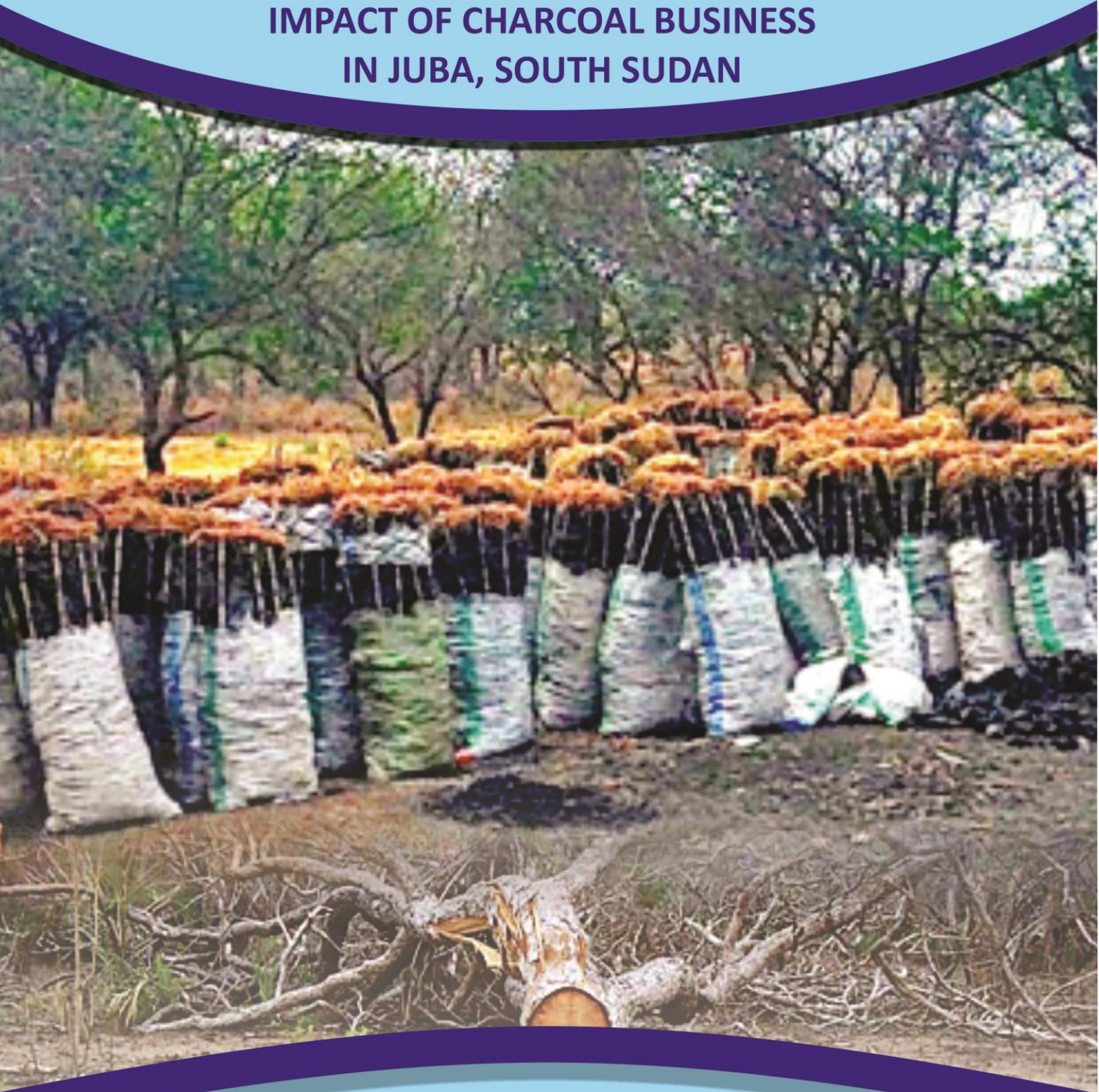


THE SOCIO-ECONOMIC AND ENVIRONMENTAL IMPACT OF CHARCOAL BUSINESS IN JUBA, SOUTH SUDAN



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First of all, I would like to thank God Almighty for giving me the strength, health and guidance to be achieving my goal and completing the day to day tasks required for this study.

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ABSTRACT

The global energy demand was reported as one of the major energy challenge faced by the global community. However, in South Sudan, charcoal constitute the principal energy required for heating and cooking. Charcoal business also provides an opportunity for households affected in one way or another by the country's protracted crisis situation to generate income. . With a rise in demand, there has been a rise in supply of charcoal and firewood into the city; this in turn causes devastating effects on the environment. The purpose of this study was to help the reader understand the socio-economic and environmental impact of the charcoal business; documented from production, marketing and consumption in Juba. The research method used was tailored towards mapping of all the stakeholders in the business and roles of different institutions as well as bodies regulating the charcoal business. The study also aimed at reviewing policies in order to understand reasons as to why policies are not being implemented and present recommendations on how the environmental impact emanating from the business could be mitigated without compromising on the socio-economic impacts. A total of 70 respondents were selected for the study, 30 respondents were charcoal consumers, both household and business consumers and 20 charcoal retailers were selected as well. 5 transporters and 5 producers were selected for the study. The respondents were selected using random sampling technique. 10 key informant interviews were conducted with a policy expert and energy engineer, professors in higher institutions of learning, executive director of a national Non-Governmental Organization involved in youth empowerment through charcoal briquette making and community involvements in tree planting, chambers of commerce, director general of climate change in the National Ministry of Environment and Forestry and head of Afforestation in the State Ministry of Environment and Forestry. Both quantitative and qualitative analysis methods were used and the results were analyzed using Microsoft Excel. Results from the study show that the annual charcoal consumption rate for households only as 1,608,000 sacks: The qualitative survey also showed that most consumers preferred charcoal because it is cheap and readily available compared to alternative sources of energy. Retailers found themselves in that business because of survival and lack of employment in other sectors especially with work in the government and stiff competition in other areas. Education-wise, a large number of retailers ended in primary level of education: Thus, narrowing their chance to compete in the job market/ business world. A high percentage of retailers knew the devastating impacts of the business on the environment but since they have no other option, they could do nothing about the effects. This all boils down to the absence of policies required to regulate the business. Lack of implementation of the policies and weak policies according to the key informants were due to the lack of political will, insecurity in the region forcing armed soldiers to take part in the destruction of natural forests with no one to stop the acts, the absence of accountability and transparency among the top government officials and financial constraints on the part of the Ministries dealing with conservation of natural resources. The recommendations from the study are; introduction of an alternative source of energy. Liquefied Petroleum Gas could be produced right from the oil refineries and Hydro Electric Power Plant in Fulla falls to introduce a much affordable energy source to the population. Reforestation and Afforestation projects should be funded by the government and international partners in order to reverse the already existing devastating impacts of the current deforestation and

desertification levels in the country such as heat waves, delayed rainfall, soil erosion which may hinder Agriculture and loss in biodiversity. All the recommendations hinge on the arms of policy reforms with which nothing can be done in its absence. Establishment of Forest Tribunal for accountability and transparency, consequences for violators should be put in place.

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ABBREVIATIONS AND ACRONYMS

| | | |
|------------------|---|--|
| CES | : | Central Equatoria State |
| CH ₄ | : | Methane |
| CO ₂ | : | Carbon Dioxide |
| CPA | : | Comprehensive Peace Agreement |
| CSPS | : | Centre for Strategic and Policy Studies |
| FAO | : | Food and Agriculture Organization of the United Nations |
| GDP | : | Gross Domestic Product |
| GHGs | : | Green House Gases |
| GOFC-GOLD | : | Global Observations of Forest Cover and Land-use Dynamic |
| GOSS | : | Government of South Sudan |
| IEA | : | International Energy Agency |
| JASP | : | Jeffrey's Amazing Statistics Program |
| JCC | : | Juba City Council |
| JICA | : | Japan International Cooperation Agency |
| KG | : | Kilogram |
| LPG | : | Liquefied Petroleum Gas |
| MJ | : | Mega joules |
| MoE | : | Ministry of Energy |
| MoEF | : | Ministry of Environment and Forestry |
| N ₂ O | : | Nitrogen Dioxide |
| NGO | : | Non-Governmental Organization |
| OCHA | : | United Nations Office for the Coordination of Humanitarian Affairs |
| OECD | : | Organization for Economic Co-operation and Development |
| REDD+ | : | Reducing Emissions from Deforestation and Forest Degradation |
| SSA | : | Sub Saharan Africa |
| SSP | : | South Sudanese Pounds |
| UN | : | United Nations |
| UNDP | : | United Nations Development Programme |
| UNEP | : | United Nations Environment Programme |
| UNFPA | : | United Nations Population Fund |
| UNHCR | : | United Nations Higher Commissioner for Refugees |

| | | |
|-------|---|--|
| UoJ | : | University of Juba |
| USAID | : | United States Agency for International Development |
| USD | : | United States Dollar |
| WFP | : | World Food Programme |
| WHO | : | World Health Organization |

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CHAPTER ONE

INTRODUCTION

1.1 Background of Study

The rising energy demand is one of the major global challenges the world faces today. According to (Kaygusuz, 2011), approximately 2.4 Billion people use solid biomass fuels for the purpose of cooking and heating. Furthermore, (Kaygusuz, 2011) reported that large-scale charcoal production, primarily occurs in the sub Saharan Africa (SSA) and it has been a growing concern due to the threat of the industry resulting into deforestation, land degradation and climate change impacts. Deforestation and forest degradation are the principal causes of forest cover change and account for a large proportion of global carbon emissions (Achard, 2007) (Van der Werf, 2009). Deforestation is defined as the long-term or permanent conversion of land from forest use to other non-forest uses (GOF-C-GOLD, 2009), represents an abrupt and rapid change in land cover. Wood based fuels account for over 80% of primary energy supply and more than 90% of the population rely on firewood and charcoal (IEA/OECD, 2006). It is cited as the most environmentally devastating phase of this traditional energy supply chain, and despite increasing per capita income, higher electrification rates, and significant renewable energy potential, charcoal still remains the dominant source of cooking and heating energy for eighty percent of households in SSA (Arnold K. P., 2006) (Charcoal, Livelihoods and Poverty Reduction: Evidence from Sub Saharan Africa, 2013). As a traditional fuel that has been used for hundreds of years, it serves as a lifeline for the rapidly increasing populations in the urban centers of the region, in addition to potentially significant portions of the rural population. Population projections indicate an unprecedented increase in the urban population in African cities, increasing from 30% in 2000 to reach 60% by year 2050 (Boko, 2007): (Parry, 2007), (Montgomery, 2008) (UN HABITAT, 2010). The energy needs of the growing urban population will pose an increasing pressure on forest resources of rural areas (D. F. Barnes, 2004).

Charcoal is the principal fuel in Kenya, providing energy for 82% of urban and 34% of rural households (Ministry of Energy, Government of Kenya, 2002). Surveys also revealed that charcoal is the preferred fuel for heating and cooking in Uganda's urban areas, both by households and commercial enterprises. The report added that the annual consumption of charcoal was about 400,000 tons, with 300,000 tons of that being consumed in Kampala (Government of Uganda, 2015). Households in Tanzania generally use a combination of energy sources for cooking that can be categorized as traditional (agricultural residues and fuel wood), intermediate (charcoal and kerosene) or modern energy sources such as (Liquefied Petroleum Gas), biogas and electricity. Electricity is mainly used for lighting and small appliances like radio, Televisions and phone charging rather than cooking, and represents a small share of total household consumption in energy terms (Kilahama, 2005) Over one million tons of charcoal is used for cooking annually in Tanzania's urban areas which is equivalent to 109,500 ha of forest loss (Sustainable Energy and Development Forum, 2009) The government tried to institute a ban of charcoal in 2006 but was largely unsuccessful because no alternative source of fuel was provided. (Ministry of Natural Resources, Tanzania, 2007)

South Sudan, the world's youngest country, is endowed with extensive grasslands, wetlands, wildlife, and tropical forests. Its natural assets include significant agricultural, mineral, timber, and energy resources. But despite having one of Africa's lowest population densities, less than 13 people per square kilometer, the landlocked Central East African country's forests remain under immense pressure from charcoal and fuel wood production and consumption. (UNEP, 2018)

According to the United Nation's definition, forest is a land area of more than 0.5 ha, with a tree canopy cover of more than 10%, which is not primarily under agricultural or other specific non-forest land use. "Tree" means forest trees, including bushes, palms, bamboos, shrubs, brushwood, creepers and climbers at all stages of their growth. The definition of "forest land" is any land containing a vegetation association dominated by trees of any size, including woodlands, whether exploitable or not, that is capable of producing wood or other products, are potentially capable of influencing climate, which exercise an influence on the soil and water regime and provide habitat for wildlife.

Natural forests form the vast majority of South Sudan's forest estate. They are located mainly on the Ironstone plateau of Central and Western Equatoria. In addition to the forests west of the Nile, Eastern Equatoria has a significant forested area. A mixture of Congolese forest species and fire climax species characterizes the natural forests of the Equatoria. The forests of the Imatong Mountains, which are a mixture of both natural and plantation blocks, are of particular importance for their biodiversity and ecosystem services (Adkins, Forestry and Prospects for Stability, Livelihoods and Peace-building in the Equatorial States of South Sudan, 2015).

For instance, Jebel Lado County, north of the capital Juba, home to the Bari ethnic communities: a 45-minute drive from the capital is adorned with a woodland savannah landscape in which sorghum farming and livestock production have traditionally thrived. However, insecurity in the area forced many locals to abandon their crop fields in fear of having their produce stolen. They shifted to charcoal production instead as their main source of income. On-going conflict further prevents sustainable development and management of forest resources, jeopardizing the future of entire communities (UNEP, 2018).

Charcoal production; fuel wood and charcoal make up approximately 80 per cent of the country's energy supply due to the lack of alternative sources of energy, such as electricity, wind, solar power, and gas. Charcoal is the main fuel used in urban centers and its use in brick making is growing. Its production requires large quantities of wood, and the harvesting of trees to make charcoal likely contributes significantly to deforestation. Charcoal is the favored fuel for a number of other reasons, including the lack of licensing requirements to generate it; the simple technology and tools used in its production; and the perception that it is a "free" primary resource, since forests are not privately owned. As a result, charcoal making is an attractive economic activity. With population growth, more people are becoming involved in charcoal production, accelerating deforestation and erosion, and contributing to climate change from land-use change (Ministry of Energy, Government of South Sudan, 2015); (Ministry of Energy, UNDP, 2012). Charcoal — cleaner and easier to use than firewood, cheaper and more readily

available than gas or electricity — has become one of the biggest engines of Africa’s informal economy. But it has also become one of the greatest threats to its environment (Society of Environmental Journalists, 2016). Many rural residents sell forest products in formal and informal markets to obtain cash income. For many rural inhabitants, these sales provide “important buffer & insurance roles as the households struggle to maintain vulnerable livelihoods at the margins of survival (Shackleton, 2007). A livelihood comprises of the capabilities, assets and activities required for a means of living (Conway, 1992).

Charcoal presents a classic grey market, where laws or regulations are flouted at some point in the value chain, but where the final sale is not illegal in the strict sense. Illegality often concerns only one point in the value chain – such as production, or perhaps transport of domestically produced charcoal – but by the time charcoal has reached large urban markets it has been successfully merged with licit forms of trade and cannot be identified as an illegal commodity. Also, as the charcoal trade concerns a ubiquitous, mundane and vital basic commodity, it is largely perceived as legitimate and socially acceptable, even if it is unlawful. This is why we use the term ‘grey’, even though there are strict trade bans on charcoal in some countries (Simone Haysom, *Black Gold: The Charcoal Grey Market in Kenya, Uganda and South Sudan*, 2021). A good majority of urban population who use charcoal on regular basis doesn’t seem to know its adverse environmental impact (Mekonnen Bekele, 2014).

1.2 Problem Statement

Large-scale charcoal production, primarily in sub Saharan Africa, has been a growing concern due to its threat of deforestation, land degradation and climate change impacts. Charcoal use in SSA is predicted to double by 2030, with over 700 million Africans relying on it as a durable, preferred, and cheap source of energy. With a forecasted increase in consumption, there is a great need to identify real versus perceived energy futures with respect to charcoal (World Energy Outlook Special Report, 2019).

Population increases and deviations from the energy ladder model suggest that charcoal demand for heating and cooking in Sub-Saharan Africa will continue to increase through the year 2030 and beyond. As Africa’s population is expected to swell and urbanize at an even faster rate over the next decades, the continent’s demand for charcoal is likely to double or triple by 2050, according to the United Nations Environmental Programme.

The charcoal business, along with the expanding use of land for farming, is expected to increase deforestation and worsen the effects of climate change on a continent poorly equipped to adapt to it. Even with evidence of such high dependence across the continent, policies often fail to adequately address the social and environmental concerns associated with its life cycle (Jones B. , 2018).

According to the country’s inaugural State of the Environment Outlook Report, launched in June 2018, fuel wood and charcoal account for over 80 per cent of all wood used in South Sudan, with an annual deforestation rate estimated at between 1.5 and 2 per cent. A 2015 survey carried out jointly by UN Environment and the Government of South Sudan estimated that, in

the capital Juba, 88 per cent of households, 74 per cent of businesses, and 40 per cent of institutions depend on charcoal energy. Furthermore, 15 per cent of households, 8 per cent of businesses, and 40 per cent of institutions use fuel wood to supplement charcoal for cooking. This demand translates into an estimated five million trees being logged annually to supply Juba with charcoal it currently consumes. However, local consumption is not the only threat, as rapid urbanization and demand from neighboring countries, including Sudan, Uganda, and the Middle East, also drive the market for charcoal (UNEP, 2018).

The current rate of charcoal production – its flow from production sites into Juba city and the mushrooming charcoal business– is negatively impacting forests in Central Equatoria and other parts of the country. Studies show that demand for charcoal rises with urbanization and population growth, as does the pressure on forests and woodlands, most of which are poorly managed and prone to degradation (UNEP, 2018).

“Until that is achieved, there is enormous pressure on natural resources, especially on the forests, as over 99 percent of the population of South Sudan depends on forests as their source of energy – fuel wood and charcoal, and timber for construction and furniture,” writes President Salva Kiir Mayardit.

Charcoal production adds to greenhouse gas emissions and contributes to global warming. Charcoal production is changing the landscape of the region and the potential of its natural resources. But an even greater argument for protecting the forests is the role of deforestation in causing global warming. According to the UN Environment Programme (UNEP, 2010), between 20 and 25 per cent of all annual carbon dioxide emissions are caused by the practice of burning forests to clear the land for farming — more than is caused by the entire world transportation sector. Burning trees and brush releases the stored carbon back into the atmosphere. On land, the impacts of biodiversity and ecosystems, including species loss and extinction. The sources of CO₂, CH₄ and N₂O emissions can either be natural or human. The main sectors contributing to GHG emissions in the globe are transportation and energy sector, land use and forestry.

Poor forest management policies; including unrestricted logging, excessive harvesting of firewood and medicinal plants, and road construction do contribute to the occurrence of shocks and stressors such as drought, flooding, forest fires and other natural disasters. Collection of wood for heating and cooking necessities and it is a particular problem in Africa, since wood supplies about 70 per cent of domestic energy needs, a significantly higher percentage than in the rest of the world (Fleshman, 2008). The continuous felling of trees with no replacement poses a great risk on the environment and contributes to desertification and climate change. The Minister of Environment and Forestry stated, “If we continue to cut trees without replacing them, not a single tree will be left in south Sudan in 50 years’ time”,

However, the demand for charcoal and wood fuel for energy contributes to deforestation which the UN Environment Programme estimates at 1.5% annually, from 0.84% a decade prior. From 1990 to 2005, South Sudan lost 11.5% of its forest cover and if this continues unabated, the country may lose all of its forest covers in about 50 years. Loss of forest cover causes food

insecurity via decreases in rainfalls and topsoil erosion (Ministry of Energy; Government of South Sudan, 2014).

1.3 Objectives and Research Questions

The study was carried out to understand more about the charcoal business in Juba; the social, economic and environmental impacts the industry has.

1.3.1 Main Objective

The objective of the study was to understand the socio-economic and environmental implications of charcoal production, marketing and consumption in Juba; to know who was directly involved in the business across the value chain with the aim to generate and increase awareness among the general public and review policies through dialogue with the key stakeholders in order to develop mitigation pathways for the identified environmental impacts.

1.3.2 Specific Objectives

1. To establish the roles of main actors in charcoal business.
2. To highlight the real situation of charcoal production
3. To determine the scale and the importance of the charcoal business
4. To assess the level of demand for charcoal in Juba city
5. To document the extent to which the charcoal business has affected the environment
6. To review the existing environmental policies and propose appropriate actions

1.3.3 Research Questions

To fulfill the objective of the study, the following specific research questions were employed;

1. What are the socio-economic implications of the charcoal business in Juba?
2. What is the scale and importance of the charcoal production business to the producers, transporters, brokers and consumers?
3. Why is charcoal the most preferred fuel energy used in Juba? And what percentage of households prefers to use charcoal over other fuel sources?
4. What are the roles of Ministry of Environment and Forestry, Juba City Council, States and counties administration in the charcoal business in Juba?
5. How effective are the policies and government laws on regulating the charcoal business and its impact on the environment?
6. What measures are being taken in consideration of environmental degradation and deforestation impact done by this business?
7. Who are the main stakeholders in the business and what percentage of nationals are involved?

1.4. Scope of study

This study research was carried out for three months as per Centre for Strategic and Policy Studies (CSPS) policy. The study was conducted mainly in Juba city of Central Equatoria State. Information about the topic was gathered from the region through face-to-face interviews with stakeholders, households, charcoal producers, and charcoal retailers. Questionnaires were also administered to the producers and retailers in order to gather as much information as possible.

Secondary data was also solicited from UNEP, WFP, WHO and other international organizations. The following contributions have made an impact to the research paper: Juba City Council, Ministry of Environment and Forestry, South Sudan center for census statistics and evaluation, University of Juba, UNFPA and policy experts in focus group discussions.

1.5 Importance of the Study

The rapidly increasing demand and urbanization in many developing countries have not seen an increase in modern fuels (kerosene, LPG, natural gas, and electricity) supplied over the period, making traditional energy source use unavoidable (Chidumayo, 2011). Charcoal production is an important economic activity as well by providing a considerable amount of employment and also serves as a source of livelihood for most rural households. However, there are some downsides associated with dependency on charcoal for fuel energy. Thus, reliance on charcoal triggers a number of concerns regarding the sustainability of this essential industry with regards not only to its economic value, but the proper management of forest resources as well as livelihoods of those most responsible for producing this fuel. As a result of weak, unenforced or disjointed forest policies, South Sudan is experiencing increased rates of deforestation from charcoal production in protected areas. Unlike the use of fuel wood for cooking and heating, which is often supplied from ground harvesting and has no major impact on environmental degradation, current methods of charcoal production require vast amounts of resources for relatively little return.

This research paper will help the reader understand the socio-economic impacts of charcoal in the lives of South Sudanese. Echoing the fact that charcoal is an important fuel for providing day to day basic needs which people cannot live without, however, with the influx of people in the country right after independence, demand for the fuel with no other alternatives for energy have shot up leading to increasing pressures on the forest resources that are already depleting with time due to poor natural resource management. A recent ban on the charcoal trade and illegal logging of trees was issued and only proved impractical. This and many other policies will be reviewed and investigated as to why the implementation seems non-viable despite being passed out and endorsed. The study aims to get to grips with the vicious cycle and find sustainable ways in which households will have their energy needs met without compromising on the environment.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The present chapter lays the foundation of the charcoal business, the policies concerning the business and its impacts in SSA in general and more specifically in South Sudan. This chapter deep dives into secondary data to understand the previous achievements and recommendations other researchers on the subject.

2.2 Brief Overview of Charcoal

2.2.1 Definition and Properties

Oxford dictionary defines charcoal as a porous black solid, consisting of an amorphous form of carbon, obtained as a residue when wood, bone, or other organic matter is heated in the absence of air. It is produced usually by using gradual pyrolysis; the heating of wood or other materials in the absence of oxygen. The benefit of using charcoal rather than just burning wood is to remove water and other components, which permits charcoal to burn at a higher temperature and the fact that the product of its combustion is mostly carbon dioxide, resulting in very little smoke (Jones, 2015).

Additionally, charcoal is 99% flammable when dry, cheaper compared to modern sources and also accessible. Charcoal is easy to transport, efficient and produces a steady heat with little or no smoke. Dependency on charcoal is rather increasing as a result of rapid growth in urban population and rise in price of modern sources of energy like electricity, LPG and kerosene. In some of the least developed countries, like South Sudan, where less than one percent of the population is connected to grid electricity, 95% rely on traditional biomass fuels in the form of wood and charcoal (Bryan, 2018). Studies in many African countries show that charcoal making is among the primary drivers of deforestation and subsequent land degradation. If a continued reliance on charcoal is suggested, there is an even greater need to evaluate and address the environmental and social issues associated with this highly influential, and largely informal, industry (Jones, 2015). Charcoal is classified in several categories as lump charcoal, briquette charcoal, and extruded charcoal, charcoal having heating value of 28-30 MJ/kg equal to 70% heating value of kerosene 44 MJ/kg (Singh, 2000).

2.2.2 Applications/ Uses of Charcoal

Due to good heating value, charcoal can be used in various applications as:

1. Cooking fuel
2. Industrial fuel
3. Purification/filtration of wastewater
4. Horticulture and drawing
5. Making rough sketches in painting
6. Baking of local bricks

2.2.3 Production Process

Charcoal is generally unadulterated carbon, termed char, made by cooking wood in a low oxygen condition, a procedure that can take days and burns off unpredictable compounds, for example, methane, water, hydrogen, and tar (Policy Responses to Addressing the Issues of Environmental Health Impacts of Charcoal Factory in Nigeria: Necessity Today; Essentiality Tomorrow, 2020).

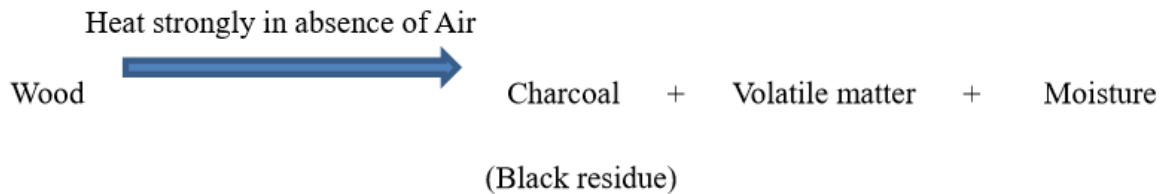


Figure 1 Charcoal production process

Charcoal can be made using various methods. In South Sudan, only the traditional method is employed. The logs are arranged in a pile leaning against a chimney (logs are placed in a circle). The chimney consists of four wooden stakes held up by some rope. The logs are entirely secured with soil and straw permitting no entrance of air. It must be lit by bringing some burning fuel into the stack; the logs burn gradually and change into charcoal in a time of 5 days' burning. If the covering of soil gets torn (cracked) by the fire, additional soil is set on the cracks. As soon as the burn is finished, the smokestack is plugged to prevent the entrance of air. The genuine art of this production technique is in managing the adequate heat generation (by combusting portion of the wood material), and its transfer to parts of the wood during the process of being carbonized. A tough disadvantage of this production strategy is the tremendous emissions amount that is detrimental to human health and the milieu (emissions of unburnt methane) (Hosier, 1993).

Technology is a major barrier to realizing sustainable charcoal. Charcoal is produced using traditional earth-mound kilns with very low wood to charcoal conversion efficiencies ranging between 10% and 15%. Sustainable production systems and appropriate modern technologies are lacking. Production is commonly carried out by small and unorganized individuals or groups (Soldiers, locals and foreigners). For this type of production, the wood-to-charcoal conversion efficiency rates range between 10-15 % with only a few cases achieving rates above 20% (Cooking With Charcoal, 2021). After the area for charcoal production is selected, a number of trees are cut and stacked together in one place, grass is covered on top with some soil to ensure proper burning and the charcoal is burnt. The process takes up to two weeks. After this, the charcoal is broken down into smaller pieces and packaged in sacks. Each sack weighs about 50kgs. If a machine is used, 3 big trees/ 15 small trees could be cut in a single day but if it is done manually, one big tree could produce around 15 sacks of charcoal and 3 small trees are needed to fill one sack of charcoal.

2.3 Demand for Charcoal for Energy

Dependency on charcoal is rather increasing as a result of rapid growth in urban population and rise in price of modern sources of energy like electricity, LPG and kerosene. In some of the least developed countries, like South Sudan, where less than one percent of the population is connected to grid electricity, 95% rely on traditional biomass fuels in the form of wood and charcoal (Ministry of Electricity and Dams, UNDP, 2013). The demand for fuel wood and charcoal for energy is projected to grow at roughly the same rate as population, with many studies predicting a growing gap between declining fuel wood supply and rising demand (Cline-Cole, 1990).

According to the National Baseline Household Survey in 2012, over 96% of the South Sudan population use firewood or charcoal for cooking. 1% of the population has access to grid electricity. Those are mainly in Juba, Wau and Malakal. 95% of the household in Juba cook with wood fuel or charcoal. There are only three isolated distribution systems in South Sudan located in Juba, Wau and Malakal. Per capita electricity consumption in South Sudan is about 1 to 3 kWh which is the lowest in the region. The average per capita consumption in Sub – Sahara Africa is about 80 kWh (African Development Bank, 2012).

The need to address this catastrophic environmental change was one of the driving forces behind leading early strategies by government and international donor agencies to restructure approaches to forestry and make them more effective in meeting fuel wood demands. This led to many proposals and plans to encourage ways to use fuel wood more economically, the more efficient management of existing wood resources, and the planting of trees to increase fuel wood (Arnold P. , 2003). The gap between fuel wood supply and demand was estimated and translated into planting targets and attracted substantial donor and government funding, resulting in significant increases in these types of forestry programs (Arnold K. P., 2006).

The initial announcement of the fuel wood crisis and analysis of wood supply was seriously constrained by a lack of accurate and reliable data. Very few countries had rough estimates of the extent and degree of fuel wood production or use, and there was inadequate data on sources of supply and the interactions between supply and demand (Arnold K. P., 2006).

According to the UNFPA, the high rates of urbanization prevalent in the region suggest that by 2050, more than 50% of Africans will reside in cities. High and ever-increasing demand for charcoal, coupled with improper forest management, and poor regulation of the trade present a solemn future for forests in Africa. In places where this combination of factors exists, the fuel wood crisis needs to be revisited (Bruinsma, 2003) (Maadubansi, 2007) (Mwampamba, 2007).

Charcoal consumption in SSA is expected to double by 2030 and fuel wood consumption used for charcoal production is estimated to be 544.8 million m³ and 46.1 million tons, respectively (Kappel, 2006) (Richardson, 2013). And traditional charcoal production has been a growing concern due to its threat of deforestation, land degradation, and climate change impacts (Nordstrom, 2003). Charcoal is the main fuel for more than 1 million families in SSA (Kumar, 2020). They added that because of the increasing use of charcoal in many countries; it is critical

to assess and develop long-range charcoal policies for African and other developing countries (Lurimuah, 2011).

According to the country's inaugural State of the Environment Outlook Report, launched in June 2018, fuel wood and charcoal account for over 80 per cent of all wood used in South Sudan, with an annual deforestation rate estimated at between 1.5 and 2 per cent. However, local consumption is not the only threat, as rapid urbanization and demand from neighboring countries, including Sudan, Uganda, and the Middle East, also drive the market for charcoal (UNEP, 2018).

In Juba, the Capital of South Sudan, charcoal dominates as the leading cooking energy, with 95.52% of the households using it. Only 9.45% use cooking gas and 13.93% use firewood for cooking (The Sudd Institute, 2018).

The negative environmental consequences of widespread use of wood as fuel and in charcoal production—namely, deforestation—are increasingly gaining attention and concern, including among populations who rely on these fuels for daily life. Without a more complete understanding of the rapidly changing energy economy, however, efforts to address the environmental consequences of these shifts are unlikely to be successful (Leonardo, 2020).

2.4 Socio-economic Impacts of the Charcoal Business

The charcoal production industry is a source of employment and livelihoods for millions all over the world. There are thousands of people who depend on the charcoal business as their sources of livelihoods from the producers, merchants, wholesalers to retailers. Most of the producers are found in the rural areas from where merchants purchase the charcoals to be sold in urban centers (a process associated with the development of civilization, it is estimated that 93% of urban growth will occur in developing nations, with 80% of urban growth occurring in Asia and Africa and up to 600 million people in urban areas in developing regions, nearly 28% of the developing world's urban population cannot meet their basic needs for shelter, water, and health from their resources (UNFPA, 2007).

Charcoal production, extraction and consumption in South Sudan represent a key livelihood activity for thousands of rural producers, a key economic activity in urban centers, and potential foreign-exchange earning resource. It is the key household energy input for the majority of urban South Sudanese. Contrastingly, it is also as driver of habitat degradation, undermining ecosystem goods and services upon which the majority of South Sudanese directly depend, and ultimately a contributing factor to global climate change.

Employment is extremely low and the youth have no means of earning income except to turn to hard tasks that pay little such as burning wood to produce charcoal. The pandemic restrictions also led to South Sudanese citizens returning from neighboring countries, with some taking up charcoal production to replace lost economic or educational opportunities in countries under lockdown (Trader, 2020).

Large-scale charcoal production was evident throughout the area and respondents indicated that almost all of the charcoal was destined for Juba. Respondents estimated that more than 95 per cent of Juba residents use charcoal as their primary fuel source. Charcoal is sold at an average of 5000 SSP per 50kg sack at the roadside in Juba City, whereas prices outside Juba are often 2500 SSP or more for the same size sack. The economic incentive to serve Juba with biomass is apparent. Survey respondents also indicated that charcoal production was becoming a very popular way to generate income quickly, and that even rural consumption is growing, particularly in roadside shops at the village level. It is unknown how many tonnes of charcoal are sent to urban centers like Juba on a daily basis. However, the scale of production and transport witnessed during the assessment indicated that this number is significant and without regulation, could add substantially to deforestation trends, particularly as neighboring countries such as Kenya and Uganda tighten restrictions on their own charcoal sources.

Domestic trade in charcoal is allowed because, other than wood fuels, there is no alternative source of energy for the majority of people in South Sudan. Charcoal production is effectively unregulated at local level. Producers neither have licenses nor are they required to get a license, according to government officials. ‘Production of charcoal has been allowed simply because we don’t have alternative sources of energy so far,’ said a MoEF Director General, but ‘production is only legal for local consumption, not for export. Economic recession and increasing price of fuel from crude oil such as petrol, kerosene, and the popular cooking gas have made a lot of households turn to the use of charcoal which is a more affordable and economical option (Simone Haysom, *Black Gold: The Charcoal Grey Market in Kenya, Uganda and South Sudan*, 2021).

2.5 Forest Use and Land Degradation

2.5.1 Types of Land Cover in South Sudan

Estimates by Global Forest Watch for 2010, which exclusively focuses on forest cover only. When compared to other types of land cover, forests and woodlands constitute the second most common type of land cover in terms of hectares, constituting more than 32% of land in South Sudan (Global Forest Watch 2021). This includes plantations with different species of teak and mahogany (Ministry of Agriculture, Forestry, Cooperatives and Rural Development, 2015). As indicated in the (Table 1), bush lands are the most frequent type of land cover in the country. The Global Forest Watch provides the most recent information available on deforestation rates in South Sudan; the organization estimates that in 2000, the country had 18% tree cover and in 2015, 11% of the country’s land was forest. The organization’s data indicates that Western Equatoria and Central Equatoria accounted for two-thirds of deforestation observed between 2001 and 2019, a total loss of over 123 kilo hectares (1.1% of total tree cover).

Table 1 Types of Land Cover in South Sudan

| Type of Land Cover | Hectares | % of Total |
|----------------------|-------------------|------------|
| Agricultural Lands | 2,777,226 | 4.22 |
| Forest and woodlands | 21,335,672 | 32.38 |
| Bush lands | 26,039,167 | 39.52 |
| Grasslands | 15,067,996 | 22.87 |
| Urban areas | 34,190 | 0.05 |
| Bare lands | 179,429 | 0.27 |
| Water bodies | 463,641 | 0.7 |
| Total | 65,887,321 | |

Source (Global Forest Watch, 2021)

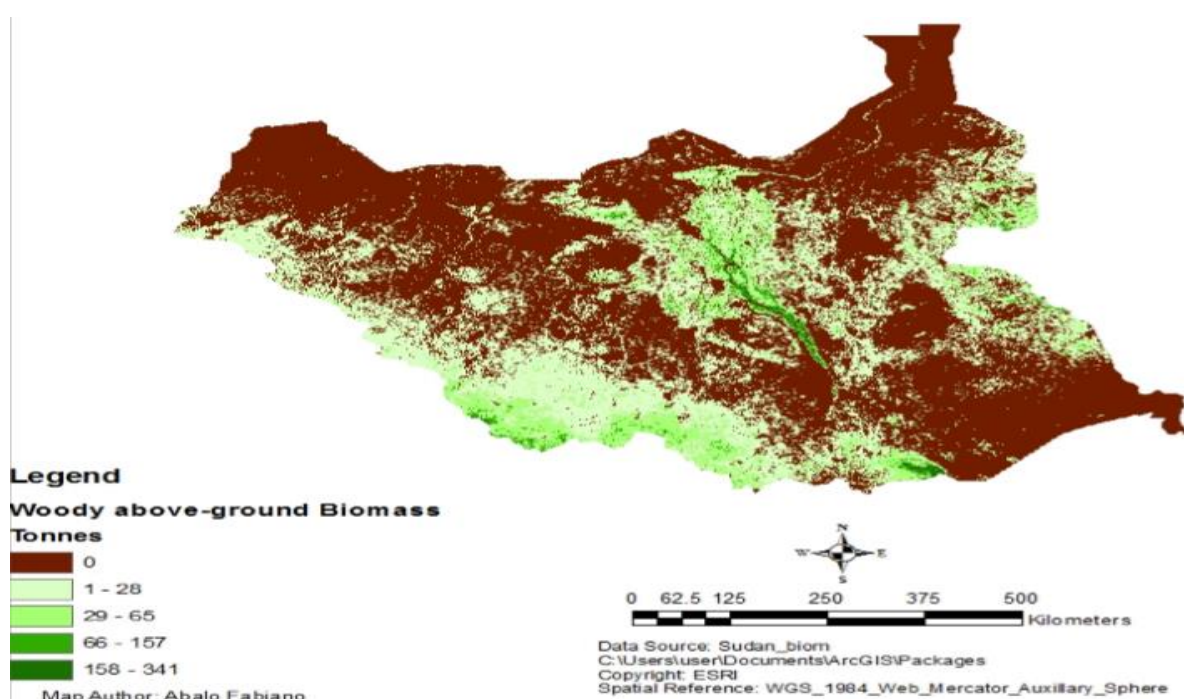


Figure 2 A map of South Sudan showing above-ground woody biomass (Fabiano, 2018)

The above map illustrates how much forest cover the country now has after the many years of on-going dependencies on it for firewood and charcoal production. It shows devastating results of the above-ground woody biomass. The whole country is very low on forests as can be visibly seen in the figure above. The only regions with about 341 tons of above-ground woody biomass are the western region, central and eastern regions. The possible explanation for the more above-ground woody biomass in the west could be due to the influence and the stretch of the Congo forests where as in the east and central, the reason could be due to the impact of the

Sudd swamp. “The Sudd swamp is the so far the largest wetland in the world and is characterized by very thick vegetation cover across the area it covers” (Fabiano, 2018)

Other remaining regions of South Sudan have very low to relatively zero above-ground woody biomass cover. In relation to the country’s overall surface area, the above-ground woody biomass cover is very low in comparison to other countries receiving similar climatic conditions such as Uganda and Kenya. The possible explanation to this is the high dependency on forests for energy fuels (firewood and charcoal). Therefore, most of the country’s forests have been extracted by firewood and charcoal retailers and entrepreneurs. (Fabiano, 2018)

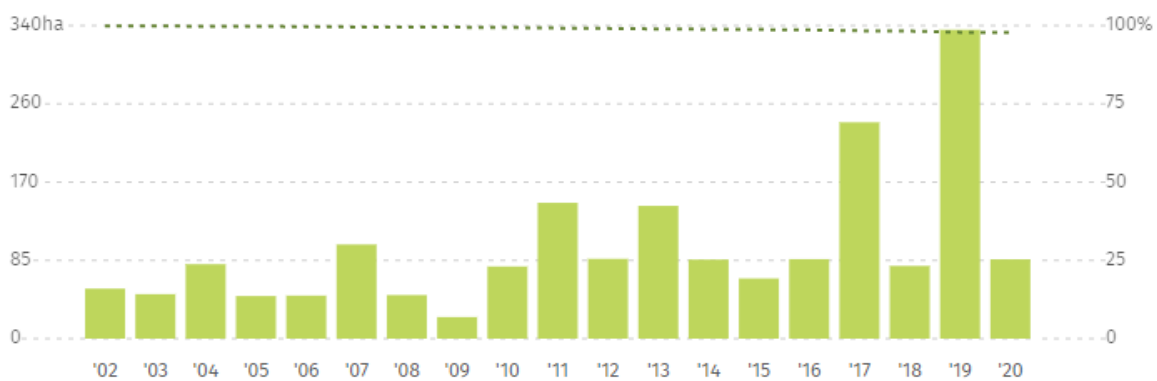


Figure 3: Primary Forest Loss in South Sudan (Global Forest Watch, 2021)

Theoretically, the use of forest resources in South Sudan is controlled by Payams – local administrative units, led by traditional authorities – that decide how communal land can be used, and by whom. In practice, however, land tenure in South Sudan is a fraught issue that has become highly complicated through waves of conflict-induced displacement, settlement and return. Returnees in particular have often cut down forests to create farmland or have turned to harvesting trees when they find that communal land is no longer agriculturally productive.⁵⁰ Displaced populations, who often have no access to land for farming, often find themselves in a similar position, and so over-exploit forest resources, which are not well regulated. UNEP and FAO estimate that the country’s forest cover is approximately 29% per cent (UNEP, 2010). Previous estimates of South Sudan’s annual deforestation rate have been in the range of 0.77 per cent per annum (FAO, 2006) to more than 1.87 per cent (UNEP, 2010) but reliable baselines for the country of South Sudan are non-existent at this point. Previously FAO had estimated that between the years 1990 to 2000, Sudan lost 589,000 hectares (5,890 km²) of forest per year (FAO, 2006). Additionally, the (UNEP, 2007) environmental assessment of all of Sudan shows that the overall rate of deforestation between 2000-2005 increased by 8.4 per cent from FAO’s estimate, to 0.84 per cent per annum. The UNEP team concluded this rate would likely increase in post-conflict environments, so that by the year roughly 2050; South Sudan could achieve complete deforestation, based on a linear deforestation model. Forest cover loss can be caused by many processes, and may be temporary or permanent depending on the land use. Drivers of forest cover change, similarly, may be limited in temporal and spatial extent and

may consist of primary and secondary drivers. In the Equatoria, the primary drivers of forest cover change reported by respondents during the assessment were the production of timber, charcoal, agriculture and unmanaged fire. The secondary drivers could largely be aggregated as a lack of socioeconomic alternatives and capacity gaps particularly in education.

In Central Equatoria specifically, I witnessed large-scale extraction of timber from both concessionary teak and from natural forests, specifically mahogany from *Khaya* sp. Rural producers receive relatively small sums for sawn timber but prices may triple by the time the product reaches the market in urban areas. Survey respondents indicated that mahogany is preferable for building in places like Juba but that softwood alternatives such as *Cedrela toona* are also available. However, without demand, foresters are not targeting softwoods for market. Without a comprehensive legal framework it is difficult to assess whether or not these supplies qualify as 'legal'. However, the volume of extraction is substantial and largely driven by demand in urban centers like Juba. I noted that several major humanitarian NGOs are also relying heavily on mahogany and other timber from natural forests for their operations, exacerbating forest degradation in the rural areas, reportedly because the cost is low (Adkins, *Forestry and Prospects for Stability, Livelihoods and Peace-Building in the Equatorial States of South Sudan*, 2015).

According to the 2018 South Sudan first environment outlook report, 96 percent of the local population depends on charcoal for cooking resulting in rapid deforestation in South Sudan. This is attributed to the fact that South Sudan produces and consumes almost all of its own charcoal. This is a phenomenon of the last 15 years: the signing of the 2005 CPA introduced a period of relatively greater peace (and higher international investment), and the development of better transport routes, and hence more efficient and interconnected markets, including those for charcoal. Central Equatoria and Eastern Equatoria states are the main regions of production for charcoal destined for Juba, which is the biggest market for charcoal in the country. Lorries heading to Juba use one of four roads: the Juba–Bor road, the Juba–Mundri road, the Juba–Nimule road or the Juba–Yei road. But like other goods, the transport of charcoal across South Sudan is seriously impeded by heavy rains (which wash away roads) and insecurity, with goods subject to ambush by rebel forces in some parts of the country, notably along the Juba–Nimule road. As well as having a fast-growing consumer market for charcoal, South Sudan is considered to be an important regional exporter. The ministerial order that came into effect in 2018 has been successful at stopping international export of South Sudanese charcoal from Juba (by air) or via Nimule, but charcoal is still smuggled through more remote border crossings and through the northern border to Sudan. Some truck drivers returning from Democratic Republic of Congo, Central African Republic and South Sudan act as brokers as well as transporters in the charcoal supply chain, moving the product through northern Ugandan provinces to the Kenya border at Busia.

2.6 Gap Analysis

Based on the results of this assessment, the researcher has noted a number of gaps in the current forestry sector. In order to avoid exacerbating tensions in the sector, it is assumed that addressing these gaps could avoid future conflicts involving forests and forest-based resources in the Equatoria. The ultimate goal in this is to understand the socio-economic and environmental implications of charcoal production, marketing and consumption in Juba, to know who is directly involved in the business from production to marketing with the aim to generate and increase awareness among the general public and review policies by the key stakeholders in order to mitigate the environmental impacts. The gaps identified are as follows:

1. Lack of quantitative analysis on knowing just how much charcoal was consumed in the city. In order to combat the adverse effects of deforestation, a study should be carried out to know how much tree cover is being lost daily due to charcoal production.
2. Previous research undertaken on the topic did not clearly state the stakeholders involved in the charcoal business in Juba, what percentage of the stakeholders are nationals/ foreigners? How much profit are they receiving from the business?
3. A third key gap was the lack of a long-term strategy for addressing the challenges that would be associated with climate change in South Sudan. The links between forest land use change, warming, and conflict over resources are well established (Schilling, 2017). Although integrating climate change considerations is a challenge that most countries in the world are only beginning to tackle, South Sudan's unique vulnerabilities, coupled with its high level of natural forest coverage, create an environment of opportunity to enact broad-reaching climate change mitigation programming. Integrating climate change strategies into ongoing programming is also an important opportunity for building resilience to shocks such as droughts.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This report summarizes the methods used by the researcher. The information gathered from the region through face-to-face interviews with stakeholders, households, charcoal producers, and charcoal retailers. It presents the research design, study population, sampling method, sample size, data collection tools, validity and reliability, measurement of variables and data analysis. The main findings are presented, alternative fuels discussed, and recommendations are put forward.

3.2 Study Area

The study was carried out in Juba City, the capital of South Sudan. Ecologically, forests in the Equatoria fall in the category of mixed deciduous fire-swept forest as described by (Smith, 1949) which forms a belt across the southern portion of the country and are further divided into zones dependent on rainfall and soil types. These forests experience a bi-modal precipitation pattern with between 800mm to 1500mm falling annually, mostly between April and July and again in November and December, increasing in volume as one moves westwards. The GFW, a project of the World Resource Institute (WRI) analyzed remote sensing data over the period of 2000- 2013 and through this process estimated that southern Sudan's forest estate was roughly 33 million hectares as of the year 2000 but that South Sudan lost approximately 154,114 hectares by the end of 2013. This estimation is based on using the FAO default forest definition of at least 0.5 hectares area, 15 percent canopy cover, and at least 5m at maturity (FAO, 2006). Using either estimate, it is safe to say that a significant portion of the country is covered in forest.

Juba is the seat of the Government of South Sudan as well as the capital of Central Equatoria State (CES). It comprises of three of the 16 Payams of Juba County: Juba, Kator and Munuki. The border of the municipality is however not clearly defined, and as the city has expanded it has incorporated surrounding rural Payams, namely Northern Bari and Rajaf. The urbanised area of Juba was estimated at around 52km² in 2009 (JICA, 2009), though Greater Juba, including sparsely-built areas, takes up some 336km² (OCHA, 2007). Since 2005, Juba has mainly expanded westwards (west of Munuki Payam towards Gudele, Gurei and Northern Bari) and southwards, towards Rajaf Payam, including Tokimaan on the Yei road. Population density tends to be much higher in un-demarcated areas than in the demarcated areas in Juba and Kator Payams in the center of town.

3.3 Research Design

The research study used a mixed methods design that comprised a case-control quantitative study, qualitative interviews in the Ministries/institution and residents in Juba city. It was formally under; Key informant interviews and focus group discussions and personal observation. To extract the required information needed to meet the objectives of the study, four major techniques were employed in the study: household survey questionnaires, key informant interviews, focus group discussion, personal observation and secondary data and document review.

The data for this report was gathered from this survey carrying out by CSPS in Juba city to collect data regarding the social and economic impacts of the charcoal business, charcoal as a means of livelihood and its demand as a fuel in the city and why it is preferred to other forms of fuel.

3.4 Data Collection

Data collection techniques refer to the device used to collect data, such as survey, interview guide and a paper questionnaire or computer assisted interviewing system. The charcoal survey targeted a sample size of 80 people: 30 consumers, 30 retailers, 5 producers and 5 transporters, 7 government officials directly related to the sector and 3 academic experts. The survey was done in Juba City and was conducted under the Statistics Act, which makes it mandatory for all business establishments operating in Juba to respond to Statistical data requests. The Act also stipulates that the content of individual returns received would be kept confidential and used only for statistical purposes. An invitation letter signed by the Statistician General was enclosed with all questionnaires to encourage the sample population to provide the relevant data relating to their businesses and to assure them of the confidentiality of the data collected.

3.4.1 Key Informant Interview

There are key institutions that are directly involved with the charcoal business sector in South Sudan. The directorates of Ministry of Environment and Forestry; provided all the details on policies concerning the business and its environmental impacts, Juba City Council and Ministry of Energy for statistical data on demand for fuels. This research work has addressed these groups of individuals using personal interviews on what has been done to curb the adverse effects of deforestation and how the policies are implemented to work effectively in protecting the country's natural forests. The interview involved was a face-to-face basis with the key informants. In order to have in-depth interviews with these responsible individuals, the interview was conducted by the researcher. Other individuals who were interviewed were the chambers of Commerce, Senior staff of College of Natural Resources and Environmental Studies- University of Juba, School of Social and Economic Studies, a Renewable Energy Engineer who is also a policy expert in the field and the Executive Director of Koneta Hub, a youth led organization focusing on finding more effective energy solutions for the rising demand.

3.4.2. Personal Observation

The researcher used observation as an additional means to the data collection which helped in tallying approximately how many retailers are involved in the charcoal business in a given market.

3.4.3. Document Review

In addition to the primary data, the researcher tried to collect written documents from the Payam, counties within Juba city, reports and publications on Charcoal in Juba, South Sudan, East Africa region, Africa and worldwide. Documents have also been reviewed to see and understand what is being done to solve some of the problems.

3.4.4 Survey

The survey's aim was to give a short qualitative view of the suppliers, transporter's, retailers' and consumers' view on the charcoal business. This was done in order to characterize the stakeholders involved in the business in terms of gender, age, educational and income level, nationality and number. The survey was also done to assess the poverty/livelihood impacts of the charcoal industry.

The questionnaire was developed through a consultative process, wherein stakeholders were invited to make meaningful input to the proposed questions designed to capture employment information. A structure questionnaire was used to collect the information from retailers of charcoal in the data collection centers all over the city. The questionnaire captured information such as: Basic characteristics of the business and the business owners were income and expenditure of the business and consumption rate.

There were four types of questionnaires administered:

1. Household survey questionnaire

Sample households were surveyed in Juba town. The samples were chosen to represent members from each house category: small houses (two or fewer rooms), medium houses (three to four rooms), and large houses (five or more rooms). A systematic sampling was used involving every fourth house and changing directions while sampling. Thirty households were interviewed and the questionnaire administered is shown in the appendices. In order to get a more diverse sample size, 5 different areas around Juba were selected with 6 households from each area; Gudele, Gumbo, Munuki, Jebel and Juba Na Bari.

2. Charcoal producer questionnaire

Since the number of charcoal producers present in the city at any particular time is small due to their engagement in production in the bush, interviewing was based on their availability. Five charcoal producers were interviewed in Juba City in a detailed manner; charcoal producers were interviewed together with village leaders and elders. The questionnaire used is included in the appendices.

3. Charcoal retailer questionnaire

Thirty charcoal retailers were interviewed and their responses were recorded. The questionnaire employed is reported in the appendices.

4. Transporters Questionnaire

This questionnaire targeted charcoal motorized transporters that link the producers with the retailers. Five transporters involved in this business were selected for the interview.

3.5 Sampling Procedure

A sampling method was used to select sample members from a population. The researcher used both purposive sampling technique to select senior staff members of the directorate of Environment and Forestry in Juba to be used in the research and random sampling was used to obtain a good representative sample of other respondents from all over Juba city residents.

3.6 Validity and Reliability of Research Instruments

3.6.1 Validity

The validity of an instrument is defined as the ability to an instrument to measure what was intended to measure. In this study, the validity of the instruments was established by a panel of experts through an assessment of selected items in the instruments that ensured that the instruments are measuring to the expectations. After identifying the vague and ambiguous questions, corrections were made and final instruments were prepared. Content validity index (C.V.I) was measured as items rated 3 or 4 by both judges divided by the total number of items in the questionnaire.

3.6.2 Reliability

Reliability refers to the ability of a measurement instrument to produce the same answer in the same circumstances, time after time. This means that if people answer the same question the same way on repeated occasions, then the instrument can be said to be reliable. Reliability (Internal consistency and stability) of the instruments were tested using coefficients. The researcher tested the inter-item consistency reliability to ensure that there is the consistency of respondents' answers to all items in the measure. A coefficient of reliability that gives unbiased estimate of data generalizability was used to test reliability of the answered questionnaires.

3.7. Data Analysis Method

In assessing the case of Juba city the researcher applied a case study design which is concerned with the nature of the charcoal business in which the researcher utilized mainly a qualitative approach, although some quantification was used with percentages.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Brief Overview of the Study

The aim of the study was to give a short qualitative view of people engaged in the charcoal business, with specific attention to indicators in order to characterize the sector of carriers involved in the supply and distribution of charcoal within Juba City. This assessment was carried out in order to understand the socio-economic and environmental implications of charcoal production, marketing and consumption in Juba. In addition to map and document all those who are directly involved in the charcoal production and marketing with the aim to generate and increase awareness among the general public and review policies by the key stake holders in order to mitigate the environmental impacts associated with the charcoal industry.

The study used both primary and secondary data generated through literature review of past charcoal studies including; status reports from relevant ministries and government agencies notably the Ministry of Environment and Forestry and Ministry of Energy and Dams, academic literature, project reports, business reports and available statistics (State Ministry of Forestry and Environment) on the charcoal-analysis of the charcoal business. Other sources of data were workshop proceedings and web posted documents. Literature relating to value chain and best practices in the sub-Sahara African region was also analyzed.

Charcoal production is expected to continue increasing in the coming years with an increase in demand and no alternatives sources of energy. The study was also carried out to determine how much charcoal is being transported and the consumption in Juba with an answered mystery of how many trees are being destroyed to produce this valuable, but destructive energy. Due to absence of coherent policies, charcoal production, transportation and distribution remain, above all, informal and unregulated – rendering them inefficient and risky.

The following data were generated via a primary source from 60 questionnaires responded to by different actors in the charcoal value chain; ranging from charcoal consumers, retailers, transporters and producers. Key informant interviews were also conducted with different individuals in the ministries; Ministry of Environment and Forestry and the Ministry of Forestry at state level, Local NGOs and Higher Learning Institutions involved with the Environment and Forestry sector and policy experts.

4.2 General Characteristics and Study Population in Juba City

Data Analysis Methods

Three classes of data were captured during the survey: data that categorizes and describes people, data that categorizes behavior of people and data that reveals perceptions, attitudes, opinions and beliefs. Typical topics used to address this data include: knowledge, perceptions, behavior, attitude and demographics. This data were analyzed using Excel spread sheets. JASP, statistical software was also used during the study.

4.2.1 Consumer Data Analysis

Charcoal is sold in all major markets of Juba City and on the roadside as well as out of small retail shops: A 50kg sack at 5000SSP and 2kg bags at 300SSP. The key actors in charcoal consumption are the consumers.

4.2.1.1 Data and Modeling Approach

The data analysis was carried out using Microsoft Excel where all the consumers were listed and each of their responses was written next to them. From the total of 30 consumers, the following are the responses that were received.

4.2.1.2 Classification of Consumers

The 30 respondents were grouped based on gender and segregated to 19 female and 11 male respondents. This is attributed to the fact that most restaurants are owned and run by women. At household level, women knew more about their charcoal consumption rates.

No correspondents were observed to be less than 20 years of age; the majority of the respondents 16 in number were between the ages of 20 to 30 years old; 5 participants were between the ages 31 to 40 years; 7 participants were between the ages 41 to 50 and only 2 participants were above 50 years old. (Figure 4)

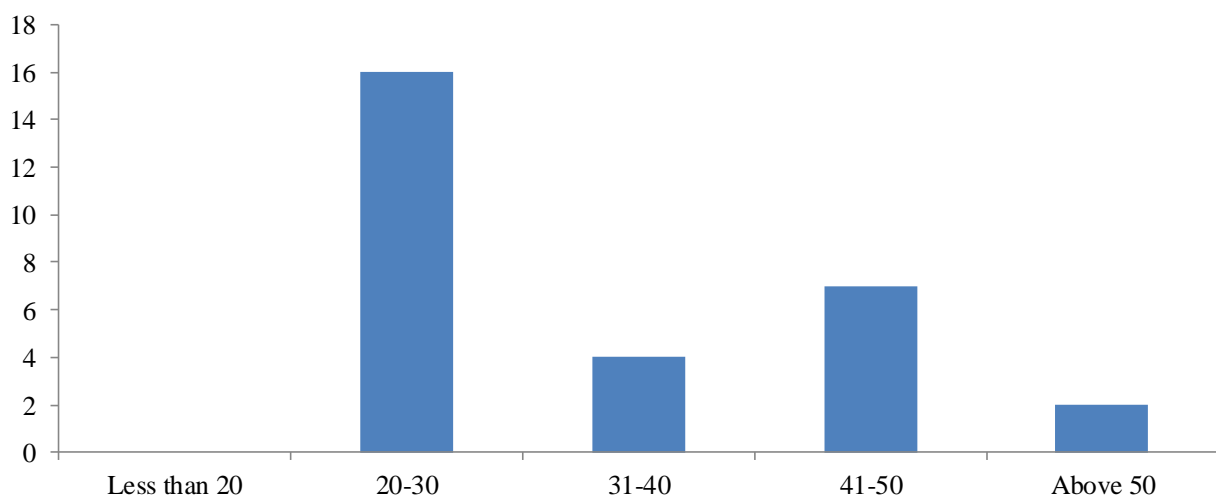


Figure 4 Age of respondents

For the study, purposive sampling was used in choosing the different respondents. This technique is essential to find the people who have similar background knowledge and experience, and also to incorporate the population density and the geographic location as described by (Etikan, 2016).

The charcoal consumers could be categorized into two groups: 1. business; under this group, the consumers use the charcoal produced to run their business such as restaurants, tea and coffee owners and pastry chefs. Household consumers are those that use the charcoal for their home energy needs. More business owners were selected because businesses often tend to use more energy than households. 17 out of the 30 consumers were business owners and 13 of the 30 consumers were household consumers.

26 out of 30 of the correspondents were South Sudanese. Majority of South Sudanese were selected because they were more willing to answer the questions and the research topic mostly involves South Sudanese in their country. Other nationalities were also selected to get a diverse view such as 3 Ugandans and 1 Ethiopian.

The correspondents who participated in the survey have different levels of education. One out of the 30 never had formal education, 6 of the participants ended in Primary level, 10 of the 30 ended in High School, 9 had finished their Diploma/ Bachelor's Degree and 4 participants had Masters. This study has shown that there is a positive relationship between education and knowledge about the impacts of the charcoal business on the environment; correspondents who have undergone a formal education gave more insight on the effects of deforestation on the climate of South Sudan and also gave a more detailed recommendation or way forward. This finding agrees with the study done by (Vandamme, 2009) in an attempt to encourage sustainable consumption of charcoal, establishing the responsiveness of the common people on the health effects and environmental impact of the usage of charcoal is a vital factor. This is where a knowledge, attitude and practice (KAP) survey becomes necessary. According to Vandamme, the KAP survey investigates human behavior related to a certain topic, and simultaneously identifies what people know (knowledge), how they feel (attitude), and what they do (practice). Such a survey proposes that knowledge forms attitude, and both knowledge and attitude are the building blocks for practice (Noor, 2015).

The low levels of education could be attributed to high poverty levels, lack of motivation to pursue higher education and a lack of opportunities as stated by one correspondent, "I did not go to school because there were no schools in my area as I was growing up".

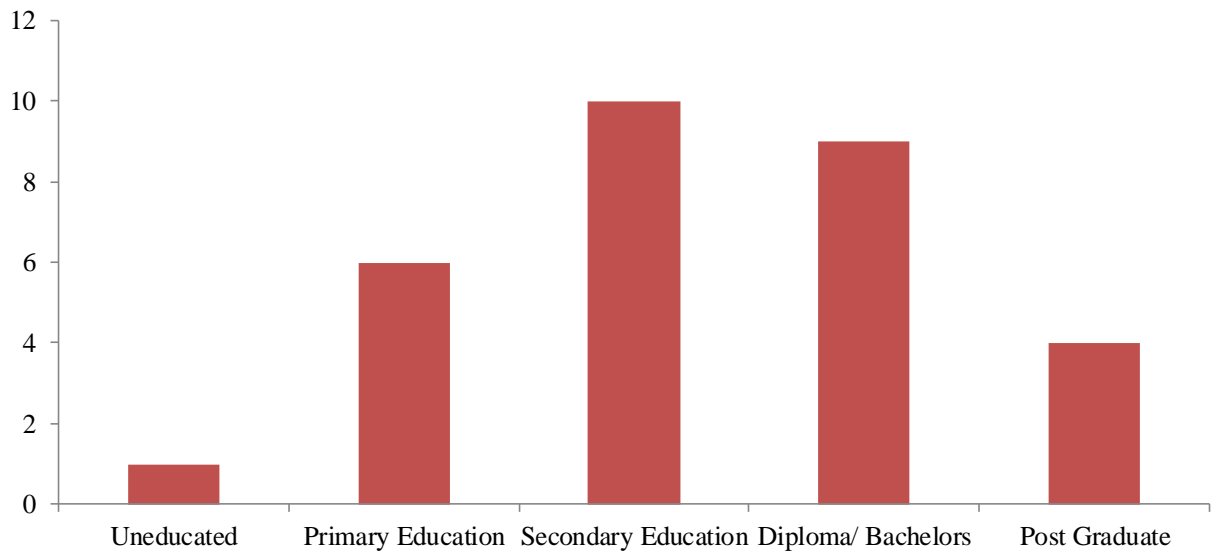


Figure 5 Level of Education

During the study, 7 Correspondents were from Juba City, 4 from Jebel Market, 7 from Juba Na Bari residential area and Gudele, 3 from Munuki and 1 each from Custom and Konyokonyo. A large number of participants from Custom and Konyokonyo were charcoal retailers.

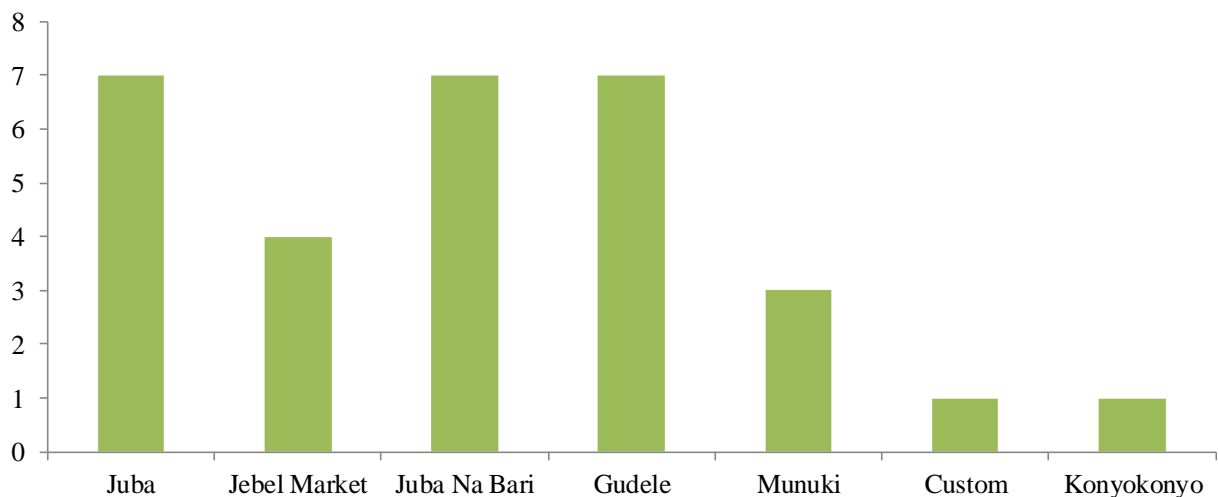


Figure 6: Location of Correspondents

4.2.1.2.1 Size of Consumers

Business

Thirty respondents were interviewed out of which 17 (57%) were business owners and in order to carry out the questionnaire, the size of the business was assessed by asking how many consumers per day visit their business. The respondents were selected using a random sampling technique. From the chart below, most of the business receive over 50 customers per day with 37.5% of the business interviewed have more than 50 customers daily, followed by businesses

with 21-30 customers (25%), 11-20 customers (18.75%), 31-40 customers (12.5%) and 0-10 customers (6.25%). No business fell under the 41-50 customers per day category (Figure 7). This was done in order to know the correlation between the size of the business and the consumption of charcoal.

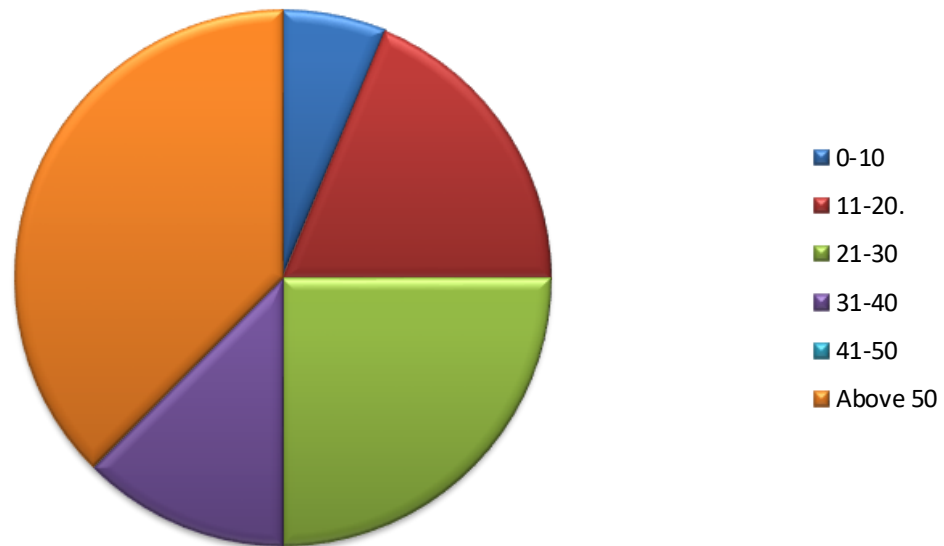


Figure 7 Size of the business

Pearson correlation analysis between income level, size of the business and charcoal consumption rate as depicted in (table 1), revealed that business size had a positive relationship with income level and level of consumption of charcoal. It has been observed that the larger the business, the higher the income and the larger the demand for charcoal. Smaller businesses such as tea businesses that were interviewed used less sacks of charcoal per month compared to restaurants that received 40-100 customers per day.

Table 2: Pearson correlations analysis relating business size and charcoal consumption rate

| Variable | | Customer/month | Income level/month | Charcoal Consumption (sack/month) |
|--------------------------------------|--------------|----------------|--------------------|-----------------------------------|
| 1. Customers/month | Pearson's r | - | | |
| | p-value | - | | |
| | Upper 95% CI | - | | |
| | Lower 95% CI | - | | |
| | | | | |
| 2. Income Level/month | Pearson's r | 0.67 | - | |
| | p-value | 0.003 | - | |
| | Upper 95% CI | 0.87 | - | |
| | Lower 95% CI | 0.23 | - | |
| | | | | |
| 3. Charcoal Consumption (sack/month) | Pearson's r | 0.56 | 0.76 | - |
| | p-value | 0.02 | ≤0.001 | - |
| | Upper 95% CI | 0.82 | 0.91 | - |
| | Lower 95% CI | 0.11 | 0.43 | - |
| | | | | |

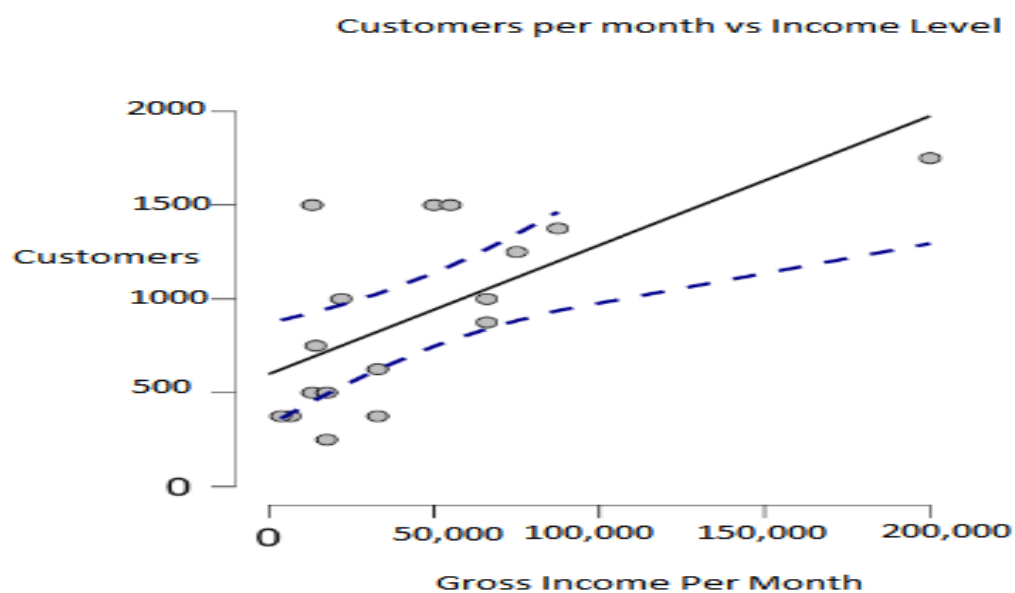


Figure 8 Number of customers vs. monthly income

Households

Households that had 6-10 members in the family (69%), 0-5 members (15%) and 11-15 members (15%) and no households had 16-20 and above 20 members.

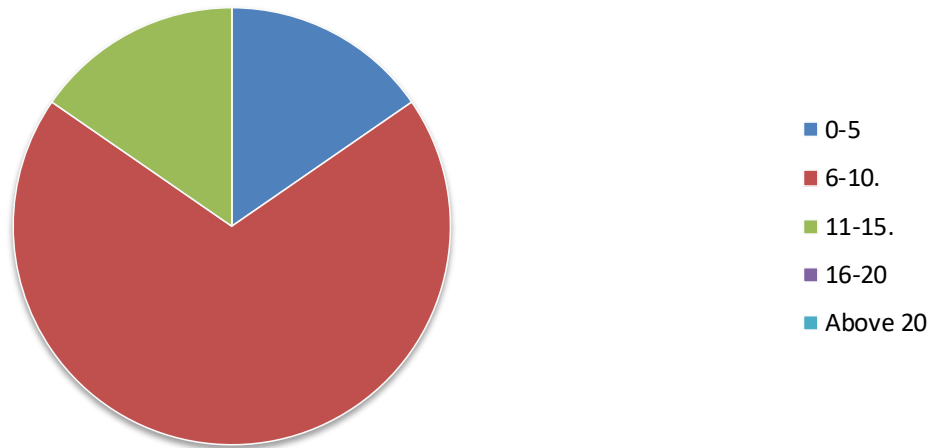


Figure 9 Respondents household size

4.2.1.2.2 Consumers Income Level

55% of the businesses receive more than 250,000SSP per month. 17% of the business receive between 150,000-200,000SSP per month. 11% of businesses receive 50,000-100,000SSP and 100, 000-150,000SSP per month and 6% of the businesses earned less than 50,000SSP per month. There is a linear relationship observed between consumers' income level and their consumption of charcoal as seen from (table 1). However, this relationship is only observed in Businesses and not in households.

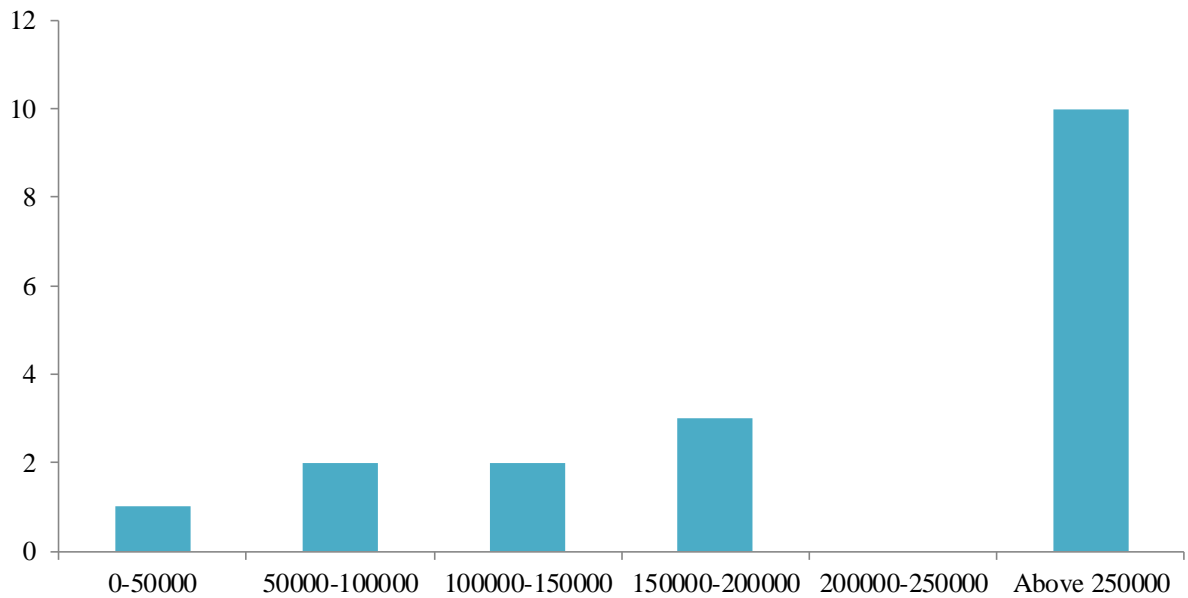


Figure 10 Business respondents' income level

4.2.1.2.3 Length of Use

Households were asked for how long they used charcoal for energy and 1 household out of the 13 (7%) of the total do not use charcoal but rather use gas for their energy needs. None of the households have used charcoal for less than 5 years (0%), 15% of households have used charcoal for 5-10 years, 23% of households have used it for 11-15 years, the majority of households, 53% of households have been using charcoal for more than 15 years. When asked, the respondents replied that they have used charcoal for as long as they have stayed in South Sudan i.e. respondents who used charcoal for 10 years have lived in South Sudan for 10 years but prior to that have been living in other countries where the primary fuel for cooking is gas cylinders and electricity.

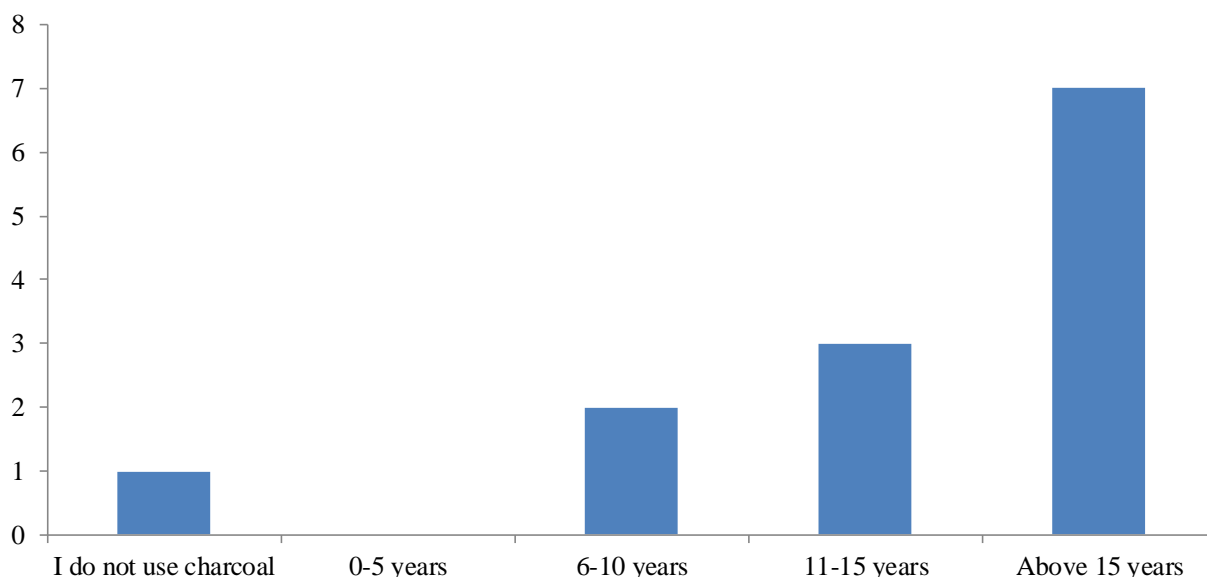


Figure 11 Length of charcoal use by households

When the respondents were interviewed, it was understood that their duration of using charcoal for energy is as a result of their migration to South Sudan since most families came back to the country they have not been using any other source of fuel. It can therefore be deduced that the length of charcoal use is the same as the length of stay in the country.

For businesses on the other hand, the question asked was for how long the business has been on operation because charcoal has been the only source of fuel for energy, it would be absurd to ask how long they have used charcoal, rather, a better question would be for how long the business has been operating. A high number of businesses (41%) of the total were less than 5 years old, and 29% of the businesses were 3-5 years and above 5 years each. This clearly tells us that most of the businesses in Juba, as a result of rapid urbanization and from observation, are still new. This implies that the demand for charcoal is much higher than it has been 5 years ago.

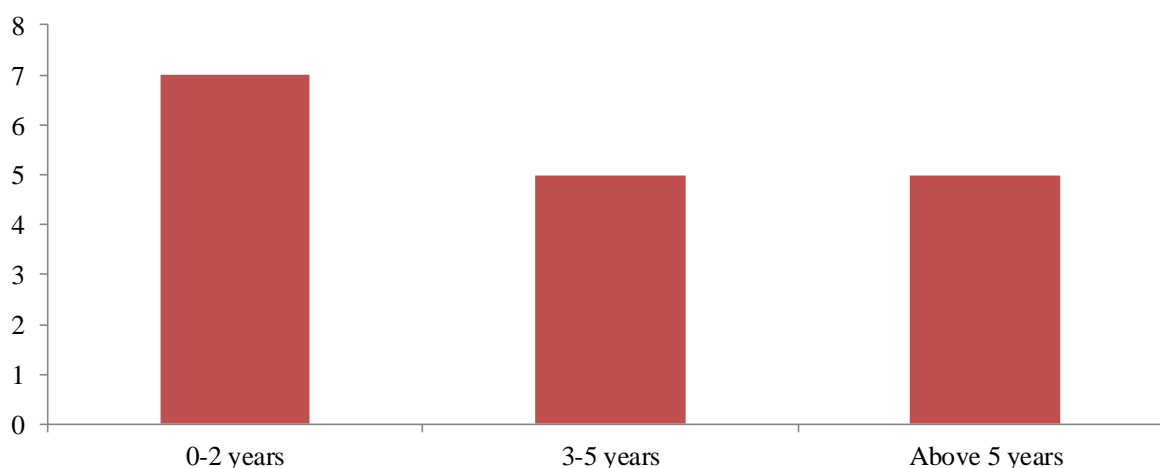


Figure 12 Age of business

4.2.1.2.4 Charcoal Consumption Rate

I. Household Consumption Per Annum

7.6% of household consumers do not use charcoal as their source of energy, 38% use 1 sack of charcoal per month, there are a few reasons behind this; these households do not use charcoal as their only source of fuel but rather have gas as a backup for breakfast and emergencies like boiling water and cooking foods that do not take time. The other reason is that there are few members in the household since it is impractical to have a household of 10-20 members use 1 sack of charcoal for their daily family needs with no alternative. 46% of households, the majority of the people, use 2 sacks of charcoal per month and 7.8% of the households use 3 sacks of charcoal per month.

A limiting factor for the project is a lack of recent census data that would help estimate the overall charcoal consumption rate across the Capital. However, it is estimated that the Capital has a population of 403,000. An average household has 6 members according to the survey:

$403,000/6 = 67,000$ Households in Juba

The average consumption rate of charcoal is 2 sacks per month

Annun Consumption Rate: 2 sacks x 12 = 24 sacks per annum

The average household consumption rate in Juba: $67,000 \times 24 = 1,608,000$ Sacks per annum

Turnover/ Value for Juba:

Taking the average price of one sack as 4500 SSP

$1,608,000 \text{ sacks} \times 4500 \text{ SSP} = 7,236,000,000 \text{ SSP} = 17 \text{ Million USD}$

II. Business Consumption Rate Per Annum

58.8% of the businesses reported to have less than 10 customers per day, 17.7% of the businesses reported 11-20 and 21-30 customers per day and 6% of the businesses claimed to have more than 30 customers per day some of which reported to have almost 100 customers in their businesses daily. The low numbers observed are due to the fact that the business owners reported that days are different; there are days where they would receive a good number of customers and other days where the numbers are very low. An average of both extremes were taken and used as the number of customers per day. 3% of the consumers buy a sack of charcoal for less than 3000SSP; charcoal is sold for 2500SSP outside Juba from Soldiers and locals. 13% buy charcoal at 400SSP whereas the majority of the consumers buy a sack at 4500SSP, 20% buy a sack for 5000SSP and 16.7% buy charcoal for more than 5000SSP as shown in (figure 13):

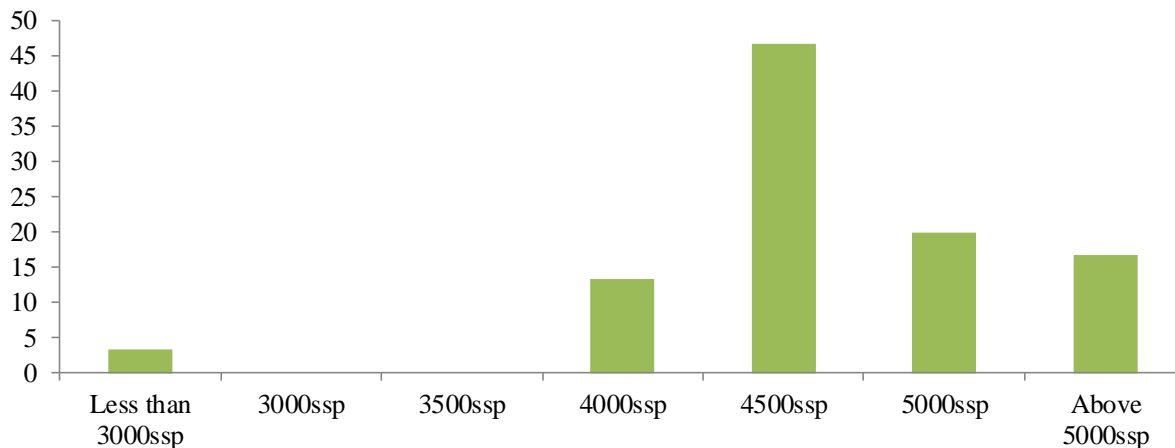


Figure 13 Selling price of charcoal

4.2.1.2.5 Aware of Environmental Impacts

The level of edification of the target about the environmental impacts is a key tool for empowering the populace on taking necessary steps to mitigate those impacts. The knowledge aspects, when combined with techniques could be applied to actions, which is effective in policy making and implementation. Public awareness, when expanded down to the local citizens and local governments through formal and informal environmental education is an effective means of creating suitable awareness of serious environmental concerns. Besides, there is a need to develop an environmentally literate citizenry to empower the general public to develop a robust sense of accountability.

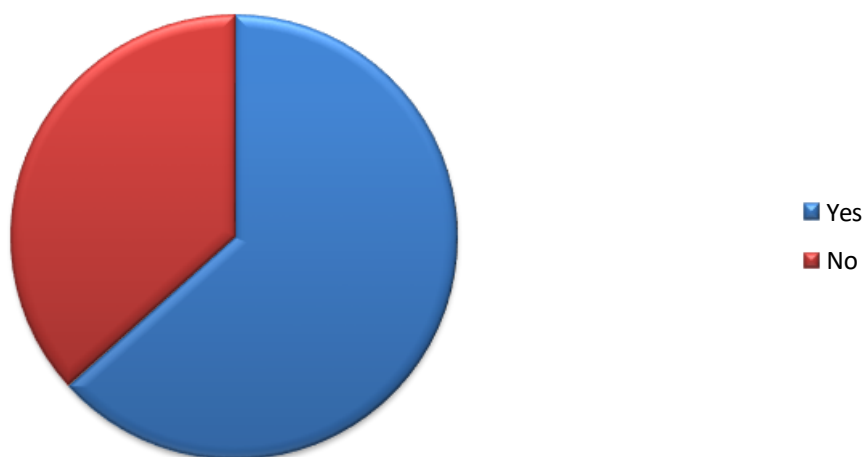


Figure 14 Aware of Environmental Impacts

From Figure 14, it is seen that 63.33% of the consumers are aware of the environmental impacts of the uncontrolled production of charcoal on the environment and 36.67% are not aware of the impacts. From those that are aware, it is observed that the consumers with formal education, high school and above could give a more detailed account of the impacts on the environment.

90% of the consumers said they would be willing to participate in protecting the environment when the need arises and 10% denied fearing insecurity and saying they simply did not have the time for that.

When asked further to explain how they felt about the impacts of charcoal on the environment, 36% of participants said they were devastated about the effects which include shortened rainfall periods, escalating temperatures, soil erosion, erotic winds and desertification. 30% of them said they felt bad/ sad about it, the respondents who did not know about the impacts from the previous question said they knew nothing about it and 15% of the correspondents feel threatened about the environmental impact this business has.

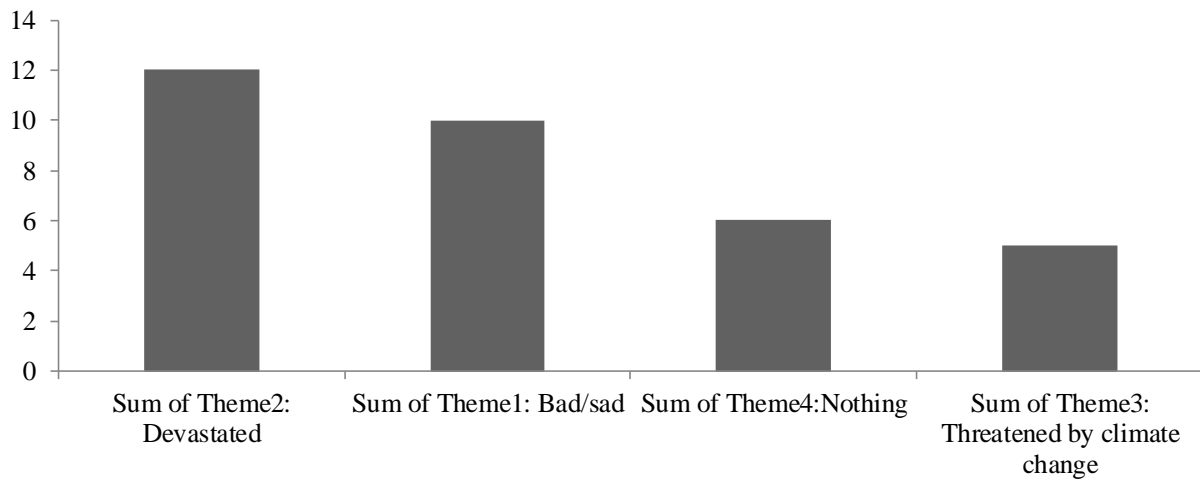


Figure 15 Respondents' prospection about environmental impact

4.2.1.3 Qualitative Data Analysis

Why charcoal is the preferred fuel

The consumers were asked why they preferred charcoal as their main source of fuel to get their perceptions and attitudes towards charcoal and other alternatives of fuel energy. From the analysis run in excel, under the different themes which describe the consumer's preferences, the following was responses were received:

From the following graph, most of the consumers preferred charcoal because it is cheaper than other sources of energy i.e., gas and electricity, this followed by the availability of charcoal in the area, some of the consumers went on and said that it is very easy to get charcoal, it can be found in shops, markets and anywhere else as opposed to gas which is found in only specific spots and electricity which is not available in the country yet. The next reason why charcoal is preferred is because alternatives are expensive and they simply could not afford it. Businesses would be making losses if they were to rely on other forms of energy to cook their foods, "it is impractical" as one of the correspondents said.

Surprisingly, other correspondents prefer to use alternative sources of energy stating that charcoal produces unhealthy fumes, is dirty and degrades the environment.

Other correspondents use gas from time to time for foods that do not consume time and other emergency situations like boiling water in the morning for tea. Some consumers stated that charcoal is clean, they compared charcoal to fuelwood and said fuelwood produces a lot of toxic fumes that makes it hard to breathe and impossible to use indoors. The next reason as to why consumers prefer charcoal is that there are no alternatives available. One correspondent stated that the country has not yet reached the level of using other forms of energy. Other reasons for their preference are; it is safe to use, reliable and efficient form of energy. The study agrees with (Yousif, 2021) which states that the major reason why consumers prefer charcoal to other alternatives for their energy needs is the affordability (60.9%). Charcoal remains the most affordable fuel option as compared to the other modern energy supplies. The second most prominent reason is the availability (15.2%) followed by the cleanliness when compared to kerosene and fuel wood (13.4%). Other preferences such as culture, safety and time saving were recorded.

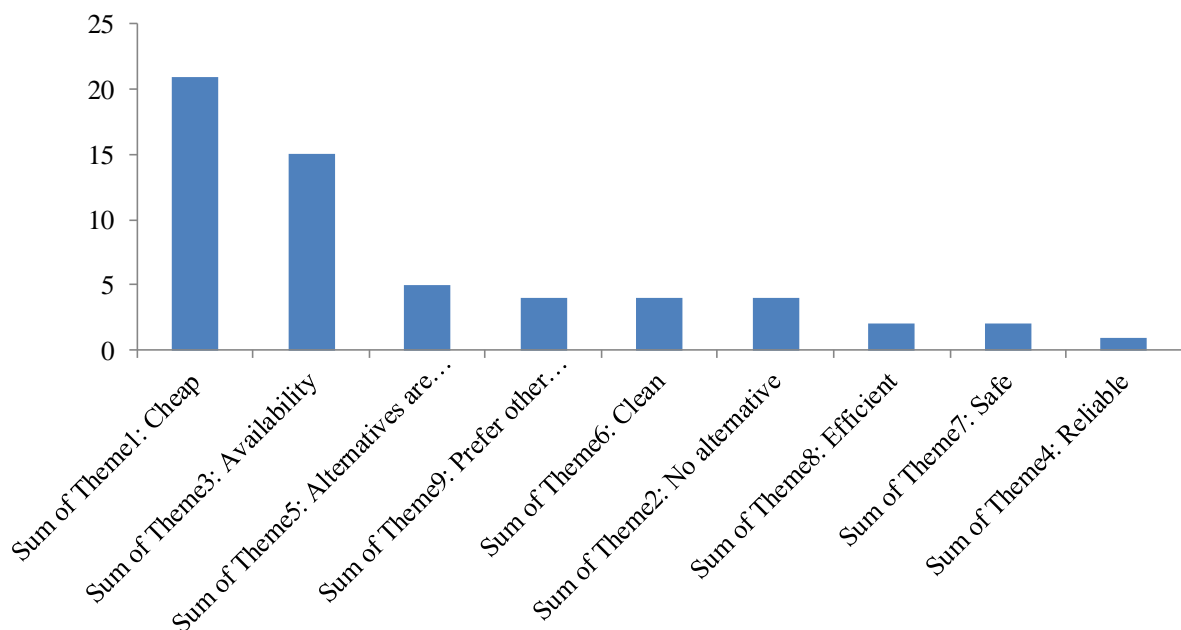


Figure 16 Consumers charcoal preference

4.2.2 Socio demographic characteristics, education and socio-economic status of Retailers

Out of 20 participants who took part in the retailers' survey, 12 (60%) were male and 8 (40%) were female. The charcoal retailing business is predominantly run by men, whereas women only sell charcoal in small bags. However, fair representations of 8 (40%) female retailers out of a total of 20 were selected for the study. Age wise, 35% of the correspondents were in the age group 20-30 and between the ages 31-40. 15% correspondents were between the ages 41-50 and above 50 as well. There were no correspondents below age 20. On the same note, 95% of the retailers were South Sudanese and 5% were Somali. The South Sudanese involved in the charcoal business are more saturated in the small scale/ direct selling of the charcoal to

consumers while the non-nationals are mostly the producers and transporters of the charcoal as will be seen later. The study equally revealed that 15% of the correspondents never had formal education, the majority (50%) only had a primary education, 25% had gone up to Secondary and 10% had reached the University (Figure 17).

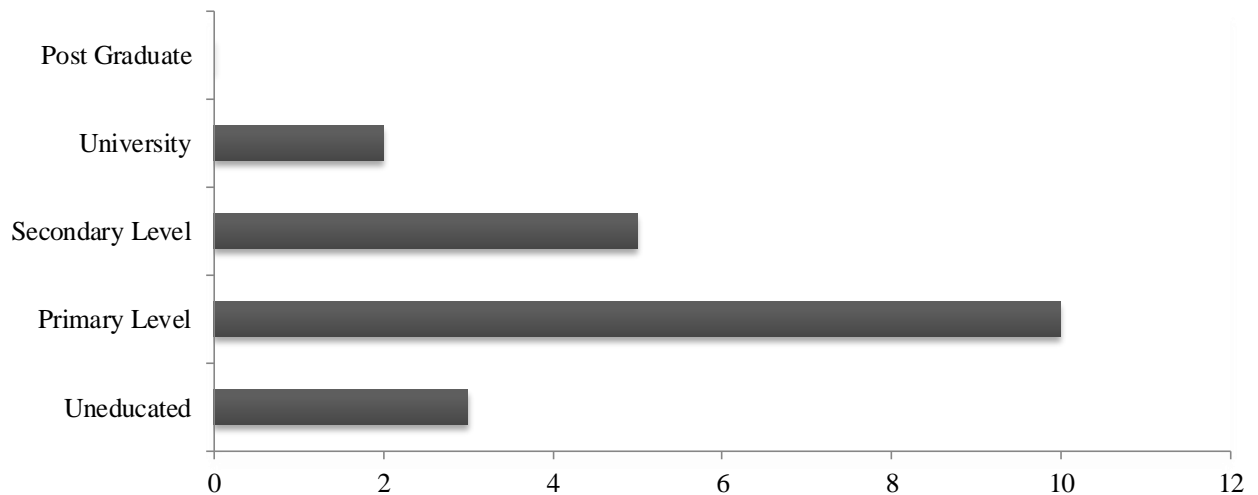


Figure 17 Respondents' level of education

The correspondents had been fairly selected from each location: With 15% of the correspondents each from Juba, Jebel Market, Gudele and Konyokonyo. 10% of the correspondents were selected from Munuki and Gumbo, and 20% of the correspondents from Custom Market.

1. Age of Business

Retailers were asked how long they have been in the charcoal retailing business and 45% of the retailers have been in business for less than 2 years. 30% of the retailers had 2 to 5 years of being in operation. 10% had been in operation for 5 to 10 years and 15% for more than 10 years.

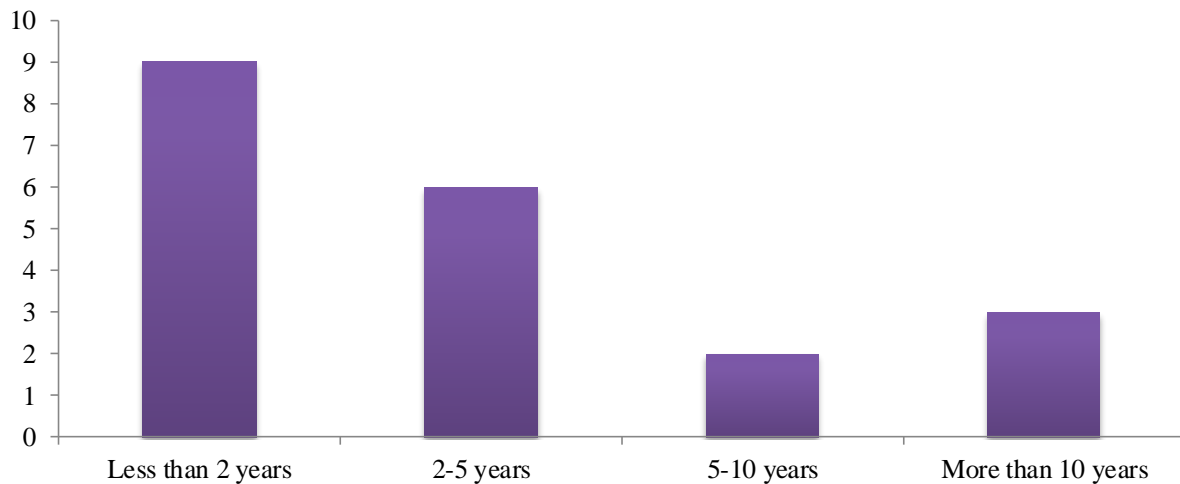


Figure 18 Age of the business

2. Earning Potential of the Business

The study showed that, 70% of the charcoal retailers reported to earn less than 5000SSP per day, 30% of the retailers earn between 5000 to 10000SSP per day and no retailers earn above 10000SSP per day from the business. As seen from this report, most of the South Sudanese participating in the charcoal industry earn peanuts from this business. The study findings indicate a high degree of poverty and low incomes as reflected where majority of the people earn less than 5000SSP per day. Retailers have to make a profit but also charge a price that is reasonable enough to ensure clients return. This has proven to create a dilemma in pricing and profits. These findings are consistent with a commodity report done by the global initiative against transitional organized crime. If dealers mark up their prices, factoring in the cost of paying bribes and other costs, retailers must weigh up whether to increase their own prices (and potentially alienate consumers) or accept a reduced profit margin. Retailers' profits account for approximately 14% of the total value of the market in Kenya (Simone Haysom, Black Gold, 2021) Profit margins are insignificant because retailers buy the charcoal at a high price from the producers and transporters, and have to add a small commission in order to attract consumers. From the study, only 25% of the correspondents buy charcoal at 3000SSP per sack and 20% of them buy a sack at 3500SSP, the majority, 35% of the retailers buy a sack at 4000SSP from producers, and 10% buy at 4500SSP and 5000SSP each. The retailers then sell it at little profits so that they get potential buyers. 50% of retailers sell at 5000SSP, 30% of them sell for more than 5000SSP, and 15% sell at 4500SSP while only 5% sell at 4000SSP per sack. A similar research conducted in Somalia by (Candlelight for Education, Health and Environment, 2012) supports the idea that charcoal retailers in the region receive the least profit from charcoal.

Since the market is saturated with charcoal retailers, there is a high competition among them to sell their charcoal at a lower price in order to get a share of the markets. Some sellers sell charcoal in sacks while others divide it into small bags for sale at 300SSP per bag. At the end of the day, 10% of retailers manage to sell only one sack per day while the majority, 50% sell 2 sacks per day and 40% are lucky enough to sell 3 sacks of charcoal per day. Although the

numbers are not exact, some days are different from others; the above results are only averages. The highest number of retailers responded to selling 1-3 sacks per day 1 sack on a slow day and 3 sacks on a good day. Others even admitted to going home without selling a single sack.

When asked why they chose this type of business because it is not profitable, involves a lot of struggles and highly saturated, the retailers' responses were listed down under specific themes that were written down using an inductive approach. The most popular theme was survival. 35% of the correspondents' answers fell under the theme of survival. With little or nothing to do, their entire livelihoods depend on the charcoal business. 29% of the responses were under the theme of unemployment. "There are no jobs in the market, so I turned to the charcoal business for support" said one correspondent. Some confessed to have started other businesses but failed, others didn't have the capital to start other businesses. 16% of responses fell under the theme: easy to start and little capital and skills required in the business. Unlike jobs which need qualifications and other highly skilled positions, the charcoal business is fairly easy to start and operate and that is why, despite the challenges involved, the retailers remain in the charcoal business. 13% of the correspondents joined the business to pay for expenses such as school fees for themselves and their children and other basic necessities like food and only 6% of the correspondents joined the retailing business because of its earning potential. The findings are in sync with other studies that show the reason retailers join the charcoal business only to earn the minimum daily basic needs (Candlelight for Education, Health and Environment, 2012). However, the research disagrees with the study done by (Syerien, 2011) which indicated that the charcoal business is highly lucrative for retailers. This could be partly because the research was conducted in and specifically for developed countries.

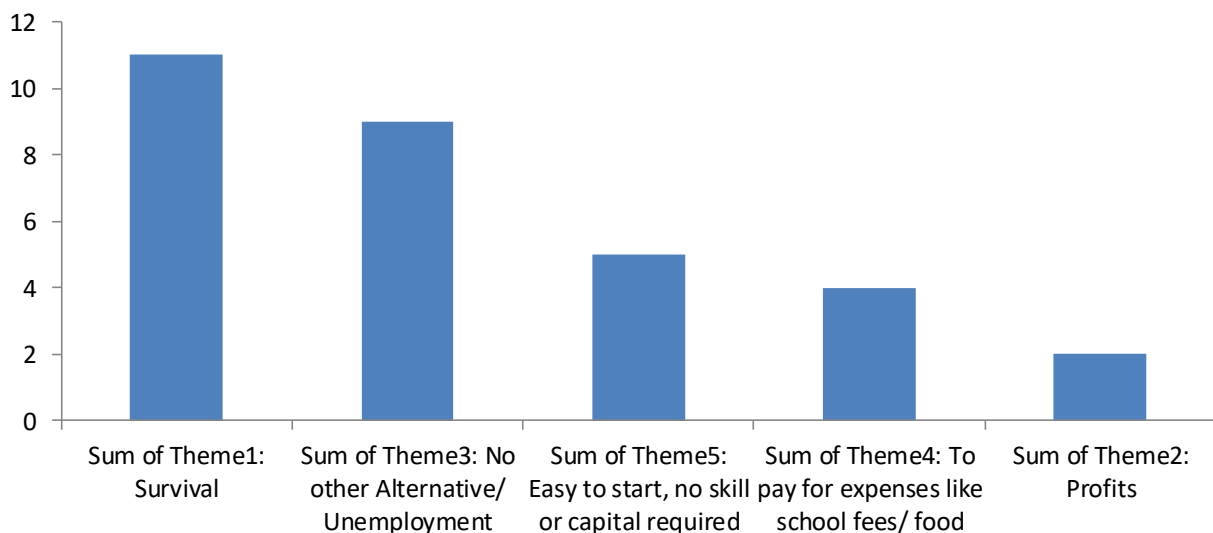


Figure 19 Retailers' preference of business

3. Legal License to carry out the Business

Just like any other business, the charcoal business needs a license for one to operate it. The license is given by Juba City Council, and the duration of the license is three months after which the traders are requested to go for renewal. From the survey, it is reported that 55% of the correspondents do have a license for operating the business while 45% do not. However, the results conflict with the study made by (Simone Haysom, Black Gold, 2021) which states that producers neither have licenses nor are they required to get a license, according to government officials. Before the export ban, the Ministry of Trade and Industry would issue licenses to companies to produce charcoal and export it, but this stopped in 2018 when the ministerial order banning exports came into effect. The Ministry has, however, expressed concern that local consumption is leading to the unsustainable harvest of trees, and that greater regulation of production would be ideal. Producers of charcoal ‘should be licensed, given specific areas to produce from and required to plant trees’, according to a ministry official, and should also be limited by prohibitions on the harvesting of certain tree species (Simone Haysom, Black Gold, 2021). The lack of regulation to guide implementation and enforcement through charcoal licensing, including what constitutes an acceptable management plan has resulting in mismanagement of the forest resources and inability to bring to book violators. It has also promoted informality and illegality within the charcoal business.

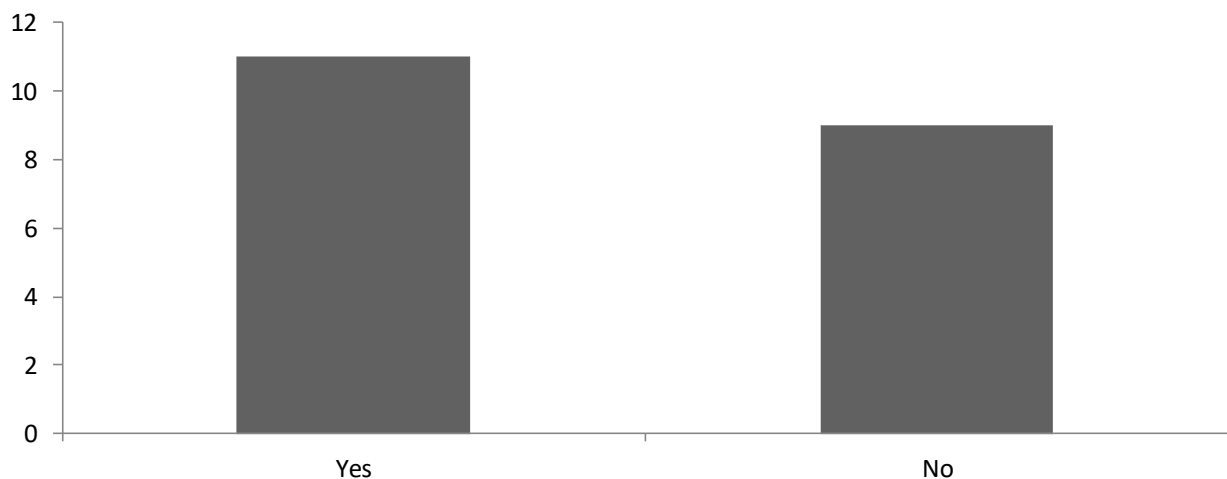


Figure 20 License to carry out the business

4. Awareness of Environmental Impacts

There was a significant high level awareness of on the effects of charcoal production and use on the environment. Going by the above findings, it could be observed that only 15% of the respondents were not aware of the effect of charcoal production and use on the environment. The correspondents who are aware expressed their knowledge about the declining tree populations in the vicinities and nearby areas hence the constant rise in charcoal prices annually. The respondents stated that finding fuel wood in nearby areas is becoming more difficult compared to the situation over 5 years ago. The respondents believed that the forests of the region will disappear within the next decade if the current unsustainable methods of land

use continue but there is nothing they can do about it because there is no other source of employment (Figure 19) and consumers have no other source of fuel for cooking and heating (Figure 16). These tie squarely with the findings of (Gumbo, 2013) who found that most of the charcoal retailers and producers were aware of the effects of their actions on the environment and on their wellbeing. However, this finding is different from the findings of (Rothkar, 2015) in a charcoal scoping study where it was reported that most people were getting to be aware of the negative effects of charcoal production to the environment and forest in particular.

During the survey, it emerged that a good number of the population were aware of the environmental effects of charcoal production and use (figure 14) (figure 21), but they cannot do much since they consider charcoal as the most affordable source of household energy (figure 16) and because they need the financial incentives to cater for their basic needs (figure 19). This was also exacerbated by the cost of acquiring different energy sources, where charcoal becomes a cheaper option. This sentiment supports the reports of (Njenga, 2013), where charcoal was on high demand and use as a result of energy costs at low income households.

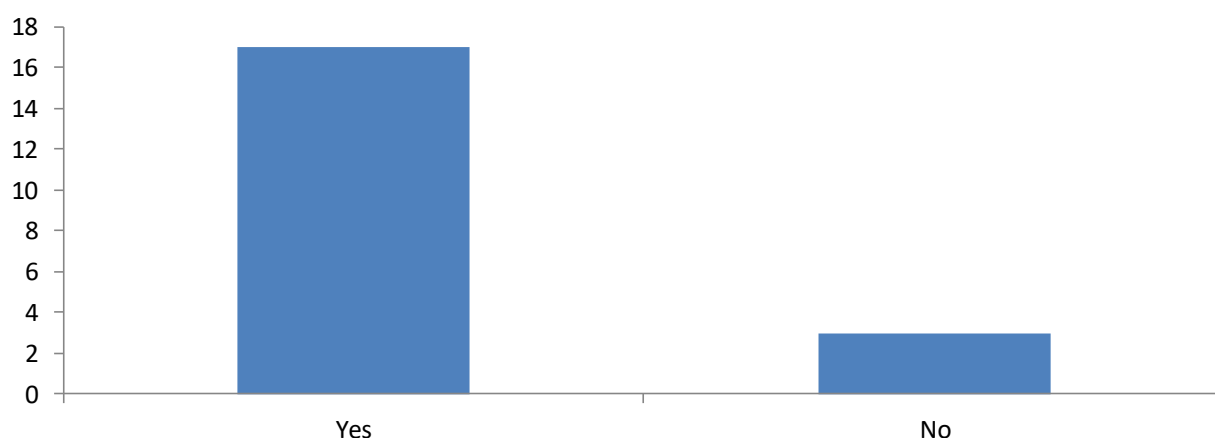


Figure 21 Respondents' awareness of environmental impacts

5. Challenges faced in the Business

As any other business, the charcoal industry does have numerous challenges. According to the survey administered, the following challenges were listed by the respondents (table 3).

Table 3: Challenges in the charcoal business

| S/No. | Respondents' responses to the business challenges | Percentage (%) |
|--------------|--|----------------|
| 1 | No markets for the charcoal/ No Profits | 45 |
| 2 | High Taxes and other expenses such as rent and transport | 21 |
| 3 | Other Challenges | 16 |
| 4 | Difficult Work Environment | 11 |
| 5 | Hard Work | 5 |
| 6 | No other Options Available | 2 |
| Total | | 100 |

One of the retailers reported under other challenges he faces and said, “The poor quality charcoal could tarnish my business reputation and bring less customers”. He added that the producers do not burn the charcoal well sometimes and place better charcoal at the top and the poor quality at the bottom of the sack so it is not easy to tell if the charcoal is of good quality, this has brought him less customers over the past few months. Other challenges of the business include insecurity and no prospects as stated by one of the retailers and that charcoal becomes expensive every year. This is due to the fact that producers have to travel longer distances in search of wood for charcoal hence increasing the prices of a sack, one of the correspondents added that his largest challenge is the dust coming from the charcoal which he finds irritating, A few other retailers said that some consumers take the charcoal on credit and refuse to pay it back, especially restaurant owners who can take more than one sack of charcoal and not pay it back stating that they have not received the number of customers they expected in order to make profit. The retailers do not just receive charcoal from one producer, charcoal transporters move around the city to sell charcoal from them. Trucks that move around the city selling charcoal to retailers and consumers are predominantly Ethiopians and Ugandans as stated by the correspondents. South Sudanese, Somalis and Sudanese as well transport charcoal within the city in trucks. The results are fairly similar to the research conducted by (Mutimba, 2021) under DFID which listed inadequate market due to high competition, price fluctuation, high rent space, low quality charcoal, no permits and licenses, transportation, harassment by police and city council, and shortage of timber as the main issues they face in the business. Yet even with all the challenges encountered, the retailers and producers continue to stay in the business in order to fulfill basic needs.

6. What retailers think about the future of the business?

While carrying out the survey, after asking about the respondents’ awareness of the charcoal business on the environment, the retailers were asked what their future prospects were and none of their responses were on continuing the business in the near future. A vast majority, 43% of the respondents, agreed that the charcoal business is unsustainable and will not continue in the next decades and 40% of the respondents replied that they were not necessarily thinking long term, they were only concerned with making sure their daily needs were met. From their responses, 60% of the retailers said they want to pursue something else like Agriculture, going back to school, tailoring and Economics, 40% had no future prospects and none of the retailers dreamt of continuing with the business in ten years. However, the retailers’ future prospects has insignificant effects to sustainable practices, management of the forest resources and regulation of the charcoal industry as the main drive for the industry is the high demand and no alternatives from the consumers’ side (figure 16) and high rates of unemployment and no other source of income from the retailers’ side (figure 19). The study findings concur with the research made by (Candlelight for Education, Health and Environment, 2012) which indicate that the charcoal retailers do believe that in a couple of years, with the continued state of unsustainable charcoal production, the charcoal business will become obsolete.

Table 4: Retailers' future prospects

| Future Prospects | Respondents (%) | Reason |
|--|------------------------|---|
| No future in the business | 45 | Charcoal becomes more expensive every year, scarcity of trees (Desertification), slow shift to other forms of energy such as gas and electricity. |
| Not thinking about the future of the business: Only a means of survival. | 40 | Coping with family demands, unemployment, lacking necessary skills for other businesses, economic instability |
| Complete Education | 10 | The business is only to help provide for their education needs |
| Dim Future for the business | 5 | High Competition |
| Bright Future | 0 | N/A |

4.3 Charcoal Production

4.3.1 Brief Overview

Charcoal is produced throughout the year, though quantities vary with seasons. Most of the charcoal is produced from Acacia trees but a producer stated that there are no limitations on the type of trees being cut. It was established that species choice for charcoal production was highly dependent on tree availability rather than the quality of charcoal. Due to their availability, Acacia species were the most widely utilized tree species based on the information collected from the producers. Other producers said they cut any type of tree except those prohibited by the chief of the area; the prohibited trees for charcoal production are mahogany and teak. "Prior to urbanization, trees used to be cut by an axe", said one local, "the tree can sprout again during the rainy season". With the influx of different people to the city, demand has shot up and producers have now turned to saw mills and machines for cutting trees at the ground level making it impossible for the trees to sprout up once rain sets in. The charcoal is being harvested from different areas including Magwi, Aru Junction which is on the Juba-Nimule road.

Table 5: Descriptive statistics on Juba checkpoint

| <i>Number of Sacks</i> | |
|--------------------------|---------|
| Mean | 75.76 |
| Standard Error | 5.47 |
| Median | 70 |
| Mode | 70 |
| Standard Deviation | 41.99 |
| Sample Variance | 1762.77 |
| Kurtosis | 4.456 |
| Skewness | 2.29 |
| Range | 160 |
| Minimum | 40 |
| Maximum | 200 |
| Sum | 4470 |
| Count | 59 |
| Largest(1) | 200 |
| Smallest(1) | 40 |
| Confidence Level (95.0%) | 10.94 |

The State Ministry of Environment and Forestry stated that there are 6 checkpoints in Juba where charcoal data is collected and recorded. However, the following data cannot be considered as absolute data due to the fact that truck owners and transporters may not give the accurate number to evade high taxes and some move using different routes in the City. The data collectors may not stay for long hours from morning to evening to tally the data. The data received from these checkpoints can therefore only be taken as approximate values. From the figure above, a total of 4500 sacks of charcoal were recorded. One sack of charcoal goes for approximately 5000SSP; this gives a monthly average of 22 Million SSP and a yearly average of 270 Million SSP= 620,000 USD assuming a constant production of charcoal throughout the year.

4.3.3 Working Environment

Producers do admit that the working environment is not friendly but they have no other option since they are only trying to make a living. The biggest fear they have is insecurity, there is a high chance of being attacked by rebels if they are deep in the bush. This is frightening because they are unarmed in most cases and cannot defend themselves. Another issue is air pollution; there is a lot of smoke produced from the burning process which is irritating if inhaled and irritating to the eyes. It is also an uncomfortable business because the producers have to live in isolation for days on end with little facilities and uncomfortable mats as beds. There are no hospitals close by in case of illness and no fresh foods supply, only beans and flour they carry with them to the bush. One producer was concerned about his health because there are no roads

and the sacks of charcoal have to be carried for some distances on the back in order to reach the truck.

4.4 Charcoal Production Rates in 5 Years (2012-2018)

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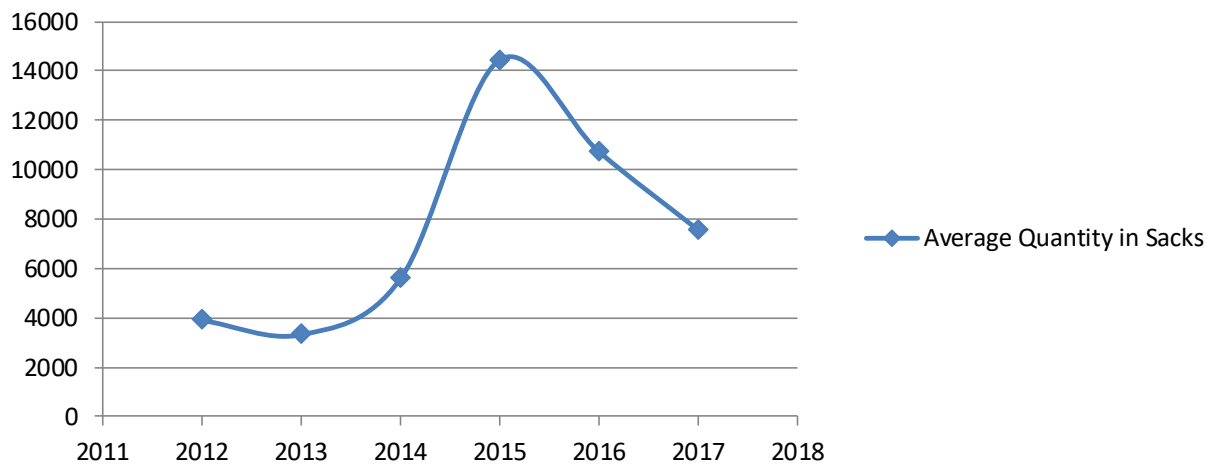


Figure 22 Average Quantity in Sacks from Checkpoints, Ministry of Environment and Forestry CES

In 2012, the average quantity of charcoal in sacks were 3894, in 2013, it came down to 3313 sacks and started escalating in 2014 to 5571 sacks. This shot up to 14442 sacks of charcoal in 2015 and 10,732 sacks in 2016. It steadily decreased to 7560 sacks of charcoal in 2017. The following data account for the specific checkpoints only and not all producers go through these checkpoints. Some have tried to elude the national authorities so the above numbers are not absolute.

4.5 Socio-Cultural Aspects

From the study, it has been observed that the major reason that South Sudanese get into the charcoal business is the lack of alternative employment. The civil war disrupted many sources of livelihoods especially Agriculture due to insecurity arising in the country. The devaluation of the economy from 100 USD= 200 SSP to the current rate of 100USD= 45,000 SSP has crushed many people's sources of income such as government jobs which are still paying workers with the previous rate which can no longer support their livelihoods. Soldiers as well have gone into the charcoal business as a means of survival since there is no other source of income in the army.

The business is fairly easy to start unlike other businesses which require prior planning, skills and a large capital. Charcoal making requires a minimum capital input and relies mostly on labor as its major input. Producers collect their wood from communal areas for free after negotiating with the chiefs of the area. Although other costs such as transportation and license

taxes may be incurred, it is considered minimal. The locals and foreigners see charcoal production as the only opportunity for earning quick cash to spend on basic needs for their families. Consumers like to use charcoal for cooking because it costs less than other sources of fuel energy. In addition to this, alternative sources of energy are not available such as electricity and LPG. As stated by the Chambers of Commerce, exact figures on the charcoal quantities produced and transported to Juba daily are not available. This is due, in part to the nature of the business which is primarily run in illegal manners, especially following the ban of the charcoal trade for exports.

4.6 Economic Aspects

A larger share of the charcoal industry is held by foreigners with the nationals; locals and soldiers having only peanut share. The producers sell the charcoal to retailers at an average of 4500SSP per sack while the retailer struggles to make an average of 5000SSP from the same sack getting only 500SSP profits per sack while also incurring other costs such as taxes and licenses hence most of the profits in the business go to the foreigners who cut the trees at no cost (MoF, 2022). Despite all this, the charcoal sector is a significant economic activity employing a great number of South Sudanese in the country who in turn have a much greater number of dependents looking up to them for survival. The self-employed retailers may sell the sacks of charcoal and use the money to buy basic needs such as food and water, pay school fees and get medical services for his/her family. The Government's margins in the business are not known because of lack of transparency and accountability. No law enforcements have been done and there are no legal routes where the margins can be traced (MoF, 2022).

4.7 Environmental Aspects

The forestry sector is one of the most important sectors in South Sudan and the most promising sector as well yet it is the most neglected in South Sudan. According to the Director General of Afforestation at the State Ministry of Environment and Forestry, several forest reserves in Yei have now disappeared. The reserves include Keggulu Forest Reserve and Yei River Forest Reserve among others (MoF, 2022).

4.7.1 Deforestation

Deforestation is a serious ecological problem in South Sudan. Tree density throughout the years has become sparse due to overgrazing, urbanization and charcoal producers. The charcoal trade in South Sudan takes a heavy toll on the acacia forests as traders' clear-cut entire swaths of forest for production. The process of turning cut wood into charcoal is also a rough, dirty process that pollutes the air, albeit in a very local fashion. The loss of ground cover and root systems leads to increased erosion in the riverine areas. This accelerates the process of desertification, decreasing the amount of land useable for agriculture or even grazing, pushing locals out of areas as they become uninhabitable after charcoal traders clear all of the trees. This deforestation also decreases bio-diversity as species that relied on the acacia groves are unable to survive without them. All of this ultimately hurts the livelihoods of South Sudanese not involved in the charcoal trade in these areas. Pastoralists and agriculturalists rely on the

acacia forests to play their part in maintaining the delicate balance that makes life possible. Pastoralists graze their cattle in the grass that flourishes while the acacia groves' root systems hold in ground water and prevent erosion. Agriculturalists grow staple crops in neighboring lands, but as erosion increase without the acacia groves holding in top soil, their lands are becoming fallow. With forests destroyed, these groups must move to other areas in order to survive, or engage in the charcoal trade themselves, which only deepens the cycle of destruction.

4.7.2 Reduction of biodiversity

Charcoal making, through its detrimental effects on rangelands and soil fertility, according to an interview with the Dean of Forestry in the University of Juba, it leads to the reduction of wildlife and biodiversity. A large number of soil fauna and plant species are immediately killed by the fire. Selective cutting of trees for charcoal has also caused the decline of some tree species e.g. *Acacia bussei*, and is threatening others. Trees provide refuge for a wide variety of animals and other plants. The declining tree populations in the region are leading to the disappearance of some species.

4.7.3 Soil erosion

Trees are an important component in the region's landscape. Charcoal production, by removing trees from the landscape, contributes to increased rates of soil erosion. The soils in this semiarid zone are fragile and highly susceptible to disturbance and erosion. Reduced plant cover, partly due to charcoaling, is resulting in loss of top soil and decreased soil fertility. Trees are a major factor protecting soil from erosion by improving water infiltration rates, reducing runoff, and modulating wind speed. Moreover, trees add organic matter to the soil, thereby improving soil water-holding capacity, and recycle nutrients from deeper soil layers (UoJ, 2022).

4.7.4 Deterioration of watersheds

Destruction of trees can damage watersheds in the region. Increased water runoff is associated with decreased water infiltration rates due to loss of trees and more compacted soils. Increased runoff also results from increased soil water due to diminishing evapotranspiration rates. This higher soil water content can cause more frequent flash floods. Underground water recharging rates also decline because of lower infiltration rates (Van Beukering, 2007). Thus water availability may decline during the dry season (UoJ D. , 2022).

CHAPTER FIVE

POLICIES AND LEGISLATIVE FRAMEWORKS

The National Environmental Policy governs natural resources. It advocates the development of a national climate change adaptation and mitigation policy and associated strategy. Although these have yet to be formally developed, adaptation strategies and plans are part of South Sudan's development plans and include strategies related to agriculture and forestry, livestock, health, water and disaster risk management.

The main challenge in policy and regulations is not lack of the instruments, but implementation failure. There is very little or no political will when it comes to conservation of the forest resources (Respondent, 2022). However, a major reason, according to the Ministry for the lack of implementation of policies and misuse of natural resources is scarcity of funds and lack of will by the government authorities. The government operates on a small budget that cannot effectively cover all government areas of responsibility. This lack of capacity to enforce environmental and forestry regulations is a major factor for the widening unsustainable methods of natural resources use (MoF, 2022).

Besides laws, there are resolutions. One of the resolutions banned the use of chainsaw machines for harvesting trees. This is due to the fact that chainsaws can be destructive and make it impossible for the trees to regenerate once the rainy season kicks in: Hence worsening the effects of deforestation. Allocation of 40% of forest resources to be given back to the forest to reinvest in the natural resources such as replanting seedlings, payment of workers and community members who participate (MoF, 2022).

5.1 Energy Act and Policy

The Ministry has developed an energy policy to guide its work, although the Energy Act has not been published, as the bill is yet to be approved by parliament. The Forest Act (1989) prevents wasteful burning, obliging farmers to make use of cleared woody material (shrubs and trees), by converting it into useful products, such as charcoal. In 2011, the forestry sector contributed US\$395.4 million to the economy, which was approximately 0.7 per cent of gross domestic product (GDP). These statistics may not include non-timber products, the most important of which is firewood, which is used by households for cooking and also provides a source of income, along with charcoal, for small-scale farmers, although this practice does contribute to environmental degradation. Many poor families use the forestry sector to sustain their livelihoods, particularly when crops fail or security deteriorates, through hunting and food gathering food for fruits, vegetables, mushrooms and honey. Guidelines on utilizing forest resources and the Forest Bill (2014) have been developed. Households are being encouraged to use efficient cook stoves and need to reduce forest fires and deforestation activities. While charcoal burning is not illegal, exports of the resource are discouraged to reduce its demand. South Sudan has also developed a REDD+ preparedness plan to help protect its forest resources.

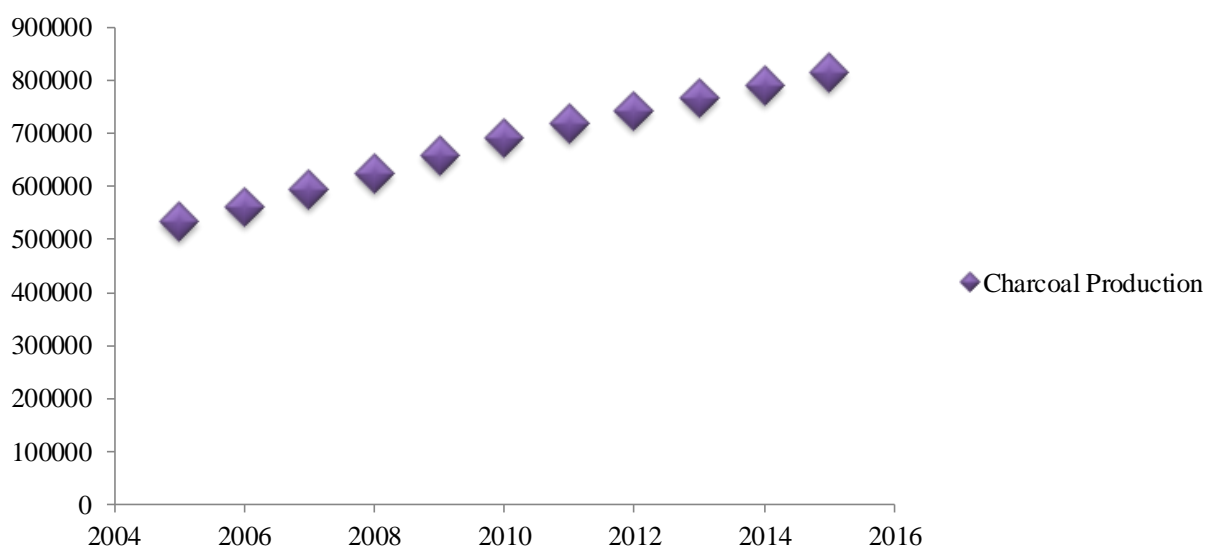


Figure 23: Charcoal Production (tons)

5.2 The 2015 Draft National Forest Policy

The broad objective of forestry policy is to provide continuous guidance to all South Sudanese on the sustainable management of forests. The issues to be addressed by implementing the policies are forest degradation and deforestation caused by rampant illegal cutting down of trees. Deforestation in South Sudan is one of the country's most under-researched and under-funded areas of policy and programming. The lack of knowledge on the scope of deforestation undermines the urgency that should be felt due to the impact that it is having on communities, as evidenced by increasing climate change and deforestation in the country. The destruction of forestry resources is also tied to worsening climate change, and in 2020 alone, more than half of the counties in South Sudan experienced flooding. However, the capacity for data collection on this issue is limited in the country. This is partly due to the exploitative nature of deforestation, and the lack of ability for authorities to hold perpetrators accountable. The limited legal and policy frameworks, as well as allocation of financial resources allocated in the national budget, also creates gaps in regulation of the extraction of forestry products.

In terms of broader legislation, the Transitional Constitution of 2011 established that the national and state governments would share concurrent powers over natural resources including forests. The revision of the national constitution was interrupted by the outbreak of conflict in 2013, and future legal provisions remain in limbo. The revitalized peace agreement provides guidance on approaching oil, land and water resources, but does not contain comprehensive information on environmental protections, and furthermore does not address forests at all (JMEC, 2018). The primary documents that guide the contemporary discourse on deforestation in South Sudan are the National Environmental Policy 2015-2025, as well as the Forestry Policy. Supporting legislation and frameworks are also discussed below. Despite the multitude of documents that have been created to mitigate deforestation in South Sudan, it continues to receive minimal funding and interventions compared to other sectors in South Sudan.

5.3 National Environmental Policy 2015-2025

The National Environmental Policy was endorsed by parliament in 2015; however it does not have an accompanying legislation to reinforce the framework. The document, which aims to frame environmental management for the country, outlines the responsibilities of different levels of government, noting that the national government will provide policy and legislative frameworks, but will not directly implement programs. In relation to forestry specifically, the policy acknowledges that without proper forest management the country risks “the gradual conversion of forest land to other land uses, the introduction and spread of exotic invasive tree species, localized soil erosion, accelerated loss of biodiversity, alterations in the hydrological and nutrient cycles” (MoEF, 2022). Risks to the country’s environment and biodiversity are said to be mitigated through afforestation and reforestation. In order to do this, the policy outlines key actions that can be taken in South Sudan to support this, including: comprehensive laws and regulations, enforce reforestation policies for those responsible for cutting trees, encourage sustainable uses of forestry products for income generation, adopt participatory approaches, integrate pest-prevention and management approaches, increase capacity of staff and research relating to forestry, prevent burning of resources, encourage voluntary tree planting by citizens as well as participate in the UN REDD+ initiative.

5.4 Forest Policy

The draft National Forest Policy was finalized in 2015 by the Ministry of Agriculture, Forestry Cooperatives and Rural Development, but the process to create it began in the post-CPA period. Since the policy was drafted, forestry resources now fall under the Ministry of Environment and Forestry. The policy acknowledges the relationship that forestry products have with food security and poverty, and “recognizes that forest and woodland resources of South Sudan are more than just trees; they including forest waters, soils, wildlife, biodiversity, and carbon, as well as their dependent communities, economies, and their collective productivity”. Similar to the petroleum industry, the forestry policy suggests creating a “South Sudan National Forest Corporation (SSNFC) to operate as a semi-autonomous, self-supporting and income-generating institution operating under a Board of Directors”. The document also outlines approaches to regulating private investment in forestry resources, as well as encouraging collaborative forest management’s agreements with communities in the country. A “National Forest Fund” to manage revenue obtained from forest resources is also recommended, which would support the equitable distribution of funds across all 10 states. The policy estimates that 45% of forest cover has been lost since the second civil war with Sudan began in 1983, and expresses urgency in regulating extraction at all levels of government. In terms of the role of community’s in South Sudan, the policy makes two main points:

- 1) Community members should pay taxes for the forestry products they extract
- 2) The government will draw from best practices globally to implement combined forestry management practices.

Furthermore, in terms of ownership, the policy states, “Communities will delineate and gazette forests in their communal land to be managed as Community Forests (CFs) at the Boma and Payam levels of government.”

National Adaptation Programmes of Action to Climate Change (2016) The National Adaptation Plan of Action to Climate Change was published in 2016 by the Ministry of Environment, with support from UNEP and the Global Environment Facility (GEF) (MoEF, 2022). The plan attributes deforestation to growing populations in the country following independence, which has increased demand for fuel sources such as charcoal and firewood, as well as increased demand for cleared land to be used for agricultural and residential purposes. The outcomes of climate change, such as increased flooding, are also noted to be a causal factor in deforestation. Rural communities are identified as being particularly impacted, not only due to the loss of wood sources, but also other forestry products such as food, and diminished water sources. Forests are also said to provide rural communities with resources and survival mechanisms when food insecurity increases due to crop failures, natural disasters, etc. To mitigate these impacts, the plan advocates for reforestation programs, the creation of forest reserves, encouragement of the use of alternative fuel sources, fire management plans, increased public awareness, as well as the establishment of seed banks. In doing so, it is anticipated that the threats of desertification, flooding and droughts will also be reduced.

5.5 A Policy Response to the “Charcoal Problem”

The use of charcoal and firewood were consistently identified by key informants as the primary cause of deforestation. It is estimated that between 90-99% of the population in the country rely on these products for daily consumption (MoEF, 2022). These products are primarily used to cook food for households, as well as to heat water. Firewood is also noted to be used as the primary source of lighting in the country, accounting for 35% of households (MoEF, 2022). Access to the two sources of fuel also varies – firewood can be found in natural environments, however charcoal needs to be produced and is often found in markets. The market for charcoal also extends beyond South Sudan. Key informants described growing road trade routes from Juba to Nimule, at the border with Uganda, to export these resources. An additional example was provided of charcoal being sent to the United Arab Emirates by air in significant quantities, which became public knowledge when a shipment was intercepted by authorities at Juba International Airport. While most of the interviews focused on the role of South Sudanese citizens in the charcoal trade, foreign traders were also noted to play a role in both the charcoal and logging traders. In 2015, the Government of South Sudan banned the exportation of charcoal and timber. However, it was done through a public order issued by the Ministry of Environment, rather than an act of legislation which would be passed by the National Legislative Assembly. What further complicates the regulation of the charcoal trade in South

Sudan was the involvement of soldiers, which was observed by a number of key informants that participated in this study.

5.6 Other Policies

Important new laws with implications for forest based livelihoods include the Land Act (2009) and Local Government Act (2009). The general thrust of this legislation is to provide communities with stronger legal rights over land and natural resources. Additionally, the Land Act provides special protection for pastoralists, specifying that their communal grazing rights cannot be restricted without their permission (World Bank 2014a).

Cultural norms prohibit cutting some trees in particular due to their importance to the community, but rapid urbanization is taking a toll on these traditional forest management structures and practices largely because people from urban areas do not respect traditional norms and practices. In addition, the legal framework pertaining to forest management is weak and people are taking advantage of legal loopholes to overexploit forest resources (UNEP, 2018).

South Sudan's forest strategic policy for 2012– 2017 is strongly oriented toward rebuilding the nation's teak plantations and reestablishing the infrastructure needed to harvest those plantations and support industrial-scale timber harvesting. It also places a strong emphasis on collaborative forest management with rural communities. However, as noted earlier, lack of clarity over ownership and management responsibilities for the nation's non-reserved forests has created considerable tension between the central and state governments and rural communities.

5.7 The Role of the National Ministry of Environment and Forestry

The Ministry of Environment and Forestry has objectives to create climate resilient communities in South Sudan through building their mitigation and adaptive capacity. In this strategic plan, there are priority actions such as:

1. Development of national response strategies to address climate change
2. Ensuring sound environmental management
3. Conservation and preservation of forests and woodlands in the country

The Ministry has executed most of its plans as stipulated in the strategic plan and monitored the ongoing developments. However, the plans related to forestry are staggering because there are no laws and regulations to deter offenders. The Forestry Bill is still at the Ministry of Justice under review, so the Directorate of Forestry is acting with ministerial orders that are sometimes not honored by the army generals and other constitutional post holders when dealing with forestry products. The Ministry disclosed that illegal logging and charcoal business has become very common through the years. Forestry concessions given to investors have become a major issue that has to be dealt with. This is the main challenge the Ministry is facing in regulating the charcoal business (MoEF, 2022).

5.8 The Role of State Ministry of Environment and Forestry

To provide license to the people involved in the charcoal business and logging of trees. The license lasts for a period of one year and renewal has to be done yearly, licenses are also provided for stores of firewood and charcoal. According to the Director General, foreigners constitute the largest share of stakeholders in the charcoal business and nationals are very few.

The Ministry collects data every month on the trucks that bring charcoal to Juba. According to the Director General of Afforestation, the charcoal business has massively expanded due to the fact that the communities are not aware of the importance and value of the forest resources. This makes them negligent in protecting the forest reserves where they live. Lack of forest guards has worsened environmental degradation because there is no regulation on the usage of forest resources. This is also difficult because armed soldiers produce charcoal for survival and poses a threat on the lives of forest guards and communities (MoF, 2022).

Challenges faced by the State Ministry

Goal 12 of the Sustainable Development Goals (responsible consumption and production) is to ensure sustainable consumption and production patterns. One of the key targets is to achieve the sustainable management and efficient use of natural resources by 2030 (UNDP). This requires an urgent reduction of our ecological footprint by changing the way goods and resources are produced and consumed. Charcoal consumption can be sustainable when the constituents of sustainable consumption as summarized by (Ahamad, 2018) are considered. These include improving quality of life, assuring environmental protection, resource efficiency, and meeting the needs of future generations. The state ministry of forestry plays a crucial role in the management of forest resources. However, the current management practices that exploit these natural resources are not efficient. According to the Director General of Afforestation, the following challenges encumber the ministry:

Table 6: Challenges faced by the ministry of environment and forestry (MoF, 2022)

| S/No. | Challenge | Remarks |
|-------|------------------------------------|---|
| 1 | Mobility | No means of transport to collect data and monitor forest activities. This makes it more difficult to implement the policies and protect the resources. |
| 2 | Legislatures | Legislatures at state level have been sworn in recently and have not yet started office. |
| 3 | Motivation | There is a lack of motivation from the staff due to the absence of the 40% profits which was supposed to be allocated back to the Ministry of Forestry for carrying out its activities. |
| 4 | Development Partners | Partners working with the State Ministry are very few. At present only JICA and FAO are working directly with the Ministry. |
| 5. | Financial constraints in awareness | Awareness of the environment is not budgeted for: To make the citizens know their rights and roles in natural resource management and their roles in protecting the environment. |

5.9 Role of the University and Higher Institutions

The universities play the role of equipping students with knowledge and skills relevant to natural resource management: Different departments such as Natural Resource and Environmental Studies and Forestry department focuses on the conservation of natural resource. Sadly, for more than 10 years, not a single graduate from all the 10 batches have been employed in the Ministry of Environment and Forestry. The graduates end up working in totally different areas of work such as banks and NGOs because there is no budget for new recruitments in the Ministry. This is threatening to the country because the young and energetic youth, who could come up with innovative solutions and projects to protect the natural reserves, do not get the chance to do so and end up wasting their skills which would have been very helpful to the country by shifting to different career paths (UoJ, 2022) (UoJ D. , 2022).

CHAPTER SIX

CONCLUSION AND RECOMMENDATION

6.1 Conclusion

South Sudan is abysmal when it comes to energy access; it is downright reliant on the forest for firewood and charcoal with very little regard to alternative sources of energy. More than 90% of households in Juba use charcoal as their main source of cooking energy and the demand is likely to increase in the next several decades. Charcoal is not only an important fuel energy source but a source of livelihood for many families yet it has devastating effects on the environment. With the rise in demand for charcoal, due to rapid urbanization and population growth, the rise in unemployment and insecurity making Agriculture and other sources of employment that require high capital to start and skills difficult, the turn to charcoal business has become rampant among South Sudanese.

Deforestation and desertification is prone to occur since the country is poorly equipped to adapt to it. Even with evidence of such high dependence across the country, policies often fail to adequately address the social and environmental concerns associated with its life cycle. The attitude of the governing bodies towards sustainable energy development is very low since none of the laws and policies have been implemented. There is very little or no regard for environment and following the halt of the implementation of the Hydro-electric power plant project in Fulla, no political will or interest for renewable energy.

This research was both a qualitative and quantitative research that tried to find out the socioeconomic and environmental impacts of the business in details. The charcoal value chain was described in details with key stakeholders acting as informants: From charcoal producers to transporters, retailers both wholesale and small scale charcoal sellers to the consumers who are using the fuel for household and business consumption. The role of different Ministries, Institutions and Non-Governmental Organizations were stated.

7.2 Recommendation or Pathways

The forestry sector has played a very great role since 1901. It reserved, conserved, and gazettes the forests of Sudan, managed it sustainably until South Sudan seceded from the Sudan. However, because South Sudan emerged from war, there is still rampant logging and charcoal burning which lead to the destruction of most plantations and natural forests. These illegal activities and destruction of the natural resources could only be brought to a halt through the collective efforts from government and civil society organs that should get awareness raising and protection of the forests.

As part of efforts to reduce the environmental impact of an emergency, the provision of a stable and sustainable supply of fuel for cooking can help ensure that forests are not overexploited as a result of the concentration of displaced people and host communities. However, sustainable supplies of fuel are rarely available in conflict settings and would have to be provided by

humanitarian actors from zones outside degraded forest areas. Rather than focusing on fuel supply in acute emergencies characterized by violent conflict, environmental impacts can be addressed by changing the demand for wood fuel. Consumers were asked what they felt should be done to help combat or mitigate the impacts of the charcoal business and tackle the issues on the rising demands on the energy source on the limited natural resource. The following were their responses:

7.2.1 Alternative Source of Energy

The first theme stated by the consumers was for the government to offer other alternatives for the population. This is the most obvious and common recommendation because the major problem is the unavailability of other sources of energy, so people tend to depend on the forests and natural resources for meeting energy needs. The alternatives that respondents suggested were gas (90%) and electricity (10%). Respondents also expressed their concerns about the Fulla Dam Project that was promised once the country got its independence: Electricity, if made available nationwide would steadily decrease.

10% of responses were about making alternative forms cheaper. One way, as clearly stated by a respondent was to start producing fuel in the country since South Sudan is an oil producing country, “we shouldn’t have to import fuel and gas if we are an oil producing country. Refineries should be constructed so that we have our own petroleum products in order to reduce the heavy demand of charcoal for energy needs”.

The revival of the South Sudan National Development Plan 2011-2013 should be revived to ease the pressure on forests to cope with the rising energy demand.

South Sudan National Development Plan 2011- 2013

The SSDP is an interim National Plan to promote growth and development following the country's independence in July 2011. The long term goal of the Government is to invest heavily in hydropower generation. The national plan aims to:

- Build 2 mini hydro on River Yei
- Conduct feasibility study for Fula Rapids hydroelectric power plant

The institutional and regulatory framework for developing a national energy policy or development of RE technologies is still in early stages in South Sudan, and the SSDP serves as an interim policy document to guide further policy making.

Although charcoal is a paramount source of energy for a majority of the South Sudanese, the depletion of forests at such an alarming rate should not be overlooked. While the search for alternative livelihood strategies continues, efforts should in the meantime also look into sustainable charcoal production and replanting for the internal market, perhaps drawing on lessons learnt from Sudan (Middleton et al., 2018).

7.2.2 Reforestation and Afforestation Projects

15% of the correspondents mentioned reforestation and afforestation to help combat the environmental impacts, 13% of the responses were to regulate the cutting of the trees. Some correspondents expressed their concerns about the cutting of trees for charcoal production, producers, who are mostly foreigner cut using saw mills which are banned from being used but due to poor implementation of policies, there is no follow up and repercussion for those who go against the law. One consumer who was once a charcoal producer said he used to cut trees with an axe, this allows the tree to sprout up again when the rain sets in but the foreigners cut trees from ground level with machines that help them clear large areas of land in a short period of time. The level at which the tree is cut makes it impossible for the tree to sprout again hence causing deforestation and later, desertification. The next common suggestion was to stop cutting trees 9% which was later backed up by other themes.

The 100 Million Trees Campaign

The 100 Million trees campaign is a campaign launched in 2021 during the World Environment Day to plant 100 million trees in the next 10 years to ease the effects of climate change and restore wasteland. It was launched under the theme, Ecosystem Restoration for Sustainable Livelihoods and focused to plant at least 10 million trees in each state of South Sudan.

The project was initiated by the Green Climate Fund through FAO to the Government of South Sudan. The project so far has started to produce seedling in the nursery designated for the project in Aru Junction on the Juba-Nimule Road. It is the central nursery that will supply Eastern and Central Equatoria with planting materials to prospective farmers and groups of people interested in tree planting. In 2022, the projects is set to assess the nurseries in other states and start planting and sowing of seeds to supply the particular state with tree/fruit seedlings. According to the State Ministry of Environment Forestry, 5000 tree seedlings have already been received so far and there is a progress.

Factors that may challenge the feasibility of the campaign

According to the responses from key informants concerning the 100 million trees campaign, there is little hope that the project may be carried to completion. The table below lists the factors and possible solutions to the campaign:

Table 7: Factors that challenge the feasibility of the 100 million trees campaign

| S/No. | Factor | Remarks | Solution |
|-------|---|---|--|
| 1 | Lack of Accountability and Transparency in the financing of the project | The project is funded by FAO and the Ethiopian Government to South Sudan but the channels used for financing the project are not transparent. Thus questioning the motives of the campaign. | Offer Transparency in all projects and follow up the activities. |

| | | | |
|---|--|---|---|
| 2 | Lack of experts in forestry | The project may not be feasible because the original plan was to plant 100 million trees in the country; 10 million trees for each state but the states vary and some states have a capacity of handling more trees while other states may not have that capacity due to the nature of vegetation and soil. | Hire experts in this field to conduct a survey. |
| 3 | Importation of tree seedlings from Neighboring Countries. | The tree seedlings are being imported from Uganda without inspection for plant diseases. This could encourage the spread of diseases. The seedlings imported from other countries may not be able to cope with the South Sudan Climatic Conditions and the topography of the land. | Indigenous tree species should be used for the campaign. This helps in conserving indigenous tree species that are endangered |
| 4 | Lack of qualified personnel and trainers to help the community in implementing the project | The project was not properly planned and hence there are a significant number of pitfalls. With no qualified trainers, the communities will not know how to plant the seedlings or care for it till maturity. | Proper project planning. Hiring of qualified staff and trainers. |

7.2.3 Policy Reforms

Respondents urged the government to review policies and ensure they are implemented. 9% of the responses were stressing policy reforms, the illegal logging of trees and uncontrolled charcoal production are as a result of weak policies and the current policies should be reviewed and implemented. Periodic public reports should be prepared on the state of the environment in various states of the federation through strict regulation and enforcement of logging activities and increasing support for non-governmental organizations (NGOs) and community tree-planting programmes.

In addition to the policy reforms, forest reserves should be established, protected and properly maintained by both Federal and State governments. Also, all local government areas should earmark at least 25% of their landmass for forestry and this should be properly manned and protected. Other states should ensure the creation of forests on at least 15 percent of their land area.

7.2.4 Economic Reforms

Last but not least, 6% of the responses stressed that alternative employment should be given to the locals and soldiers cutting trees. Unemployment has been a huge factor affecting the nation and has a strong influence on the crime rates. Therefore, providing charcoal producers and retailers with an alternative source of income would help reduce the illegal and uncontrolled cutting of trees for livelihoods. It would require more legal and regulatory reforms to build investor confidence to attain the required capital to develop needed energy infrastructure. The Government should develop and implement an environment-friendly job-creation initiative for poverty reduction and green growth development and combine desirable features of the traditional approach (of ecosystems management) with modern scientific methods of conservation.

The effect that this system of economic incentives is having is difficult to measure because of South Sudan's security situation. However, considering the charcoal industry has been behind deforestation in other parts of Africa, one can assume that, with the lack of any oversight or restrictions, the charcoal trade will have a devastating effect on forests. This is also likely to increase the occurrence of desertification, depriving pastoralists of grazing land and farmers of cultivatable areas. Income from the charcoal trade also provides important financing for some warlords and faction leaders, enabling them to maintain their strength and continue their predatory regimes. While predatory militias profit from the charcoal industries, it is the more powerful businessmen that are the real power behind the industry. This section of society is powerful enough to hold a veto over any political arrangement that threatens their interests.

7.2.5 Raise Awareness

10% of the respondents did not know what to recommend since they were not aware of the environmental impacts in the first place and they did not have the knowledge of other forms of energy.

More efforts should be put to educating the general public about the environment to prevent wasteful consumption and irresponsible cutting of trees for farmlands and charcoal production. Awareness should also be created among communities and community leaders in order to conserve natural resources. There is a need to mandate the inclusion of tree planting as a criterion for building plans approval and approving authority shall determine the number of trees based on the size of the land and encouraging viable afforestation and reforestation programmes using tested drought resistant and/ or local species.

7.2.6 Energy Saving Stoves

In South Sudan, cooking stoves are classified into two categories; metallic and or clay stoves that use charcoal as fuels (locally known as “Kanoon”), and three stone stoves and sometimes mud stoves that mainly use firewood as fuels (locally known as “Ludaya”) (James, 2015). It is shown in a research report by the United Nations Development Programme (UNDP) that, historically, in the past, only the three-stone stoves were used for cooking. This was until in the late 1950s when the use of wire stoves in the Northern region of Sudan became popularized in the Southern part of the country as well (UNDP, 2013). The provision or local production

of fuel efficient stoves (FES) helps reduce the amount of wood and the time needed for cooking, which can allow women more time to engage in productive activities. The use of FES also reduces exposure to indoor air pollution, which constitutes a major health concern in many developing countries. Over 4 million premature deaths every year are attributed to indoor air pollution caused by the inefficient use of solid fuels (WHO, 2014).

Promote energy-saving technologies like improved charcoal stoves, biogas and solar. Over-reliance on biomass for energy has contributed greatly to vegetation loss and degradation. Efforts should be made to identify and promote suitable energy-saving technologies. This will entail supporting institutions to install such technologies, examples of which include energy efficient stoves and solar, biogas and efficient charcoal production kilns. Promotion of improved biomass conservation measures should go hand in hand with building the capacity of local artisans to install some of the affordable technologies. Speaking to the executive director of Koneta Hub, an innovation led organization that works with young people and vulnerable communities; unemployment is the biggest problem facing the youth in South Sudan thus the need for helping them through training and financial support. Their aim is on innovation and bringing up new ideas to solve some of the existing problems in the society through training and capacity building for young entrepreneurs through programmes and financial aid for startups. Their main focus of SDGs is on climate change through support from the Canadian Embassy. They train women in Juba to make briquettes and energy saving stoves. The briquettes are made from waste paper and charcoal dust. This is a good sustainable option since it focuses on recycling waste materials. The briquettes are much cheaper than charcoal. Three briquettes have a higher energy value than charcoal hence last longer. Using the energy saving stoves, the efficiency is doubled hence one sack of charcoal could last twice as long. The stoves are made from clay and designed in a way that is energy efficient hence needing only little charcoal/ firewood for cooking. This could be very effective in cutting down on the demand of charcoal for fuel energy.

In addition to the energy saving stoves and charcoal briquettes, the organization also has nursery beds of tree seedlings with more than 1000 tree seedlings. They also train the communities in tree planting and taking care of the trees. They also distribute to companies and other organizations that need them. The trees species are Eucalyptus and Acacia, and in future fruit trees and moringa. The risks and negative impacts of increased charcoal production call for well-structured policies which will cover tree planting and preserving the forests which serve as a source of raw materials for the production of charcoal

7.3 Limitation of the Project and Further Studies

Like all other research studies, there were challenges incurred during the survey where respondents may not have been very sincere on all the answers they gave. Other problems were incurred during interview of key informants who did not have sufficient data and relevant documents that may have helped answer the research questions for effectively.

There is therefore a need for further empirical research to answer the research questions more effectively on quantifying the charcoal value chain in detail from how many charcoal producers are there and the main stakeholders in the business, charcoal retailers, transporters and middle men. Further research should be done on the quantity of charcoal being consumed per annum especially small scale businesses that constitute a large share of consumers as well. More research needs to be done to find exactly what the Government's margins in the business is and how much of that is going back to the Forestry sector.

Lastly, GIS mapping should be done to evaluate how much of the environment has been depleted in order to cater for the consumer's energy needs and accurate estimates should be made to know the exact forest cover loss and the consequences in the coming years if the same unsustainable practices persist. Rainfall data throughout the decade should also be collected to test the hypothesis of forest cover loss with relation to the climatic effects.

List of Appendices

APPENDIX A: Interview Questions: Dean and Head of Department, Department of Forestry College of Natural Resources and Environmental Studies, University of Juba

1. What role is the University playing in conserving South Sudan's natural resources?
2. Describe the forestry sector of South Sudan.
3. From your expert opinion, what are the main threats to the forests and forestry sector?
What do you think is the current rate of deforestation and what are the main actors responsible for it?
4. What role do you see the forestry sector playing in the sustainable economic developments of the region?
5. Are there barriers to investment in the sector? If so, what are they?
6. How far have you gone into the implementation of the 100 million trees campaign, under the theme, "Ecosystem Restoration for Sustainable Livelihood"? What action has the University taken so far?
7. What is the future of the forestry sector if we cannot ban charcoal use and yet demand keeps going higher with time? How can we make this sustainable? To what extent will the charcoal business affect the environment over time, say 50 years: If we are left to the current practices of harvesting and producing charcoal?
8. Are there any environmental policies especially in respect to cutting of trees for energy? If so, what are they?

APPENDIX B: Interview Questions: Environmental/ Energy Engineer and Policy Expert

1. What has your experience been as an Environmental/ Energy Engineer in South Sudan?
2. Tell me more about yourself and your line of work.
3. Are there environmental policies especially with respect to cutting down of trees for timber and energy? If so, what are they?
4. How can national energy policies be more effective in achieving positive outcomes?
5. Sustainable development in relations to energy is meeting our energy needs without compromising the needs of the future generation. Charcoal meets our needs yet it is unsustainable. As an Energy Engineer, what is your take on making it more sustainable? What other sustainable options do we have for a population of 10 million living below the poverty line?

6. In 2010, the demand for charcoal was around 84%. The population then was around 260,000 people. Currently, with a population of half a million, the demand has increased to 95% of the total population according to UNEP. So ultimately, the demand for charcoal is rising steadily as we speak.

Tell me about the particular concerns we have with these particular numbers.

7. To what extent will the charcoal business affect the environment if left to the current practices and negligence in say 30 years?

8.

8. How can we reform the energy sector? And what are the approaches to sector reform?

9. How are experts involved in policy making/ how **should** they be involved in policy making?

10. What conservative measures should be put in place to curb the **current** damaging effects and how should the government go about it?

APPENDIX C: Interview Questions: Chambers of Commerce and Juba City Council

1. What role does chambers of commerce/ Juba city council plays in the Charcoal business in Juba?

2. Are there government laws, policies and regulations for the charcoal business in South Sudan?

3. What are the Socio-Economic implications of the charcoal business? What is the contribution of the business in employing the people of South Sudan?

4. What are the major challenges facing the city council and chambers of commerce in regulating the charcoal business?

5. How many licenses do you issue annually? How much does each individual pay for the license?

6. Who are the main investors in this business? What percentages of South Sudanese/ foreigners are in this business?

7. What are the government's margins in this business?

8. Is charcoal being exported to neighboring countries as other reports have stated? Given, Kenya and Uganda have been banned from cutting natural forests yet demand is still high and Dubai is mostly deserted?

9. What are the challenges in the current governance framework for environmental management?

10. What is your vision for Juba and South Sudan at large in terms of environmental health and natural resource management?

APPENDIX D: Interview Questions: State Ministry of Forestry and National Ministry of Environment

1. What roles does the Directorate play in the Charcoal business in Juba?
2. Are there government laws, policies and regulations for the charcoal business in South Sudan?
3. What are the Socio-Economic implications of the charcoal business? What is the contribution?
of the business in employing the people of South Sudan?
4. What are the major challenges facing the Directorate in regulating the charcoal business?
5. Could you quantify the value chain in detail: The stakeholders in each of the processes from charcoal producers to transporters and wholesalers? Product volumes and their market shares, amounts of revenue accruing at different stages of the value chain: This is to better understand the overall economic significance and provisionally identify intervention priorities and opportunities.
6. Who are the main investors in this business? What percentages of South Sudanese/ foreigners are in this business?
7. What are the government's margins in this business?

APPENDIX E: Interview Questions: Koneta Hub

1. Tell me more about your organization.
2. From your 'about section', you stated, "Koneta is a youth led organization that is focused on providing community led solutions to the socio-economic issues affecting the society", what are the main socio-economic issues facing the society and how is the organization planning to solve the issues?
3. How is the organization ready to tackle the energy crisis? What steps are you taking to equip women and youth in curbing the disastrous impacts of over dependence on an unsustainable form of energy for their livelihoods?
4. What are the current developments with regard to fuel energy?

5. Tell me more about your latest project on the energy saving stove and how effective it is in saving us from the high demand of charcoal use in the country.

APPENDIX F: Questionnaire Demographic Data

There are demographic questions to identify the names, ages, nationalities and educational backgrounds. All information will be kept secure for privacy and confidentiality:

1. Full Name:
2. Age:
3. Nationality:
4. Phone:
5. Education Level:
6. Address:

APPENDIX G: Charcoal Consumer Questionnaire

1. How many family members are in your household?
2. What is your monthly income level in SSP?
3. Do you use charcoal for cooking and other energy requirements in the house? Tick where appropriate.

Yes
No

Answer questions 4 to 7 if Yes for Qn 3. Proceed to 8 if No for Qn 3.

4. How long have you been using charcoal?
5. How many bags/sacks of charcoal do you use per day/month?
6. At how much do you buy the charcoal? (Bag/sack)
7. Why do you prefer charcoal to other forms of energy?
8. If no for Qn 3, what form of energy do you use for cooking and heating? And why do you prefer it?
9. Are you aware of the impacts of charcoal on the environment? If yes, list some of the impacts.
10. What do you think the Ministry of Environment, Energy, Agriculture and Forestry should do about the impacts you listed about?
11. Will you be willing to participate in any tree planting campaigns/ activities if the need arises? Why or why not?

APPENDIX H: Charcoal Retailer Questionnaire

1. For how long have you been doing the charcoal business?
2. Why did you choose this particular type of business?
3. What are the challenges you face in this business?
4. How much do you sell per day/ month? (Bags/ sacks)
5. Who do you buy the charcoal from?
6. At how much do you buy the charcoal? (SSP)
7. At how much do you sell a bag/ sack of charcoal to your customers? (SSP)
8. How much do you earn per day/month from selling charcoal? (SSP)
9. How much charcoal do you sell per day/month? (Bags/ sacks)
10. Do you have the legal license to carry out the business?
11. If Ans (Yes) in the above, who issues the license?
12. What do you think is the future of this business?
13. Are you aware of the impacts of charcoal on the environment?
14. What are your future prospects?

APPENDIX I: Charcoal Transporter Questionnaire

1. For how long have you been transporting charcoal?
2. Who do you get the charcoal from?
3. From where do you buy the charcoal?
4. How much charcoal do you transport per day/month? (Sacks)
5. Where do you transport the charcoal to?
6. To whom do you sell the charcoal?
7. Which means do you use to transport the charcoal from the producers to retailers?
8. At how much do you buy the charcoal? (SSP)

9. At how much do you sell it to retailers? And what is your profit? (SSP)
10. Do you have the legal license to transport charcoal?
11. If Ans (Yes) in above, who issues the license?
12. Why did you choose this particular business?
13. What do you like most about this business?
14. What are the challenges you face in this business?
15. What do you think the future of this business is going to be in 20-50 years?
16. What are your future prospects in this business?
17. Are you aware of the impacts of the charcoal business on the environment?

APPENDIX J: Charcoal Producer Questionnaire

1. From where do you harvest the charcoal?
2. Who owns the land?
3. How do you harvest the charcoal? (List the process)
4. What is the working environment like?
5. How much charcoal do you harvest per day/ month?
6. What types of trees do you cut in order to produce the charcoal? Why?
7. How many trees do you cut per day/ month?
8. How much land has been cleared to produce charcoal this year? (Hectares)
9. How many sacks of charcoal do you produce from the trees?
10. Who do you sell the charcoal to? How many are they?
11. At how much do you sell the charcoal? (SSP)
12. How much do you earn from this business? (SSP)
13. How often do you fell trees in order to produce charcoal? Day/Week/Month
14. Do you have a legal license for operating this business?
15. If YES to above, who issues the license?
16. How long have you been in this business?
17. Why did you choose this business?

18. What do you like most about this business?
19. What are the challenges you face operating in this business?
20. Where do you see yourself and the business after 10 years?
21. Do you have any plans or initiatives of planting trees to replace the ones harvested?

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