to domestic energy to poor households.

Charcoal has been the major source of domestic energy for majority of urban dwellers in Tanzania and in the southern region of Africa (Mnzava 1991). In Tanzania it is the main affordable source of energy for cooking especially in urban areas (Ishengoma 1982; Kilahama 1986; Monela 1992); Mulokozi (undated); Temu 1982). Charcoal is used for cooking, boiling liquids, frying or roasting food. Other charcoal users (food vendors, restaurants, hotels, bars, kiosks, "Mama Lishe" and public institutions) consume substantial amounts of charcoal ranging from 10 to 100 kg day^{-1} depending on amount of food and services rendered. For instant, a restaurant in Tanga, serving customers from 06 am to 22 hours is using about 100 kg of charcoal day^{-1}. It was observed that the restaurant is cooking food using 5 improved and 4 traditional charcoal stoves. Also a large grill/oven is used for roasting meat (Nyama Choma). A food vendor at the Kimara Safari Resort who specializes in cooking pig meat "Kitimoto" uses about 50kg of charcoal day^{-1} to prepare 100kg of meat (using one kg of charcoal to prepare 2kg of meat) but at the same time cooking some other food stuffs such as "Ugali" (stiff porridge) as well as roasting/frying bananas.

Charcoal Utilization Efficiencies

Majority of the households and business entities are using traditional charcoal stoves. Very few were noted to use improve charcoal stoves. It was also observed that ignition is done by using papers and/or a little kerosene and allow charcoal to burn into hot fire before placing the cooking pot or frying pan on it. Observations indicate that charcoal cook stoves are fired when stuffs to be cooked not ready. Charcoal is ignited with fire and sorting out what to cook follows. This practice is wasteful in terms of energy utilization. Cooking should immediately start once charcoal catches the fire. Adopting improved charcoal stoves will enhance energy utilization and therefore become economical (cost effective). Very often efficiencies in utilization of woodenergy in rural and urban areas are not encouraging despite the fact that there have been

some initiatives to improve the situation. However, the overall impacts as far as efficiency in woodenergy use is concerned are still low. For instance, majority of the households in the rural sector are still using the three-stove style whose cooking efficiency in woodenergy utilization is less than 10%. Almost the same applies to the traditional charcoal burners that are still popular and widely used in the urban sector. According to Openshaw (1978) the improved cooking devices and styles for firewood and charcoal are noted to raise woodenergy utilization efficiencies of between 15% and 30% respectively. Kaale 1984 reported an increase from 7-8% to 15% (open fire) and from 10% to 20% for charcoal stoves: the latter reducing charcoal consumption by about 40% a significant saving and if achieved in real terms can enhance woodlands conservation.

Equally important are the methods of producing charcoal. Although, charcoal is recognized as the principle cooking fuel in Tanzania production methods leaves a lot to be desired. Charcoal production pits and earth mound kilns have very poor conversion (carbonization) efficiencies hence do not offer a satisfactory use of raw materials (Enrich and Mwihava, 1989). Thus, the traditional system of making charcoal is held responsible for significant contribution to natural forests and woodlands destruction. In the 1990s the Government through the Ministry of Energy and Minerals (MEM) in collaboration with the MNRT and other key stakeholders/partners attempted to improve and advance appropriate technologies but with little success and impact. Dissemination of charcoal making technology such as the half-orange brick kilns (Argentina type) and the Cassamance, in the Coast, Iringa and Tanga Regions did not make any notable changes in terms of adoptability (widely used) and therefore impacting positively to woodlands conservation. Cassamance, which is an improved earth kiln, is reported to attain wood-charcoal conversion efficiency of up to 40% (Ishengoma and Ngaga 2000),

CONCLUSION

The problem of meeting domestic energy needs on Tanzania mainland is not an easy one. There is no panacea or quick solutions especially for resource-constrained countries like Tanzania. Replacement of charcoal with other forms of domestic fuels such as LPG, electricity, solar or wind power would mean considerable investments (Peet, 1984) that may require substantial foreign exchange. It is also very difficult for the Government to adopt a household energy subsidy programme that could warrant wide application of alternative cooking energy sources. Hence charcoal will remain the principle source of cooking energy at least for the foreseeable future in Tanzania. This is due to the fact that alternative sources of domestic energy are available but many households cannot afford to use them (e.g. electricity) because of very low incomes. Thus, meeting clean and affordable domestic energy needs of urban households remains a challenge in the Tanzanian context. On the other hand, increased tree planting rates and establishment of large-scale energy plantations within economic distances (less than 100 km from urban centers) could ease the situation. Despite the fact that past Government efforts to establish large scale commercial charcoal production have not been successful (Emrich and Mwihava (1989) but commercial energy plantations are still considered a viable option. Any attempts to abolish using charcoal for cooking in the urban sector in the context of enhancing forests and woodlands conservation will not work or will face strong opposition. Perhaps what is required is to scale up efforts to improve charcoal production and utilization efficiencies and grow more trees for woodenergy purposes. It should be noted that the importance of the traditional fuels in the socio-economic setting in Tanzania is not decreasing but the challenges faced in meeting

demands for woodenergy are not easy to handle, as there are no simple or quick solutions due to persistent and widespread poverty conditions that exist in both rural and some urban areas.

RECOMMENDATIONS

One of the ways to solve or minimize Tanzania's household energy crisis is to have a positive attitude about it. In the short term, increased rate of forests and woodlands destruction is definitely likely to occur. The National Environmental Policy (1997) encourages energy development and use efficiency initiatives that will minimize environmental degradation. The National Forest Policy (1998) and the National Forest Development Programme (2002) both encourage enhanced domestic energy options. The Millennium Development Goals (MDGs) also encourage adoption of clean and affordable energy sources so that the poor could easily access to such energy options. To attain these it means joint efforts are needed: Energy, Forestry, Water, Agriculture and the Environment sectors to encourage more woodenergy production at all levels including aspects of improved woodenergy utilization technologies and user efficiencies. The means efforts should tailored to:

- Minimize woodenergy consumption rates through development of alternative energy sources and improving woodenergy end-use efficiencies;
- Promote sustainable renewable energy resources for instance establishment of energy plantations is considered a feasible option to sustain domestic energy requirements in Tanzania. It is important that national policies should encourage the private sector to invest heavily in energy plantations close to large urban areas like Dar-es-Salaam, Mwanza, Arusha, Mbeya and other fast growing urban centers like Iringa, Morogoro and Shinyanga. The Ruvu fuelwood pilot project in the Coast Region, about 60km west of Dar es Salaam, has demonstrated that it is possible to grow trees for energy by involving the local communities. According to Balla *et al.,* 1991 energy plantations enables the farmers to maximize benefits based on the multiple land use concept and contribute to poverty reduction through regular income. Under normal circumstances preference should be given to indigenous tree species and in trials for fuelwood plantations local species should always be given priority (National Academy of Sciences, 1983);
- Enhance energy efficiency and conservation programmes. So far providing improved energy services for the poor on Tanzania mainland has received little attention from the public and the private sectors. This also relates to establishing strong linkages between Poverty and Environmental degradation;
- Increase efforts in conservation especially through widely used improved charcoal stoves and charcoal production technologies. Is also important to encourage and popularize fuel-switch from using more charcoal to other domestic sources of energy such as LPG, Biogas, and Solar.

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