



## **Assessment of household charcoal consumption in urban areas: the case of Dar es Salaam City, Tanzania**

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### **ABSTRACT**

A study on household charcoal consumption was carried out in Ilala, Temeke, and Kinondoni Municipalities in Dar es Salaam City. Data were collected through household surveys and key informant interviews. Statistical Package for Social Sciences (SPSS) was used to analyze socio-economic characteristics, income level and charcoal consumption per month. A regression model was used to establish the relationship between socio-economic characteristics of the respondents and charcoal consumption. Results revealed that regardless of their income level, 79.8% of the respondents used charcoal as their main source of energy for cooking followed by gas (16.9%). Charcoal was found to be relatively cheaper than other sources of energy while gas was the more efficient source of energy for cooking. Results further showed that there was a positive and significant relationship between charcoal use and occupation, family size, and education level. The results also showed a negative and significant relationship between charcoal use and age. There was a positive and insignificant relationship between charcoal use and years of experience and a negative insignificant relationship between charcoal use and marital status. It is concluded that household charcoal consumption in Dar es Salaam City has increased despite an increase in price. It is recommended that the government considers subsidizing alternative sources of energy in order to reduce pressure on natural forests for the supply of charcoal.

**Key words:** Energy, charcoal, consumption, Dar es Salaam City

### **INTRODUCTION**

Many communities in developing countries use wood fuel as their major source of energy. For example, in Tanzania, most of the energy sources are not sustainable and reliable and the country is struggling to meet its energy needs and access to modern energy is still very limited (Nyoni 2014). Over the last ten years, domestic energy demand has grown rapidly due to increase in economic activities and population growth. Access to electricity and other forms of renewable energy is extremely limited and the energy balance is dominated by biomass-based fuels, particularly charcoal and firewood which are the main sources of energy in both urban and rural areas (Nyoni 2014).

Charcoal is one of the major sources of biomass energy next to firewood in terms of demand and use in Tanzania. It is produced in rural areas and consumed mainly in cities and towns (Malimbwi and Zahabu 2008; Gmünder *et al.* 2014; Nyoni 2014) while fuelwood is the main source of energy in rural areas. More than 90% of the primary energy consumed in Tanzania is from biomass. A study by CHAPOS (2002) reported that around 91% of all energy consumed in Tanzania is woodfuel. Studies have reported that wood fuel consumption in Tanzania in 2005 was about 46.2 million m<sup>3</sup> of solid round wood (Nyoni 2014). It is further estimated that more than 95% of households in Tanzania use firewood and charcoal as their source of energy for



cooking. Miombo woodlands are the source of 60-70% of the annual consumption (Monela *et al.* 1993). With increase in price of alternative energy sources, it is evident that the importance of charcoal is unlikely to decline in the near future. The country's reliance on the biomass energy indicates a potential over exploitation of natural forests and at the same time a potential extinction of tree species.

Charcoal is perceived as reliable, inexpensive and accessible compared to alternative energy sources. A study by Kaale (2005) found that charcoal was the most preferred source of energy in cities and towns because of its higher calorific value per unit weight compared to firewood. Completely carbonized charcoal with about 5% moisture content can produce up to 31.8 MJ/kg of energy compared to about 16 MJ/kg of firewood with about 15% moisture content (Kaale 2005). Given the high cost of alternative energy sources, many people, especially in urban areas are increasingly switching to charcoal (Gmünder *et al.* 2014). Furthermore, charcoal is more economical to transport over long distances compared to firewood (Malimbwi and Zahabu 2008). In Tanzania, most of the charcoal is produced in dry woodlands. These range from the *Brachystegia – Julbernardia* (miombo) and *Acacia* to savanna woodlands (Malimbwi and Zahabu 2008). However, observations in Pwani Region, Tanzania revealed that trees on farms, mainly cashew (*Anacardium occidentale*) and mango (*Mangifera indica*) and mangroves have also been used for charcoal production (Malimbwi and Zahabu 2008).

Dar es Salaam is a rapidly growing commercial city which has attracted many immigrants from all over Tanzania and beyond. The city has attracted traders dealing with various products including charcoal. It is estimated that about half of Tanzania's annual consumption of charcoal

amounting to approximately 500,000 tonnes per year takes place in Dar es Salaam City (World Bank 2009). A study by Malimbwi *et al.* (2007) estimated that the amount of charcoal entering the city was about 6,777 bags per day. Furthermore, World Bank (2009) estimated that charcoal production in Tanzania between 2001 and 2007 was about one million tonnes per year. The proportion of households in Dar es Salaam City using charcoal increased significantly from 47% to 71% over the period (World Bank 2009). The continuing increase in electricity and gas tariffs and population growth may have influenced the consumption of charcoal in cities and towns in Tanzania. No study has been conducted to estimate the amount of household charcoal consumption as a result of the rapid increase in human population in Dar es Salaam City. The main objective of this study was to assess household charcoal consumption in Dar es Salaam City.

## METHODOLOGY

### Study area description

This study was conducted in Ilala, Temeke, and Kinondoni Municipalities in Dar es Salaam City. The City is located at 6°48' South and 39°17' East (Figure 1). According to the 2012 population census, Dar es Salaam had 4,364,541 people and estimated 1,095,095 households (URT 2013).

### Sampling and data collection

In each Municipality, one ward was randomly selected for study. In Ilala municipality, Ilala ward was selected while in Temeke and Kinondoni Municipalities, Temeke and Sinza wards respectively were selected. Further, Tabata, Mbagala and Sinza C streets were selected to represent Ilala, Temeke and Sinza wards respectively. Primary data were collected through administration of household questionnaires and interview of key informants (government officials).

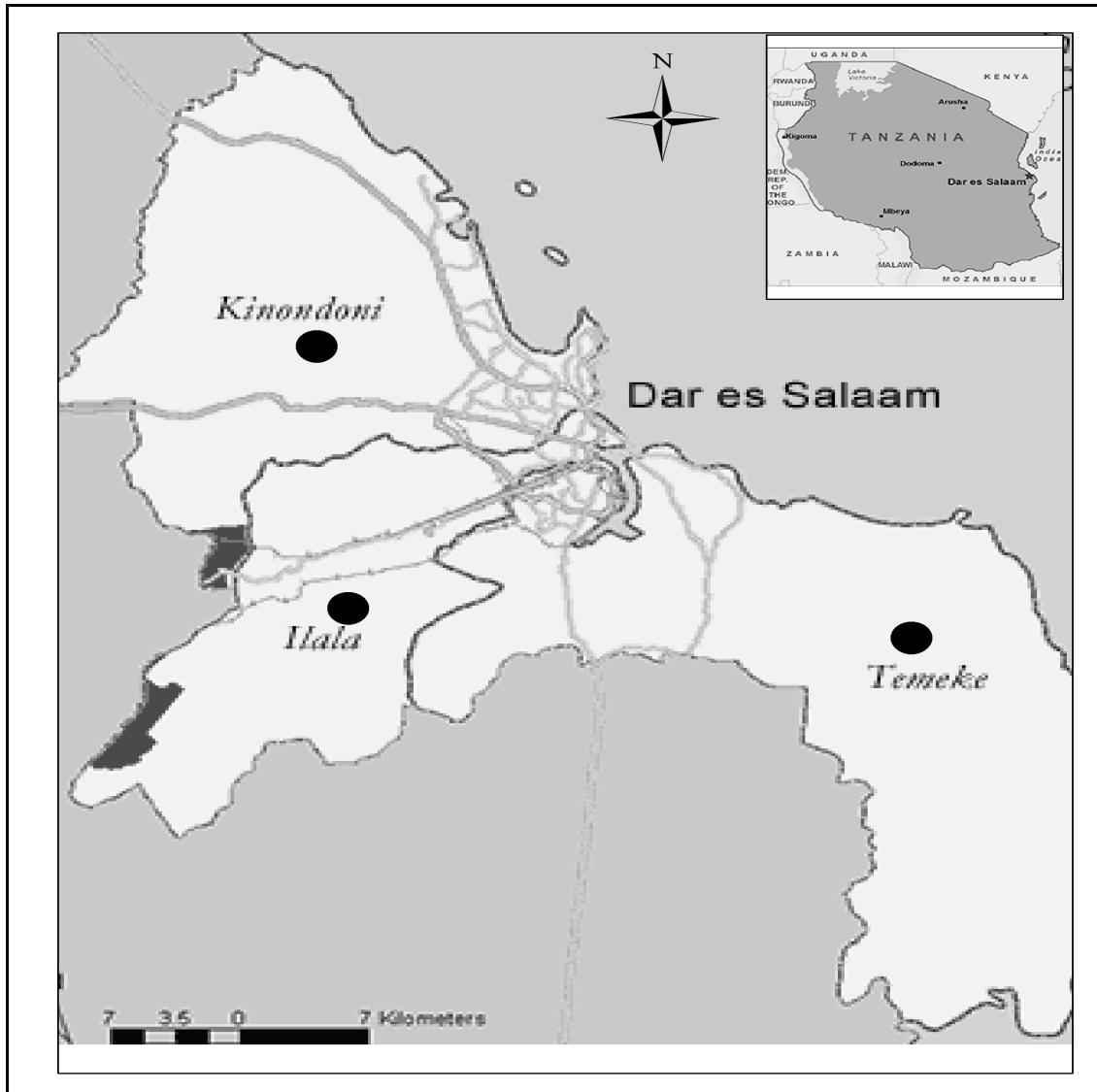


Figure 1. Map of Dares Salaam showing the study sites (Source: URT 2013)

A total of 90 households (30 households per municipality) was randomly selected for questionnaire administration. According to Bailey (1994), regardless of the population size, a sample of 30 cases is the bare minimum for studies in which statistical data analysis is to be performed. During household questionnaire administration, data on demography, income level, daily use of charcoal and the use of other sources of energy were recorded. Also, the Ministry of Natural Resources and Tourism officials at various check points were interviewed on key issues related to charcoal supply and consumption in the city. Secondary data were collected from journals, reports, books and internet.

#### **Data analysis**

Statistical Package for Social Science (SPSS) was used to summarize data on socio-economic characteristics of the respondents, their income levels and charcoal consumption per month. A regression model was used to establish the relationship between charcoal consumption and socio-economic characteristics of the respondents.



## RESULTS

### Socio-economic characteristics of the respondents

Table 1 presents the socio-economic characteristics of the respondents. The results showed that 42.4% of the respondents were below 18 years old, 66.7% were 18-45 years old while 8.9% were above 45 years old. It was found that 58.9% of the respondents had family size

ranging from 6 - 7 people, 26% had between 2 and 5 people while 14.4% had more than 7 people. About 8% of the household heads had received primary school education, 37.8% completed secondary education while 52.2% had Certificate and Diploma levels education. Only 13% of the respondents had acquired university education. About 74% of the respondent households were male-headed while 25.6% were female-headed.

Table 1. Socio-economic characteristics of respondents

Variables	Frequency (n)	Percentage (%)
<b>Gender</b>		
Female	23	25.6
Male	67	74.4
<b>Total</b>	<b>90</b>	<b>100</b>
<b>Age</b>		
<18 years	22	24.4
18-45 years	60	66.7
>45 years	8	8.9
<b>Total</b>	<b>90</b>	<b>100</b>
<b>Household size</b>		
2-5	24	26.7
6-7	53	58.9
>7	13	14.4
<b>Total</b>	<b>90</b>	<b>100</b>
<b>Education level</b>		
Primary school	7	7.8
Secondary school	34	37.8
Certificates and Diploma	47	52.2
University	12	13.3
<b>Total</b>	<b>90</b>	<b>100</b>

Source: Field data (2013).

### Household sources of domestic energy

Results showed that regardless of their wealth status, 79.8% of the respondents use charcoal as their main source of energy for cooking followed by gas (16.9%). Results further showed that only 1.1% and 2.2% of the respondents use firewood and kerosene for cooking respectively. Results also showed that the average household charcoal consumptions per month were  $1.5 \pm 0.76$ ,  $1.7 \pm 1.14$  and  $1.3 \pm 0.13$  bags of 56kg in Ilala, Temeke and Kinondoni municipalities respectively. There was no significant difference ( $F=1.58$ ,  $df = 86$ ,  $p=0.214$ ) between the amount of charcoal consumed by households in the three municipalities.

The majority (96%) of the respondents in Dar es Salaam City admitted to use charcoal in combination with other sources of energy. Furthermore, the results showed that only 1.1% of the respondents use electricity while 1.1% admitted to use both charcoal and gas as sources of energy for cooking. It was learnt that the type of energy used is closely related to income and education level. Results revealed that 80% of the respondents who use firewood and kerosene have low income living on less than US\$ 150 per month and have primary education level. Charcoal and kerosene consumers are generally low and middle income households while a combination of gas, electricity and charcoal is used by higher



income level, with more than 77% of those households earning over US\$ 500 per month. It was observed that electricity users appeared to have the highest income. In this

study, the main reasons for the energy preference differed between respondents were cost, cooking time and habit/tradition (Table 2).

Table 2. Reasons for households preference for a particular source of energy in Dar es Salaam City

Response item	Frequency (%)
Cost	53 (58.9)
Preference regardless of the cost	12 (13.3)
Little knowledge on the use of gas	3 (3.3)
Fear on the safety of gas	4 (4.4)
Cooking time	14 (15.6)
Availability of the source of energy	4 (4.4)
<b>Total</b>	<b>90 (100%)</b>

Source: Field data (2013)

Results showed that charcoal was purchased in different quantities depending on affordability of the household. The cost of charcoal varied from TZS 1,000 to 60,000 depending on the volume of the package (Plates 1a-c). For example, the price of a tin

of 3 – 5 kg (Plate 1a) ranged from TZS 1,000 to 1,500. The price of a small bag (Plate 1b) ranged from TZS 8,000 to 11,000 while the price for a big bag of over 84 kg (Plate 1c) ranged from TZS 55,000 to 60,000.



Plate 1a: 3-5 kg tin



Plate 1b: 28 kg bags



Plate 1c: ≥84 kg bags

### Relationship between socio-economic characteristics and the use the of charcoal

Results showed that there was a positive and significant relationship between charcoal use and occupation ( $\beta= 0.562$ ), family size ( $\beta =0.361$ ), education ( $\beta=0.137$ ). There was a negative and significant relationship

between age ( $\beta=-0.091$ ) charcoal use. The results also revealed that there was a positive insignificant relationship between charcoal use and years of experience of using charcoal ( $\beta=0.079$ ) and a negative and insignificant relationship between charcoal use and marital status ( $\beta=-0.076$





Table 3. Relationship between socio-economic characteristics and use the of charcoal

Variable	Unstandardized Coefficients ( $\beta$ )	Std error	Standardized Coefficients ( $\beta$ )	Std error	P-values
Constant	6.468	2.225	0.490	2.822	0.004
Age	-0.009	0.032	-.342	-1.831	0.056
Marital status	-0.076	0.353	-.026	-2.35	0.814
Occupation	0.562	0.237	0.290	2.421	0.013
Family size	0.361	0.194	2.37	2.020	0.046
Income	-1.10	0.00	-0.074	-0.503	0.548
Education level	0.137	0.083	0.206	1.656	0.082
Years of experience in charcoal use	0.079	0.067	0.136	1.304	0.232

Source: Field data (2013)

## DISCUSSION

### Socio-economic characteristics of the respondents

In this study, most of the respondents interviewed were between 18 and 45 years old middle age. It was learned that the higher the age of the household head the lower the probability of household switching to efficient fuels like gas. Mensah and Adu (2013) reported that age of the household head had a significant negative effect on the probability of switching to other sources of energy. It was observed that higher percentage of family size ranged from 6 to 7 persons. Large families in urban areas have an implication on the household fuel needs. The number of persons in the household influences the types and quality of food to be cooked, as well as the quantity of charcoal to be used. It is obvious that a household with big number of persons will use more charcoal than those with few numbers of persons. Ouedraogo (2005), in his study of household energy preferences for cooking in urban Ouagadougou in Burkina Faso, showed the existence of significant relationships between the use rates of charcoal and household size.

Population growth has historically been a major factor influencing charcoal consumption and it is not likely that the

close relationship between population growth and growth in consumption will change significantly in the foreseeable future. There has been a change in patterns of the charcoal consumption in Dar es Salaam City. Growth in population can provide a crude, but effective indicator of trends in total consumption. According to the 2012 national census, Dar es Salaam City had a population of 4,364,541 with a 5.6% average annual population growth rate. It was also the most densely populated City with 3,133 people per square kilometre (URT 2013).

Most of the respondents had either certificate or diploma level education. Education level determines the level at which the head of the household is informed. Like other socio-economic factors, education level can trigger fuel switching to charcoal, as well as the quality of charcoal that is needed in the household. These findings are similar to a study by Mekonnen and Kohlin (2009) on the determinants of household fuel choice in major cities in Ethiopia. It was found that higher percentage of the respondents interviewed were male-headed than female households.



Ogwuche and Asobo (2013) found higher percentage of male headed than female-headed households in Makurdi, Nigeria. It might be due to the fact that most of African countries have adopted patrilineal system. Sex of the head household is very important in decision making. Charcoal issues are kitchen items that are in the domain of women. Women can make better decisions about the quality and quantity needed for the household for the various types of food to be cooked than men. This implies that female headed households can make better decisions about the quality needed for the household for the types of foods to be cooked compared to men. Similarly, Ogwuche and Asobo (2013) reported that women are better managers of kitchen items (including charcoal) than men, where they are the main actors.

### **Sources of domestic energy**

The main sources of domestic energy in Dar es Salaam City are charcoal, firewood, electricity, liquid petroleum gas and kerosene. Electricity, liquid petroleum and gas are available only in urban centres, and to the wealthy members of the community. Kerosene is usually used by the low income groups for lighting. Charcoal and firewood are the main sources of heat to the majority of rural people and town dwellers. It was learnt that charcoal is the main source of cooking energy used by households in Dar es Salaam City. It was also observed that among the various form of energy source available in Dar es Salaam City, the respondents preferred charcoal to any other sources of energy. This again confirms that charcoal as a source of energy plays a vital role in household energy requirements. Furthermore, it was learned that charcoal has been used in combination with other sources of energy or on its own. Sabuhungu *et al.* (2015) reported that charcoal is either consumed by householders in combination

with other fuels or on its own in Bujumbura City in Burundi. This study found that about 96% of the respondents in Dar es Salaam City use charcoal as a main source of energy. The results are different from Malimbwi and Zahabu (2008) who found that 77.8% of the people in Dar es Salaam use charcoal as a primary source of energy. Similarly, a study by World Bank (2009) revealed that about 71% of the respondents use charcoal as their main source of energy in Tanzania. The difference might be due to increase in population in the city and high prices of other alternatives sources of energy.

The demand for woodfuel is rising due to the relatively high cost of electricity and petroleum-based fuels (e.g. kerosene) as well as the rapid human population growth, particularly in urban areas in Tanzania. Demand for woodfuel in the urban areas of developing countries is usually higher than in rural areas. One of the main reasons for this is inability of the households to have access to other sources of energy. For example, under normal conditions, high-income households use electricity and/or liquidified petroleum gas while the low-income families depend heavily on basic sources of energy such as firewood and charcoal (Serenje *et al.* 1994). Charcoal, which is hardly used in the rural areas because of availability of fuelwood, is quite popular in urban areas because of higher income and other factors such as its lightness and non-smoking nature (FAO 1993; Brouwer and Falcão 2004; Luoga *et al.* 2000). It is estimated that 75% of urban households use charcoal and all poor households use it for cooking, about 50% use charcoal for heating water for bathing and water for drinking, and 70% use charcoal for heating in cold season in some African countries (Agarwal 1986; Brouwer and Falcão 2004; Luoga *et al.* 2000). It was



noted that charcoal consumption per household per month was slightly high in Temeke municipality and low in Kinondoni municipality. This might be due to better economic situation in Kinondoni than other areas that they can afford to use other alternative sources of energy. It was further showed that no significant difference on the amount of charcoal consumed by households in the three municipalities. It implies that both higher and low income households use charcoal as source of energy the difference is the once with higher income there able to use more than one source of energy.

### **Relationship between charcoal use and socio-economic characteristics of respondents**

It was observed that increase in charcoal use was associated with an increase in family size as well as irregularity or erratic supply of the other sources of energy. It was clear that the size of the family plays a major role in determining the quantity of charcoal consumption by the household in Dar es Salaam City. This suggests that the associated economic burden of increasing family size affects households' ability to switch to cleaner fuels. Similarly, Reddy (1995) reported that although households in Bangalore, India ascend an energy ladder and the choice is largely determined by income, factors such as family size and occupation of the head of the household also influence the household's cooking fuel choice. A study by Ouedraogo (2006) found that the inertia of household cooking energy preferences in Burkina Faso were due to poverty factors such as household size, high frequency of cooking certain meals using wood fuel as cooking energy.

As expected, respondents with university education ranked the highest in terms of electricity use for both cooking and heating

and those with no formal education ranked the highest on wood use for both cooking and heating. These results are in line with Tortop (2012) who found that education had a great impact on creating awareness regarding the importance of using wood alternative sources of energy in cooking and heating. In addition, Link *et al.* (2012) maintain that education provides information on the use of alternative energy sources. Income growth permits, in the first place, purchase of improved stoves which reduce the quantity of fuelwood and then the substitution of more convenient commercial fuel. This movement will tend to be lead by urban communities where the supply price of woodfuel is higher due to transport cost and the availability of discretionary income allows the choice. Several factors may favour some future increase in the use of charcoal. For example, in parts of the developing world where fuelwood is plentiful, 2000 kg or more may be used per person per year, while in areas of scarcity, only one-quarter of that amount may be used (Eckholm *et al.* 1984). Economic factors are also, of course, a major influence on levels of consumption. According to Foley (1985), price influences the amount of fuel that is consumed, but does not have a great influence on choice between fuels. This conclusion has not answered the question of what determines the transition from wood to other fuels as a country becomes richer. Real income and an index of commercial energy prices are significant factors in relation to demand, but adjustment in consumption in response to these factors tends to be very slow and slight (Laarman and Wohlgement 1984). These authors also found that a contracting forest area was a significant variable in terms of supply, but that it had a stronger braking effect on fuelwood consumption.





## **CONCLUSIONS AND RECOMMENDATIONS**

### **Conclusions**

This study concludes that household charcoal consumption in Dar es Salaam City has increased regardless of the increase in charcoal price. Charcoal was found to be the most preferred energy source for domestic purposes among the urban households followed by gas, kerosene, and firewood in Dar es Salaam City. The majority of the respondents in Dar es Salaam City admitted to use charcoal in combination with other sources of energy. Cost, cooking time and habit/tradition were the main reasons for the energy preference by the respondents in this study. The number of persons in the household influences the types and quality of food to be cooked, as well as the quantity of charcoal to be used. It is obvious that a household with big number of persons will use more charcoal than those with few numbers of persons. Serious efforts therefore must be made by Government at all levels, forest and energy stakeholders to mitigate the pressure on the forest and its effects as result of biomass as the major source of energy for domestic purposes in Dar es Salaam City.

### **RECOMMENDATIONS**

Charcoal consumptions have direct contribution to deforestation and forest degradation and households charcoal consumption is likely to continue to increase due to the population growth in the city. Therefore, based on the results of this study, it is we recommend that the government facilitates and encourages the use of alternative sources of energy such as gas through reduction of their tariffs. As charcoal becomes an important tradable commodity, there is an opportunity for the government to recognize and regularize charcoal production by putting in place long-term plans for sustainable production,

while at the same time creating a supportive legal and economic framework for development. The weak enforcing control mechanisms to check overuse of resources, needs to be strengthened in Tanzania.

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### **REFERENCES**

- Agarwal, B. 1986. Cold hearths and barren slopes: the woodfuel crisis in the Third World. Zed Books, London.
- Bailey, K. D. 1994. Methods of Social Research. Fourth Edition. Free Press. Toronto. 588 pp.
- Brouwer, R. and Falcão, M.P. 2004. Wood fuel consumption in Maputo, Mozambique. Journal of Biomass and Bioenergy, 27(3): 233-245.
- CHAPOSA 2002. Charcoal Potential in Southern Africa. EU INCO\_DEV Project. Final Report. 88pp.
- Eckholm, E., Foley, G., Barnard, G. and Timberlake, L. 1984. Fuelwood: the energy crisis that won't go away. Earthscan, London.
- Falcão, M.P. 2008. *Charcoal production and use in Mozambique, Malawi, Tanzania, and Zambia: Historical overview, present situation and outlook*. The Conference on Charcoal and



- Communities in Africa, INBAR, Maputo, Mozambique.
- FAO 1993. A decade of wood energy activities within the Nairobi Programme of Action. Rome.
- Foley, G. 1985. Woodfuel and conventional fuel demands in developing countries. *Ambio*, 14: 253-258.
- Gmünder, S., Zah, R., Rainhard, J. and Charron-Doucet, F. 2014. Transforming Tanzania's Charcoal Sector. Life Cycle Assessment Component. Quantis. 96pp.
- Kaale, B.K. 2005. Baseline study on biomass energy conservation in Tanzania. SADC Programme for Biomass Energy Conservation (ProBEC) Report. 55pp.
- Laarman, J.G. and Wohlgement, M.K. 1984. Fuelwood consumption: a cross-country comparison. *Forest Science*, 30: 383-392.
- Link, F.C., Axinn, W.G. and Ghimire, D.J. 2012. Household energy consumption: community context and the fuel wood transition. *Soc. Sci. Res.* 41:598-611.
- Luoga E.J., Witkowski, E.T.F. and Balkwill, K. 2000. Economics of charcoal production in miombo woodlands of eastern Tanzania: some hidden costs associated with commercialisation of the resources. *Ecological Economics*, 35:243-257.
- Malimbwi, R., Zahabu, E. and Mchome, B. 2007. Situation analysis of charcoal sector in Dar es Salaam. Consultancy report submitted to WWF. Tanzania. 48pp.
- Malimbwi, R.E. and Zahabu, E.M. 2008. Woodlands and the charcoal trade: the case of Dar es Salaam City. Research and development for sustainable management of semiarid miombo woodlands in East Africa. Working Papers of the Finnish Forest Research Institute, 98: 93-114.
- Mekonnen, A. and Kohlin, G. 2009. Determinants of Household Fuel Choice in Major Cities in Ethiopia. Working Papers in Economics No 399, University of Gothenburg, Sweden.
- Mensah, J. and Adu, G. 2013. An empirical Analysis of household energy choice in Ghana. Working Paper Series 2013. 30pp.
- Monela, G.C., OKtingáti, A. and Kiwele, P.M. 1993. Socio-economic aspects of charcoal consumption and environmental consequences along Dar es Salaam - Morogoro highway, Tanzania. *Journal of Forest Ecology and Management*, 58:249-258.
- Nyoni, J. 2014. Mandate 2: Knowledge, Attitude and Perception Study of the Biomass Energy Sector. Final report submitted to the Swiss Agency for Development and Cooperation Swiss Cooperation Office, Dar es Salaam, Tanzania. 132pp.
- Ogwuche, J.A. and Asobo, V. 2013. Assessment of Socio-economic Factors Affecting Household Charcoal use in Makurdi Urban Area of Benue State, Nigeria. *E3 Journal of Environmental Research and Management*, 3(7): 0180-0188.
- Ouedraogo, B. 2006. Household Energy Preferences for cooking in Urban



- Ouagadougou Burkina Faso. Energy policy, 34: 3787–3795.
- Ouedraogo, B. 2006. Household energy preferences for cooking in urban Ouagadougou, Burkina Faso. Energy Policy, 34: 3787-3795.
- Palmula, S. and Beaudin, M. 2007. Greening the Charcoal-Chain Substituting for Charcoal as a Household Cooking Fuel in Dar es Salaam. Poverty Reduction and Environmental Management (PREM), Institute for Environmental Studies. Vrije Universiteit, Amsterdam, The Netherlands.
- Reddy, B.S. 1995. A Multilogit Model for Fuel Shifts in the Domestic Sector. Energy, 20(9): 929-936.
- Sabuhungu, E.G., Ndimanya, P. and Lebailly, P. 2015. An Analysis of the Urban Consumption of Charcoal by Household: The Case of the City of Bujumbura in Burundi. International Review of Research in Emerging Markets and the Global Economy (IRREM), 1(3): 430-440.
- Serenje, W., Chidumayo, E.N., Egneus, H. and Elegard, A. 1994. Environmental impact assessment of the charcoal production and utilization system in Central Zambia: Stockholm Environment Institute (SEI): Energy, Environment and Development Series no. 32, Stockholm, Sweden.
- Tortop, H.S. 2012. Awareness and misconceptions of high school students about renewable energy resources and applications: Turkey case. Energy Educ. Sci. Technol. Part B: Soc. Educ. Stud. 4:1829-1840.
- URT, 2013. 2012-Tanzania Population and Housing Census. Population Distribution by Administrative Areas, National Bureau of Statistics, Dar es Salaam. 244p.
- World Bank 2009. Environmental crisis or Sustainable development opportunity? Transforming the charcoal sector in Tanzania. A policy note. 72pp