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INCREASE IN DEFORESTATION: A KEY CHALLENGE TO HOUSEHOLD CHARCOAL SUPPLY – A CASE OF TANGA URBAN, TANZANIA

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Abstract:
This study investigated an increase in deforestation and its impact in charcoal supply for households in Tanga district (urban). Tanga district was chosen because it has high urban population as compared to her neighbor Districts of Muheza and Mkinga. The district was also chosen because it is so close to natural and reserved forests in both Muheza and Mkinga districts in which effect of deforestation on charcoal supply can be clearly seen and determined. The study involved 61 respondents including (households, charcoal venders and forest officer). Questionnaire survey, interview and documentary review methods were employed in data collection. A quantitative data were analyzed using Statistical Package for Social Sciences (SPSS 20th version). While qualitative information was analyzed using content analysis. The study findings show that majority 56 (92%) of the respondents reported that there is high rate of deforestation which was mainly contributed by charcoal production in the study area. The study further revealed that the observed high rate of deforestation affect the availability and supply of charcoal for domestic use. The scarcity of charcoal coupled with high and fluctuating price give the evidence on presence domestic energy crisis in the study area. Along with other recommendations, the study recommends that the Government Regulator (Energy and Water Utilities Regulatory Authorities - EWURA) should consider reducing tariff on other sources of energy particularly gas and electricity to allow many people afford and resorting to alternative energies for their domestic use and hence reduce the extent of deforestation.

Keywords: deforestation, household charcoal consumption, fuel wood crisis

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JEL: Q23, Q21, R23

1. Introduction

Historically, forests have played a major role to influence patterns of economic development, supporting livelihoods, helping structure economic change, and promoting sustainable growth (UN, 2013). Forests are more than trees, are fundamental for food security, and improved livelihoods (FAO, 2016). The forests of the future will increase the resilience of communities by: providing food, wood energy, shelter, fodder and fiber; generating income and employment to allow communities and societies to prosper; and harboring biodiversity (Ibid). They will support sustainable agriculture and human well-being by stabilizing soils and climate, and regulating water flows (FAO, 2016). Forests also provide substantial levels of employment whereas more than 13 million people are employed in forest formal and informal sector (UN, 2013). Forests are also very potential in reduction of total greenhouse gas emissions produced from other sectors of economy (Ibid).

Forests cover almost third of the earth's land surface (FAO, 2010). In Africa forests currently cover about 23% of the land, however about 75% of hectors of forestland converted to other uses between 1990 and 2010 (FAO, 2012). Tanzania has about 48 million ha of forest cover which is approximately 55% of her forest, woodland cover provides people with various benefits, and services (Malimbwi, 2014) cited in Kessy *et al* (2016).

However, there is significant change in ability of forests to provide important goods and service including employment, wood products, non-wood forest products and services (FAO, 2016). It was indicated that, natural forest area is decreasing, the global annual net loss of natural forests decreased from some 10.6 million ha in the 1990s to 6.5 million ha between 2010 and 2015 (Ibid).

Indirectly deforestation has been influenced by Population growth, while agriculture, logging, mining, oil extraction, urbanization, wood fuel production and acidic rain being the direct cause (FAO, 2007). According to the United Nations Framework Convention on Climate Change (UNFCCC), about 80% of deforestation is resulted from need of agricultural land (Goldstein, 2016). In Democratic Republic of Congo for example, agriculture appears to be the main driver of deforestation and its impact will likely increase as the population grow (Tchatchou *et al*, 2015). Operationally, logging can interact with other drivers of deforestation, in many instances logging creates partially cleared areas, which become accessible by logging roads, and can therefore be more easily converted to agriculture, preventing the forest

from growing back (Boucher *et al*, 2011). Illegal logging on the other hand increase the extent of deforestation as it undermines governmental regulations and hence destroys large parts of the forest, because, unlike the legal logging, it is hardly ever paired with reforestation efforts (Goldstein, 2016). Therefore, the paper set out to examine the relationship between deforestation and wood fuel (charcoal) crisis in Tanga District-Tanzania.

3. Overview of the Study

3.1 Extent and Rate of Deforestation

Definitions of deforestation vary, because deforestation is not official until tree cover has fallen below the national thresholds for forest (WRI, 2000). Deforestation can be defined as the conversion of forested areas to non-forest land through cutting, clearing, and removal of rainforest or related ecosystems into less bio diverse ecosystems such as pasture, cropland, or plantations, urban use, logged area, or wasteland (Kricher, 1997) Cited in (Mahbub, 2008). Deforestation can also be defined broadly to include not only conversion to non-forest, but also degradation that reduces forest quality, the density and structure of the trees, the ecological services supplied, the biomass of plants and animals, the species diversity and the genetic diversity (Mahbub, 2008).

Deforestation and forest degradation therefore are undoubtedly part of the largest environmental problems facing the world today, of which the 16 million square kilometers of forest that once covered the earth's surface; only 6.2 million remain up to date, 2.3 million have been destroyed between 2000 and 2012 (Goldstein,2016). Statistics show that there is net annual loss of 56.3 million hectares of forest cover all over the world (FAO, 2003; WRI, 2000). Study by CIFOR, (2001), show that tropical forests are being destroyed in an alarming rate all over the world. Estimates show that more than 5 million hectares are being converted into poorly managed secondary vegetation and it was projected that forest cover will continue to be depleted at more or less rates in the year 2020 (FOSA, 2003). If the current rate of deforestation continues, the world's rain forests will vanish within 100 years causing unknown effects on global climate and eliminating the majority of plant and animal species on the planet (Ibid).

Although developed countries in Europe also suffer deforestation resulting from acidic rain caused by industrial pollution, they are highly concerned with environmental management and conservation leaving deforestation problem to be a major challenge to development of developing countries than developed (FAO, 1982). In western Europe for example, deforestation rates declined as a result of several factors, such as improvements in the productivity of existing agricultural land; an

increase in timber imports from other parts of the world; and the replacement of wood fuel by coal as the main source of fuel (FAO, 2016).

In third world countries, more than 11 million hectares of forest are cleared annually (WRI, 2000). At regional level, South America suffered the largest net loss of forests between 2000 and 2010 whereas about 4.0 million hectares of forest cleared per year, followed by Africa, which lost 3.4 million hectares annually (FAO, 2010). Country wise, Burundi reported to be the second largest country with high deforestation rate in the world, followed by Togo and Mauritania (Rademaekers *et al*, 2010). Other country with high deforestation rate in Africa includes: Ivory Coast with 5% per year and Nigeria with 6% per year (WRI, 2000).

Tanzania has about 48 million ha of forest cover which is approximately 55% of her forest and woodland cover, however, this amount of forests cover expected to be reduced to 28.4 million hectares by the year 2020 (FAO, 2003; Malimbwi, 2014). Although the rate of deforestation is increasing yearly, the precise extent cannot accurately be measured due to the remoteness of many areas from which the forest is removed. National forest inventories are frequently outdated and non-comparable; many forest conversions go unrecorded or are illegal (WRI, 2000). In Tanzania for example, there is an agreement that the country is deforested but there is no agreement on the extent of depletion as there is a wide variation in data explaining the extent of forest depletion (Ministry of Land Natural Resources and Tourism, 1989). Despite the disagreement on the extent of deforestation, various studies show that there is widespread loss of trees in most parts of the country (Nkonoki, 1983; Kikula, 1988; Reeds, 1996, Malimbwi, 2014; Lusambo; 2016).

3.2 Situation of Charcoal Consumption

Traditional sources of energy in the form of firewood and charcoal account for over 80% of the total energy use in sub-Saharan Africa (Belward *et al*, 2011). Charcoal meets most of the gap and more than 95% of the urban demand (Ibid). Global production of wood charcoal was estimated to be 47 million metric tons in 2011(FAO 2013). Since 2003, global production of charcoal has increased by 11% whereas more than 80% of this wood-based energy is used for domestic purposes; due to population growth coupled with increasing urbanization (Ibid).

Recently, there is decline in wood fuel consumption in developed countries due to increase in use of fossils fuel (FAO 2014). Thus, wood fuel remains the important source of energy for developing countries particularly for poor people (Ibid). Statistics show that global charcoal consumption is 45% million ton/year, with a great variation across the region whereas Africa consume 27% million ton/year, Latin America and the

Caribbean 17%, Asia and Oceania 5% ton/year, (FAO, 2014). It was indicated that Africa has higher household biomass energy consumption than other developing regions due to presence of higher share of fuel wood and other biomass as compared to Asia and South America (UN, 1999). In SADC Region, it was indicated that more than 60 million people rely upon biomass in form of charcoal and firewood for their household use (Munslow *et al*, 1988). About 91% of Ugandans both household and public institutions use wood -based energy for cooking, lighting and baking (Alvarez *et al*, 2014).

In Tanzania, fire wood and charcoal accounts for 91% of total domestic use (Nkonoki, 1983; Mnzava, 1984; Alvarez *et al*, 2014; Lusambo, 2016). Tanzanian energy balance is dominated by biomass-based fuels, particularly firewood and charcoal which account for more than 90% of primary energy supply (Lusambo, 2016). It was estimated that with the rapid population growth, urbanization and the increase in cost of alternative fuels, the demand for charcoal is expected to double in Africa by 2030 (Arnold *et al*. 2006; GiZ, 2009). The status of energy consumption in Tanzania as other developing countries is highly characterized by low per capital income that indicating presence of wood fuel crisis (Nkonoki, 1983; Kjellstrom, 1992).

3.3 Wood fuel crisis

The wood fuel crisis appeared to be a classic case of rising energy demand outstripping supply. Although the resources in this case were renewable, unlike oil, gas and coal they were apparently being over-used at unsustainable rates (Mearns and Leach, 1989). The dynamics of the fuel wood situation in Africa represent a growing crisis, whereas population pressure coupled with increased in rate of deforestation has created acute wood-fuel shortages in most of Sub Saharan African Countries (Schandorf, 1990). Africa has the highest birth -rate of any continent and also the world's highest urbanization rates with an average urban growth rate of 4% per year (Belward *et al*, 2011). The growth in urban population is directly linked to a growth in charcoal demand. Every 1% increase in the level of urbanization is estimated to result in a 14% increase in the consumption of charcoal (ibid).

Statistics show that in 1980, 55 million people in Sub- Saharan Africa lived in areas where there was acute fuel wood scarcity and another 146 million lived in areas with an increasing deficit, it is estimated that by the year 2000 about 535 million people will experience a critical fuel wood deficit if exploitation of forest continues at the current rate (Schandorf, 1990).

Evidence of fuel wood crisis in Tanzania is shown by annual fuel wood deficit of 18 million cubic meters in 1983 which forecasted to reach 25 cubic meters in 1985 (Nkonoki, 1983). The wood deficit was expected to continue to grow at a rate of 19.5m^3

in 2012 and will continue to increase to 47.2 million m^3 in year 2030 (Ishengoma, 2015). Commercialization of fuel wood is increasingly entering the commercial sector in the big towns and other small rural based township where most of household rely on charcoal/fire wood for their domestic use (Nkonoki, 1983; Kaale, 1985). In Zambia for example, Ministry of Tourism, Environment and Natural Resources (2007) indicates that extended droughts and an increasing prospect of forest fires threaten the country's forests and could reduce the availability of biomass as a local energy source, directly affecting low income families that depend on biomass for cooking and lighting.

Despite the increase in demand of fuel wood in Tanzania there is no plan to sustain the supply. The situation that lead to fuel wood crisis (Mwandosya and Luhanga, 1983; Mnzava, 1984). The overview of Tanzania energy policy (1992), show that fuel wood as non-commercial energy is not given much attention despite the fact that it is a dominant source of domestic energy for more than 90% of the population in the country (Kjellstrom, et al, 1992). Dewees (1989), argue that fuel wood scarcity could result into increased deforestation, changes in cooking and eating habits, and the emergence of fuel wood markets. This is particular true from the study area where various charcoal market centers have been established in Tanga Urban. Jones, (2015) commented that large charcoal markets for example, have evolved across Liberia, leads to the increase in transportation of charcoal from the interior to the coastal urban center for shipment to neighboring countries.

The scarcity of wood fuel and the rapidly growing population has encouraged an alarming rate of deforestation that manifested itself in wood fuel (charcoal/ fire wood) crisis. The situation will in turn jeopardize livelihood of many people in developing countries especially in Sub-Saharan due to the fact that over 80 percent of households are still heavily rely on traditional fuels (IEA 2010). Mearns and Leach, (1989) claimed that, in rural areas, the distance and time to collect wood fuels is commonly used as the yardstick of scarcity and the need for remedies. For urban centers, it is commonly assumed that wood fuel prices will rise as forest stocks are depleted and the transport distance from the city to its main wood fuel resources lengthens.

4. Methodology

4.1 Study design

The study used case study research design. Miles and Huberman (1994) define a case study as the investigation of a phenomenon occurring within a specific context. Furthermore, Gall, Gall & Borg (2007), Case study has been chosen so as to save time and obtain in depth information about the increase in deforestation a key challenge in

household charcoal supply. Both qualitative and quantitative research approach were used.

4.2 Study area

The study was conducted in Tanga urban district, one of the districts in Tanga Region. The District has been chosen because of the researcher's familiarity, high population compared to other districts and numerous forests in the neighbor districts (Muheza and Mkinga).

4.3 Study population

Population is defined as the total number of subjects or the total elements of interest to researcher (Kothari, 2004). In this study, the target population was both men and women from the selected household randomly. The choice of both genders is due to the fact that the group has more chance of making decision as far as domestic energy consumption concerned. The study also involved charcoal venders from Tanga Urban and forest officer who had enough knowledge and experience concerned forest and charcoal production.

4.4 Sample size and sampling procedures

In this paper, simple random sampling procedure was used in selecting the required number of household members form the study area. In other hand Purposive sampling procedure used in obtaining key informants such as forest officer (Tanga district) and charcoal venders from the study area, because they were considered by researcher to be more knowledgeable about the cultural arena of the study area.

4.5 Data collection methods

In this paper questionnaire survey, interview and documentary review methods were used in data collection. For example survey method was used in capturing information of 61 household members (including men and women) relaying in charcoal use. Interview was used in capturing data like extent of charcoal production in deforestation, the price of charcoal and the current situation of charcoal availability that could not captured through questionnaire. Data obtained through household questionnaire analyzed quantitatively while information captured through interview analyzed qualitatively.

5. Results and Discussion

The findings on deforestation a key challenge to household charcoal supply were discussed as follows.

The respondents were asked whether charcoal production contribute to deforestation or not. The findings revealed that 56 (92%) of the respondents agreed that charcoal making contribute largely to the loss of forests compared to 5(8%) who disagreed with the statement (Figure 1). Equally, in Paraguay the production of charcoal and the harvesting of firewood are considered as the key drivers of degradation and devastation of forests after agricultural expansion (Alvarez *et al*, (2014).

Probably it attributed by the increase of charcoal demand in urban household for domestic use including cooking, boiling water and ironing clothes. Contrary to this study, Jones (2015) suggested that, charcoal production is not an initial driver of deforestation, but it follows timber harvesting. Similarly, Regional studies by WRI (2000) indicated that two thirds of wood fuel (charcoal) worldwide comes from non-forest sources that includes alternative sources for collecting fuel wood; from logging, wood industries residues and from agroindustry plantations.

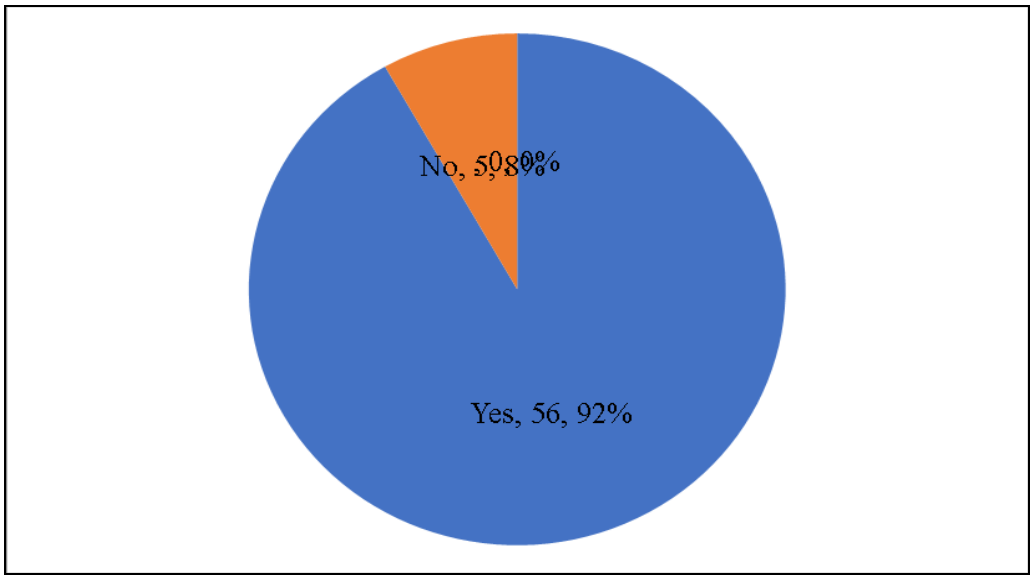

Figure 1: The contribution of charcoal making in deforestation

Source: Field data, 2017

5.1 The extent to which charcoal production cause deforestation

The respondents were further asked to state the extent to which charcoal production leads deforestation. The study observed that, 28 (45.9%) of the respondents reported

that charcoal production in large extent cause deforestation (Figure2). This implies that the increase in demand of charcoal for urban dwellers associated with deforestation in rural areas. Similarly, the study by Sedano *et al* (2016) in Mozambique revealed that, in areas where charcoal produced in large extent the rate of deforestation is highly contributed by charcoal production rather than agricultural expansion.

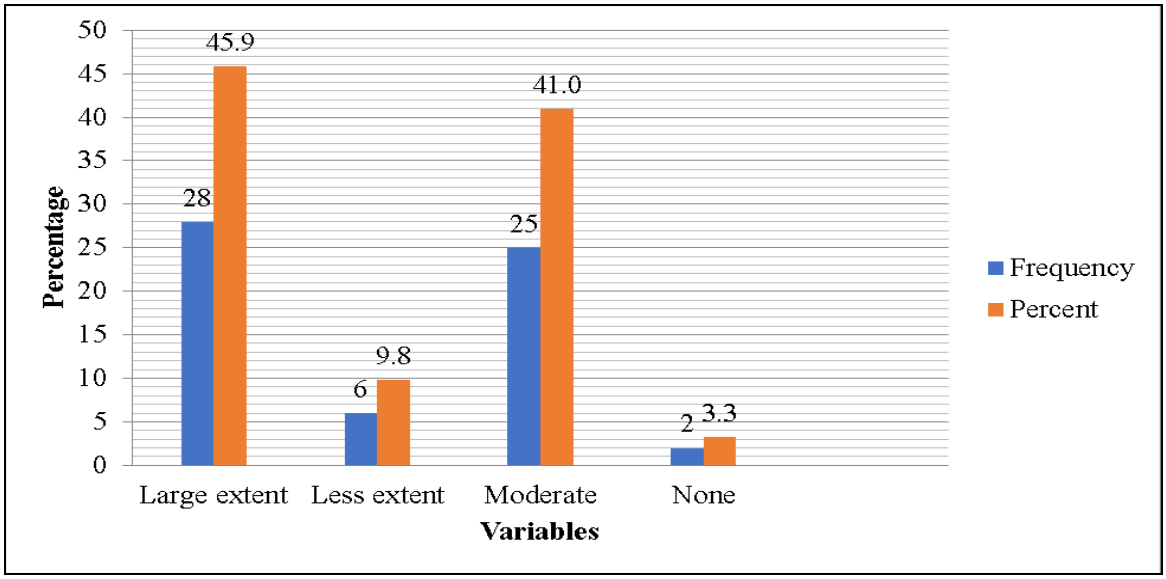

Figure 2: The extent to which charcoal making degrade environment

Source: Field data, 2017

5.2 Types of energy used in the study area

The study also was investigated the types of domestic energy often preferred in the study area. The result indicated that many respondents 45 (73.8%) rely on charcoal, 10 (16.4%) gas, kerosene 3 (4.9%), firewood 2 (3.3%) while 1 (1.6%) of the respondent use Electricity (Table 1). Equally, the study by Kambewa *et al* (2007) in Malawi shows that, larger cities consume about 6.08 million standard bags of charcoal per year. CHAPOSA (2002) reported that in Lusaka (Zambia), 65% of the households used charcoal as the only energy source while the rest of the households used charcoal in combination with firewood (23%), kerosene (17%) and electricity (1%). As for Dar es Salaam, 86% of the households used charcoal as their first choice fuel for cooking. But, most of the households (88%) combine two or more types of fuels (Ishengoma and Ngaga, 2000). Contrary to this in developed countries (Western Europe and North America) there is decrease in per capita household wood (charcoal /firewood) consumption due to increase in use of fossils fuel (FAO, 2013).

Table 1: Types of Energy used in the study area

Energy types	Frequency	Percentage
Charcoal	45	73.8
Fire wood	2	3.3
Kerosene	3	4.9
Gas	10	16.4
Electricity	1	1.6
Total	**61**	**100**

Source: Field data, 2017

5.3 The charcoal availability

The increase of charcoal consumption in urban areas tends to affect natural and artificial forest in Tanzania and Tanga specific where the study was conducted. The study investigated the current availability of charcoal. The respondents were asked whether charcoal is more available or not. The study findings revealed that 53 (86.9%) of the respondents reported that currently there are difficult in obtaining charcoal for domestic use (Figure 3). Equally, during interview, the charcoal venders made a statement that reflects the real situation of charcoal availability in the study area**.** They had this to say:

> *"It is difficult in obtaining charcoal for selling due to loss of trees that impacted to the increase in distance from where charcoal produced"*

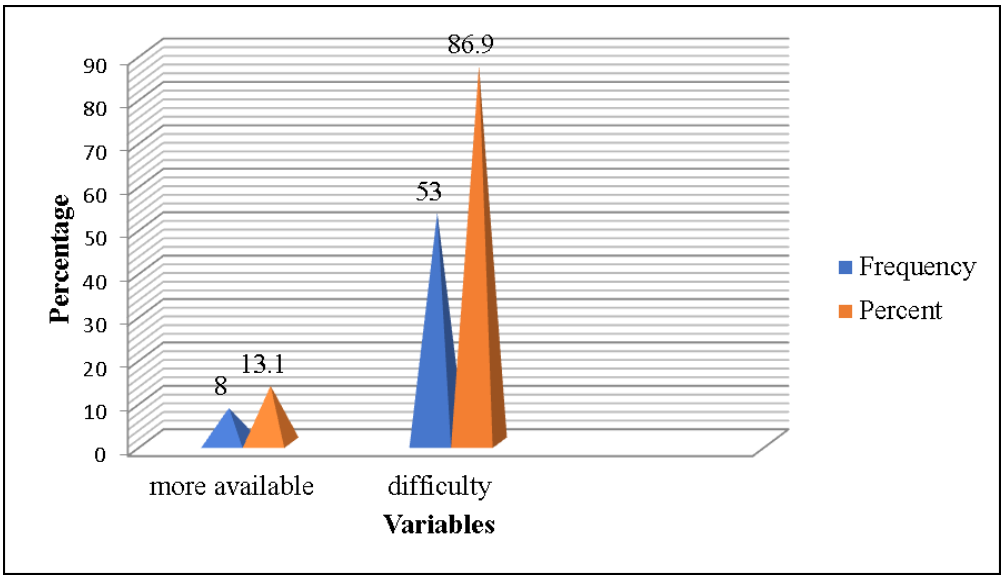

Figure 3: Charcoal Availability

Source: Field data, 2017

5.4 Factors influencing charcoal scarcity

The respondents were asked to mention the factors for difficultness in obtaining charcoal for domestic use**.** The following factors: deforestation, poor technology and exportation of charcoal to neighbor countries were outlined (Table 2).

5.4.1 Deforestation

The study findings revealed that deforestation is a key driver to the fuel wood (charcoal) crisis in the study area where as 57 (93.4%) of the respondents reported that forest depletion affects charcoal availability. The study by Dewees (1989) and Heltberg *et al*. (2000), revealed the same that, deforestation has created a situation of fuel wood scarcity to the point that an impending "fuel wood crisis" as observed in many areas where charcoal is the source of domestic energy.

5.4.2 Poor Charcoal Making Technology

The study observed that 2 (3.3%) of the respondents commented that lack of modern tools and the use of traditional method of charcoal making results into shortage of charcoal in the market. The study by Girard, (2002), observed the same that traditional methods of charcoal production that are still persist today in many developing countries, are often produce very low yields (typically 1 kg of charcoal from 8 to 12 kg or more of wood), with low quality of charcoal product because it is difficult to maintain uniform carbonization.

Table 2: Reasons for difficulties in obtaining charcoal

Reasons	Frequency	Percentage
Deforestation	57	93.4
Poor technology	2	3.3
Exportation of charcoal to neighbor countries	1	1.6
None	1	1.6
Total	61	100

Source: field data, 2017

5.5 Status of charcoal price in the study area

This study revealed that the price of charcoal is highly determined by climatic condition and distance from which the charcoal is being produced. The study findings show 54% of respondents admitted that currently the price of Charcoal is very high as compared to the previous time, while 41% claimed that the price of charcoal is fairly moderate but fluctuating seasonally (Figure, 4). The findings correspond to what has been raised

during Interview with charcoal venders. The charcoal vender made the following statement that reflects the price of charcoal in Tanga urban City:

> *".....the price of charcoal varies from 30,000 to 50,000/bag, but the price can change seasonally, ie during rainy season the price become a bit higher when compared with dry season"*

This trend was equally shown by Schaafsma *et al* (2012), that the price of charcoal varies from TSH 4000 to TSH 45,000 per 60 kg bag across the study area (Dar es Salaam, Arusha, Morogoro and Tanga) with a mean price of TSH 30,088 (USD 21) per bag in Dar es Salaam and TSH 16,584 (USD 12) elsewhere. Likewise, observation of the charcoal price in Maputo (Mozambique) and Kwazulu (South Africa) support the findings of this study as 1 ton of charcoal sold around 400 USD in Maputo and 732 USD per ton in (KwaZulu-Natal (GiZ, 2009). The study also found that there was price fluctuation in the study area that occurs when charcoal production hampered by rainy season. The study further noted that despite the increase in charcoal price in the study area many household (73.8%) still rely on it as the price of other sources energy are extremely high when compared to charcoal. This was equally observed by GiZ, (2009), that most of household in the cities of Africa, prefer charcoal for their domestic use because the price of charcoal is often lower when compared with other types of energy and can be purchased in small quantities for very little money on a daily.

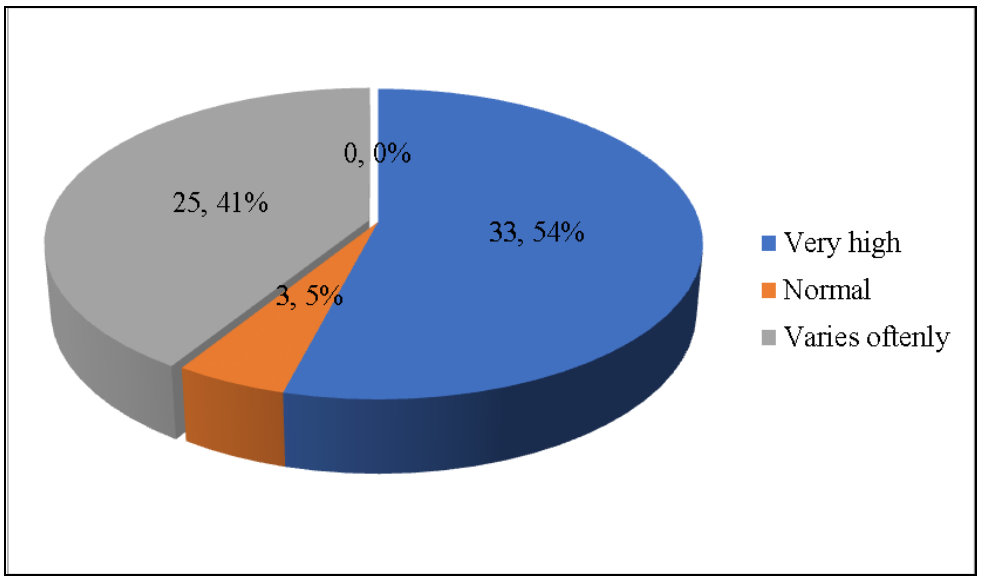

Figure 4: The current price of charcoal

Source: Field data, 2017

5.6 Household Charcoal Consumption per Month

Charcoal is the main energy source for Tanzania's urban population regardless the household economic status, although electricity and gas are the principal energy sources among wealthier households, these households still use considerable quantities of charcoal (World Bank, 2009). The findings of this study show that 52.5% of respondents consume 1 bag of charcoal per month while 34.4% claimed to consume less than 1 bag per month. Probably this trend of charcoal consumption resulted from the observed high and fluctuating price of charcoal coupled with the difficultness in obtaining charcoal from production site. Contrary to this study World Bank (2009), shows that there is an increase in consumption of charcoal in Dar es Salaam city from 1,500 tons per day. This figure estimated to rise to 3,300 tons per day by 2030.

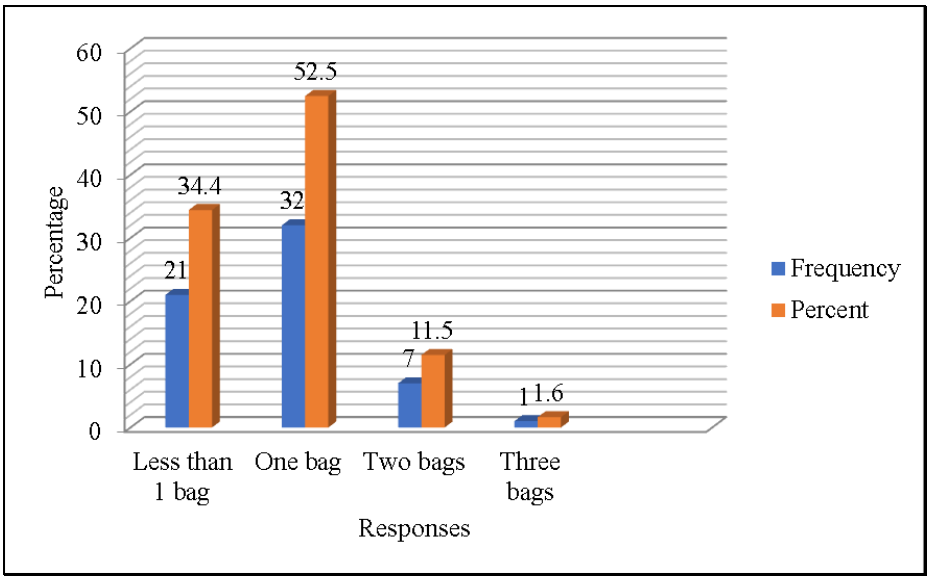

Figure 6: Charcoal consumption per month

Source: Field data, 2017

5.7 The influence of deforestation in charcoal production

The respondents were further asked to state how deforestation affects charcoal production. The study findings revealed that 56 (50%) of the respondents acknowledged that deforestation contribute largely to the decrease in raw materials for charcoal production, while 29 (25.9%) reported that deforestation leads to fluctuation of charcoal price and 27 (24.1%) admitted that deforestation contribute to the decrease in charcoal business (Table 3). This signifies that forest depletion is the main source of insufficient household charcoal supply in the study area. Contrary, Fontodji *et al* (2011) observed that, in Togo, charcoal production is greatly concentrated in the Plateaus, Central, and Savanna. It is in those regions that there is still enough vegetation, mostly in the Plateaus Region because of its forests.

Table 3: The effect of deforestation in charcoal production

Variables	Responses	
	Frequency	Percentage
Decrease in raw materials for charcoal production	56	50
Fluctuation of charcoal price	29	25.9
Decrease in charcoal dealers	27	24.1
Total	112	100

Source: Field data, 2017

5.8 Other Deforestation environmental effects:

The findings of this study noted that deforestation is not only the main cause of fuel wood crisis but also is responsible for other environmental effects including drought/floods, global warming, loss of biodiversity and indirectly hunger and starvation (Table 4). The study was equally supported by Gervert, (2007) who acknowledged that deforestation is not only convert forestland to non-forest, but also degradation that reduces forest quality, the density and structure of trees, the ecological services supplied, the biomass of plants and animals, the species diversity and the genetic diversity.

Table 4: Other effect of deforestation in environment

	Responses	
	Frequency	Percentage
Drought/Floods	56	40.9
Global warming	31	22.6
Hunger and starvation	26	19
Loss of biodiversity	24	17.5
Total	137	100

Source: Field data, 2017

6. Conclusion and Recommendation

6.1 Conclusion

Deforestation becomes a key challenge in charcoal supply in urban households. The scarcity of charcoal that caused by depletion of forest resources affect lower income earners who depend largely in charcoal for domestic use including cooking, boiling water for drinking and ironing clothes. The study found that majority of the respondents reported that currently there is scarcity of charcoal for domestic use. The main factor associated with charcoal scarcity includes depletion of forest that influence an increase in distance through which charcoal produced, as a result increase in

difficult in obtaining charcoal and price. Thus, more work is still needed to be done in this area.

6.2 Recommendations

- There is a need of integrating forest and energy polices in order to achieve the benefits that forest can offer and hence contribute in solving the problem of charcoal crisis.
- The Government should provide subsidies to charcoal makers in order to enable them to plant and care tree seedling for sustainable forest conservation.
- There is a need to raise awareness to the community on the importance of using other biomass energy such as animal dung and crop residue wherever they are available.
- Improve the efficient of wood production and use. These efforts include not only promotion of efficient wood stoves but also development of more modern energy production systems such as the use of wood and sisal waste for electricity production.
- The energy policy should consider the use of modern stoves in terms of supply and price so that local community can afford, this will reduce the amount of charcoal required for cooking.
- The Government should speed process of gas production and supply with affordable price.
- The Government should put in place series of interventions aiming at improving economic status of rural and urban poor, so as to enable charcoal dealers to resort in other income generating activities.
- Improve agricultural production through re-introduction of agricultural subsidies and ensure market for the obtained product. This will reduce the number of charcoal dealers (Charcoal produces and traders) who normal resort to charcoal business when agricultural production failed.

6.3 Areas for further studies

The study recommends the following area to be researched: Integrated strategies for sustainable forest conservation and charcoal production

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