



SOCIO-ECONOMIC AND ENVIRONMENTAL IMPACT OF CHARCOAL PRODUCTION IN RANGIRO, CYATO AND BUSHEKERI SECTORS, NYAMASHEKE DISTRICT

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ABSTRACT

This study is entitled ‘Socio-economic and environmental impact of charcoal production in Nyamasheke District particularly in Rangiro, Cyato and Bushekeri sectors. Generally the study assessed socio-economic and environmental impact of charcoal production in Nyamasheke District particularly in Rangiro, Cyato and Bushekeri sectors. Specifically examined the methods of charcoal production; identified the basis for involvement in charcoal production; analysed socio-economic impact of charcoal on rural well-being; and analysed the perception of Rangiro, Cyato and Bushekeri inhabitants on impact of charcoal production on environment. A survey instrument was administered to 88 charcoal makers randomly sampled across the community in Bushekeri, Cyato and Rangiro sectors. Additionally, in-depth interview with local leaders were conducted. Both descriptive and inferential statistics were used for analyzing data. The study findings revealed that reasons responsible for engagement in charcoal production were rated above 50%, it was concluded that charcoal makers involves in charcoal making as they regard this business as their daily activity and in it they additional income is generated. Moreover, it was revealed that all respondents confirmed that the price of charcoal per sac is from 4000 Rwf and above which simply signifies reason for deep involvement in charcoal making and this was also confirmed by 91% of informants who clarified that charcoal production positively affects

economy. Yet, it was noted that any type of environment-related impact like complete loss of forest cover, permanent reduction in the density of the forest, removal of vegetation cover, thinning of woodlands are all recognized by charcoal makers in three sectors: Rangiro, Bushekeli and Cyato and the researcher concludes that there is a need to implement adequate measures regarding charcoal production given the sustenance of environment since the mean calculated (84) itself reveals closeness to the frequencies being referred to. Moreover, the research revealed that there is a need to sensitize the population to implement other income generating projects more than charcoal making in case modern methods are unavailable in order to stop massive cutting of trees.

Key words: Charcoal making, environmental degradation, Cyato, Rangiro, Bushekeli.

1. Background of the study

According to (Hosier, 1993) wood as fuel is considered to be the first energy resource used by human and with charcoal are the most globally used. Furthermore, according to (van Beukering et al, 2007) 30,000 years ago commonly in cave drawings the natural wood charcoal has been used as energy source. According to (FAO, 2007), globally 3.3 m³ of wood is used annually as energy source more than other biomass. In addition in developing countries especially rural areas over 2 billion people still rely on fuel wood as their main energy source (FAO, 2010). This energy source estimated at 47 million metric tons; with 9% increase since 2004 (FAO 2009). Both fuel wood and charcoal provide more than 14% of the world's total energy production and this show how important those energy resources are especially in developing countries where are considered as primary energy sources. According to (FAO, 2011), Africa alone use 63% of the global charcoal production especially in rural that accounts for 94% and 73% in urban areas.

Therefore, this high demand of charcoal (Smith et al, 2004) and unsustainable production can challenge ecosystem services production, agricultural production, and human health (Zulu, 2012). As a result there is a high poverty prevalence that coupled with indiscriminate extraction of wood and other resources for charcoal production leading to deforestation.

According to (UNDP 2010, World Bank 2012), though this problem is general but in Eastern African countries is more complex reason being a large proportion of the people in the rural areas that can be categorized as poor or very poor. Therefore, according to (FAO 2012), in order to address this issue because poverty is closely related to the type of energy used in particular area, poverty reduction has been identified as main goal of many development agenda since the world's social summit of Copenhagen in 1994, the Millennium Development Goals (MDGs). In eastern Africa charcoal industry is mostly widespread in rural areas because it does not require any formal skills or big capital, (Zulu 2012). However, charcoal is still considered as one among other different alternatives of income-generation opportunities that could contribute to poverty reduction. On the other hand results into environmental degradation, lack of adequate forest cover, clean water and land suitable for farming; which in return cause more hunger, illness, poverty and reduced opportunities to make a living. This is mostly aggravated by the use of traditional methods in charcoal production due to insufficient access to education and lack of needed information and this makes it difficult for poor people to manage available natural resources sustainably, thus creating loss of livelihood opportunities and of biological diversity (UNEP 2012).

In Rwanda firewood is used by over 96.2% and charcoal is used by more than 60% of the population in both rural and urban areas (MININFRA, 2007). This extensive and ineffective use of traditional biomass contributes to the overexploitation of forest stocks, environmental degradation and health problems. Nsabimana and Wallin (2009) reported that the total forested area in Rwanda was about 30% of total land area during the 1930s and it was reduced to 10% in 2005 and Rwanda's forests have continued to be under threat. On one hand charcoal production is associated with health problems such as difficulty in breathing, coughing, tearing in the eyes, fatigue and body aches caused by fumes from the carbonized wet-wood which are poisonous. On the other hand as for the majority of families, most kitchens don't have ventilation or chimney the use of firewood is a source of respiratory diseases due to indoor air pollution.

The wood fuel sector not only employs tens of thousands of people, it also contributes Millions of dollars to the local economy in the form of revenues, taxes, and incomes as the value of charcoal and wood fuel chain is estimated to be \$122 million equivalent of 5% of GDP. However, as it is seen as "traditional", it is rarely given high priority in energy policies and poverty alleviation strategies, while comprehensive strategies have normally been prepared for the power and petroleum sectors,

there are few comparable strategies for the traditional use of biomass in the energy sector and commitments remain inconsistent and verbal. This is a major challenge in Rwanda since biomass energy supply and consumption are no longer in balance and at the current rate of wood consumption (1.2 kg/day/person in rural areas), reserves would run out by 2010-2015 if nothing was changed and in addition to existing stock 500.000 ha/yr of afforested land would be needed to achieve a wood production/harvesting equilibrium state (Mazimpake E, 2008). Therefore this paper was guided by the following questions: what are the methods of charcoal production, why do people basically involve in charcoal production, what is socio-economic impact of charcoal on rural well-being, and how Rangiro, Cyato and Bushekeri inhabitants do perceive the impact of charcoal production on environment.

2. Methodology

According to www.simplypsychology.org, education like other social sciences researchers in this field use both quantitative and qualitative approaches to go about their method of discovery. However, it is warned not to become so caught up in the polarizing differences between qualitative and quantitative research since all quantitative data is based upon qualitative judgments; and all qualitative data can be described and manipulated numerically. Hence the current study both focuses on qualitative and quantitative approach. The methods employed in this study include the use of questionnaire administration to seventy eight (78) inhabitants of three sampled sectors where charcoal production is prevalent in the study area. One settlement was picked from each of the three districts. These sectors include Rangiro, Cyato and Bushekeri. The questionnaire was administered to respondents randomly in each of the three sampled sectors. Furthermore, Focus Group Discussions (FGDs) were organized with the inhabitants (both producers and non-producers) of these sampled sectors to explore their minds on their knowledge and impact that charcoal production has on the environment. Interviews were also conducted on the producers in order to understand the method of production of charcoal and whether or not it has impact on the health of the producers. Data gathered were subjected to simple percentages, tabulation and cross tabulation.

3. Results and discussions

3.1. Characteristics of respondents

The socio-spatial and demographic characteristics of charcoal producers are summarized in this section. A total of 78 respondents were sampled. All of the sampled respondents, it is highlighted that 34% of respondents were female while 66% of them were males. The researcher noted the reason for the highest percentage of males was coincided with the idea they join charcoal making more than females. About 70 (90%) were married and larger percentage 59 (75%) were farmers while only 19 (25%) were full-time charcoal producers. The reason for larger population in farming is that farmers concentrate more on charcoal production as secondary occupation during dry or off farm season when they cannot cultivate crops.

This is similar to a report from Asia that the practice serves as off farm occupation among farmers (Bhattarai, 1998). It was also discovered that in three sectors: Rangiro, Bushekeli and Cyato the highest percentage (50%) of charcoal producers never attended school; 27% of them attended primary school while only 12% are qualified with secondary education.

This implies that the charcoal makers in such three sectors may be deprived of enough and appropriate skills to run the modern charcoal making 70 (80%) are in their middle age of between 25 and 55years. This is an indication that sampled charcoal producers are illiterates but in the economic active age. This is similar of what reported in Tanzania where 40% of the charcoal makers have no formal education (CHAPOSA, 2002). This is because the activity requires neither formal education nor large capital investment although it is time consuming and labour intensive.

3.2. Method of charcoal production

Part of the objectives of this work is to examine the method of production of charcoal and to determine whether or not the method of production has impact on the health of the producers. Charcoal production according to the producers started fully in the study area some 74% of charcoal producers are in charcoal making from 6 years to 16 years above. According to them, most of these producers are farmers but engaging in charcoal production. Some, during dry season before another farming season sets in while, others are involved in it together with their farming operations. However, it is revealed that 70% of charcoal makers in three sectors:

Rangiro, Bushekeli and Cyato proceed in making charcoal by sing heat from the incomplete combustion of the organic matter, which is to become charcoal(Direct method), while only 30% proceed by using an external heat source to “cook”(Indirect method).



Fig. 1: A Kiln burning slowly

The researcher concludes that a great number of charcoal makers in the sectors mentioned above use traditional methods of making charcoal which may entail a number of consequences on either the environment or the health. There are four processes involved in producing charcoal. The first process is to select and clear a location where the charcoal will be produced. The ground directly underneath the kiln (pile of trees covered with leaves, earth and mulch) must be loosened to about 12 inches below the surface. Secondly, trees such as are cut into different sizes. Thirdly, the trees cut into woods are stacked into a kiln (fig. 1) leaving a hole where it will be lit and covered with a layer of grass and sand. At the final process, the kiln is lit and left to burn slowly (fig. 1) for up to two weeks and at times four weeks depending on the type of trees cut. After this the charcoal is ready and all the sand and grass used to cover it are removed.



Fig 2: Charcoal packed in bags in Kigali

Charcoal is then removed and bagged (fig 2) to be sold usually to the charcoal merchants who transport them to the urban centres for prospective buyers or at times to individuals who are in need of it.

3.3. Impact of method of charcoal production on the health of the producers

When asked whether the method of production has any impact on the health of the producers, most of the respondents 78 (100%) indicated that charcoal production has its health risks and the information provided is summarized in the following table and figure:

Table 1: Charcoal production and health

Item: What is the impact of charcoal production on health?(n=78)			
Answers	Frequenc y	Mean	Percentag e
Chronic bronchitis	34	$\frac{44 + 69 + 83 + 91 + 76 + 92 + 55 + 72 + 69}{9} = 72$	44
impaired lung function	54		69
Nasal itching	65		83
Sneezing	71		91
Nasal secretion	59		76
Cough	72		92
Chronic cough	43		55
Wheezing	56		72
Expectoratio n	54		69

Source: Primary data, July 2017

The table above clarify different health-related problems evolving from charcoal production. It is noted that any type of health-related problem shown in the table above is recognized by charcoal producers in three sectors: Rangiro, Bushekeli and Cyato and the researcher concludes that there is a need to take serious measures regarding charcoal production given the health of people in three sectors mentioned above since the mean calculated (72) itself reveals closeness to the frequencies being referred to. For example fumes exuding from the carbonized wet-wood are poisonous as well as irritating to the eyes. Other health impacts include irritation such as difficulty in breathing, coughing, tearing in the eyes, fatigue and body aches.

According to Anon, (2011), health challenges such as lung, blood oxygen absorption problem and cancer can be caused by smoke. Also, they experience burns when picking burnt charcoal and the heat emanating from most of the kilns when picking burnt charcoal is over 1,000°F with little smoke just what was needed for metal work (Harris, 2012).

3.4. Impact of Charcoal Production on Rural Wellbeing

The study revealed that 133 (88.6%) of the respondents earned above 20, 000 RFW monthly from charcoal production while only 17 (11.4%) earned less than 20, 000 FRW. This is usually during the dry season period when attention is fully on charcoal production. This is in support of Kammen and Lew (2005) findings that charcoal is a major source of income generation in the rural areas. Furthermore, according to CHAPOS (2002), cited by Malimbwi (2013), in areas with reasonable accessibility, charcoal is the main may be main off farm activity of the rural households and on average each charcoal making household produce about 43 bags of charcoal per month which when sold provide an income of about USD 645 per year per household. This indicates a growing dependence on charcoal for household income whereby about 75% of farmers in charcoal producing areas had charcoal as an important source of income.

3.5. People's involvement in Charcoal Production

Of the 150 respondents, 89 (59%) claimed that they were involved in charcoal production in order to generate additional income to what they obtain from their main farming occupation. Twenty-four (16%) were involved in it as off-farm employment especially during dry season. Unemployment was the reason for the involvement of 21 (14%) of the respondents while 9 (6%) were involved because of the availability of good tree species. Furthermore, 7 (5%) claimed that they engage in charcoal production because of high demand for it in the market (Table 2).

Table 2: Reasons for involving in charcoal production

Answers	Frequency	Percentage
Additional income	45	58
Employment	41	53
Availability of good tree species	43	55
High demand in the market	45	58

Source: Primary data, July 2017

The study revealed that most charcoal producers were involved in it as diversified means of rural livelihood in order to supplement the insufficient income they realized from their main occupation. This in a way has really reduced the poverty level of the inhabitants. This is in support of Agyeman *et. al* (2012) that charcoal industry play significant role in economic development of some communities in the Upper West Region. Moreover, charcoal production is a labor-intensive process (World Bank, 2009).

A large number of people are employed in different phases of charcoal making and distribution: collection; sizing the wood; preparation of kilns; loading and unloading wood into kilns, bundling, packaging, transportation; marketing and utilization (Kituyi, 2002; Mwampamba, 2007). The Kenyan charcoal industry employs about 200,000 in production and over 500,000 wood producers, transporters and vendors and supports 2.5 million dependents (ESDA 2005).

3.6. Impact of Charcoal Production on Rural Wellbeing

Table 3: Achievement with income from Sales of Charcoal

Answers	Frequency	Percentage
Paying community based health insurance	78	100
Daily saving	56	72
Shelter construction	53	68
Paying school fees	70	90

Source: Primary data, July 2017

The study revealed that 78(100%) use the income from Sales of Charcoal to obtain health services 56(72%) use it as daily savings, while 53(68%) they use income to purchase

constructional materials, 90 and 70 (90%) indicated that they use the income to pay school fees of their children. This is an important aspect of the positive impact that charcoal production has on the lives of the producers since income realized is always used to improve their wellbeing and hence reduce their poverty situation. This is confirmed by a study by RAEL Research project, showed that over 80% of urban population in Kenya uses charcoal as their primary source of domestic energy and over 30% of rural people also use it to meet their needs. This clearly indicates the widespread use of charcoal and hence the extent of the business. On the other hand in a recent studies conducted by Ajadi et al., (2012), they found out that charcoal enterprise is on part-time basis, undertaken as a coping strategy, and the forest is depleting due to uncontrolled and indiscriminate exploitation of mature and nearly-mature tree. However the negative impact of charcoal production is discussed under the following topic.

3.7. Perception on the impact of charcoal production on the environment

Table 4: Charcoal production and environment

Answers	Frequency	Mean	Percentage
Complete loss of forest cover	65	$\frac{83 + 87 + 90 + 91 + 70 + 88}{6} = 74.4$	83
Permanent reduction in the density of the forest	68		87
Removal of vegetation cover	70		90
Thinning of woodlands	71		91
Climate change	55		70
Soil degradation	69		88
No animal	62		80
No impact on the environment	5		6

Source: Primary data, July 2017

On the perception of the respondents on the impact of charcoal production on the environment (Table 5), it was discovered that 55 (70%) of the respondents agreed that the weather of the area in which charcoal is produced is getting drier each day. About 68 (87%) of the respondents agreed that tree felling is affecting their environment negatively. The implication of this is that there will be high concentration of carbon in the atmosphere because trees that would absorb these carbons are cut down; hence, this leads to global warming. Another impact is increase in the erosion process in the area because trees that are supposed to control the washing away of the topmost soils had been removed. Sustainability of our environment is however crucial while finding cheaper means of cooking. About 69 (88%) of the respondents are in support of this.

Furthermore, 55 (70%) of the respondents indicated that during the process of burning trees a lot of smoke in form of carbon monoxide is being released into the atmosphere hence, there will be increase in temperature which is a potential consequence of greenhouse effect causing climate change. Also, 62 (80%) of the respondents agreed that there are no animals in the bush again as a result of tree felling. The implication of this is food insecurity. Only 5(6%) indicated no impact on the environment. Furthermore, inhabitants were asked whether charcoal production has any effect on the surrounding environment during group discussions. It was gathered from them that they usually experience high temperature which is as a result of deforestation. Some of them did not agree with this opinion especially the producers. According to them they claimed that God does his things as he likes. One of them has this to say “Charcoal production has no effect on the surrounding environment but rather, the high temperature we are experiencing is as a result of God’s handiwork” When the issue of afforestation was raised, none of producers indicated the practice afforestation since they embarked the charcoal business.

According to them, “we cut down only mature trees, so there is no need for reforestation and afforestation”. Deforestation without afforestation is an important aspect of climate change. When trees are cut down and not replanted there will be high concentration of carbon dioxide in the atmosphere since the plants that are supposed to take in carbon dioxide have been cut down, hence, there will be global warming. This is similar to a study carried out by Chidumayo and Gumbo (2012) that emissions of greenhouse gases from charcoal production in tropical ecosystems in 2009 are estimated at 71.2 million t for carbon dioxide and 1.3 million t for

methane. Burning releases into the atmosphere carbon dioxide and carbon monoxide which reduce the ozone layer and act as blanket escape of ultraviolet rays from the atmosphere. This increases ambient temperature, reduces rate of vegetation, increases water loss and ultimately the tendency for desertification. Furthermore the charcoal production equally affects the environment by making the temperature to be very high when compared with other environment where charcoal is not being produced. New findings show that the average temperatures in Uganda have increased to as high as 1.4 degrees Celsius since the 1960s compared to an average of 0.5 degrees in the East African region over the last century (Harris, 2012).

4. Conclusion and planning implications

Charcoal production in the rural areas of Rwanda is increasing on daily basis as a result of increase in the price of domestic fuel such as gas. An average household especially in the urban areas finds it difficult to purchase gas which are supposed to be common man cooking product as a result of increase in price. The situation is worsening reason being the high price of fossil fuels and so a lot of people could not afford these essential commodities. Hence, people particularly households rely on the use of charcoal as a source of fuel especially in the urban areas. It is very surprising to discover that most households in rural areas use firewood as domestic cooking fuel instead of charcoal simply because they cannot afford charcoal. In the study area, it was discovered that charcoal merchants usually purchase charcoal in bags and transport to the urban areas where there is high demand for it. Some merchants also sell by the road side to interested travelers.

Constraints to the production of charcoal according to the producers include challenges from government officials in charge of forestry, increased temperature as a result of deforestation, high cost of transportation as a result of increase in fuel price and having to search for tree species good for charcoal. From the study, it can be concluded that charcoal production has both positive and negative impact on the producers, inhabitants and the environment. However, in the opinion of the respondents they felt that the positive impact that charcoal production has on their wellbeing is more than the negative impact, although according to them if they have alternatives they will quit the job because of the difficulties they faced in the process of carrying out this action. The study recommends that local people as well as the society at large should be enlightened through proper awareness campaign such as training, drama, electronic media and

visual display among others (Ajibade, 2011) on the impacts of environmental degradation on human health and biodiversity.

Charcoal producers should be encouraged to practice afforestation and reforestation so as to reduce the effect of global warming in the environment and ensure sustainable rural development. Also, legislations on afforestation and reforestation should be enforced on people both at the study area and the country at large. Furthermore, cost of domestic energy such as kerosene, gas and electricity should be reduced for the poor to be able to afford. This at least will reduce the practice of deforestation for charcoal production in the country.

Local people should be included in decision making concerning sustainable ecological and environmental management. Development of energy-saving meters and solar cookers should be encouraged so as dissuade the mind of people from cutting down trees for charcoal production. It will also reduce the demand and dependency on charcoal and firewood for their daily cooking. This will reverse the problem of desertification caused by charcoal production and improve family savings.

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