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Assessing the Impacts of Traditional Charcoal Production Sites on the Environment in Daynile District, Mogadishu-Somalia

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ABSTRACT

This article examines the environmental impact of traditional charcoal production in the Daynile district of Mogadishu, Somalia. The study reveals that current charcoal production practices have caused severe deforestation, desertification, and biodiversity loss. The research evaluates how these production sites affect soil quality, vegetation, and the well-being of internally displaced persons (IDPs) in the area. Data was collected through interviews conducted with the target population, using a GPS camera to capture photos of kilns, affected plants, and soils, along with voice recorders for transcription and notebooks for structured questionnaires. The findings indicate that emissions from the kilns pose health risks to workers and nearby residents, leading to respiratory and gastrointestinal issues, and even fatalities. Soil erosion and reduced plant life were also observed. The study emphasizes the need for alternative energy sources to reduce reliance on traditional charcoal production and mitigate its negative environmental impact. The research has policy implications for the Ministry of Environment and Climate Change in Somalia.

INTRODUCTION

Charcoal, as defined in dictionaries, is the black and porous residue obtained through the destructive distillation of animal or plant matter with limited air supply. However, charcoal, or 'char' for short, can also be derived from synthetic materials like polymers, in addition to natural sources. While the basic atomic structure of char remains consistent regardless of the precursor used, the overall morphology may vary. It is important to differentiate charcoal from other impure non-crystalline forms of carbon such as coke and soot. Unlike charcoal, coke is produced through solid phase pyrolysis, usually from bituminous coal, and involves the formation of a fluid phase during carbonization. The structure and properties of coke and char differ significantly. On the other hand, soot is formed through incomplete combustion in the gas phase, rather than solid phase pyrolysis, and possesses a distinct microstructure separate from both coke and charcoal. This discussion does not cover soot in detail (Harris, 1999).

The process of traditional charcoal production requires a specialized skill set to ensure optimal results. Among various factors, the careful operation of the kiln plays a pivotal role in achieving efficient conversion of wood into charcoal. To begin with, the wood used for charcoal production needs to be adequately dried. This drying process helps remove moisture from the wood, making it more receptive to the subsequent conversion process. In addition to proper drying, the stacking of the wood within the kiln is crucial. The wood must be arranged in such a way that it allows for a uniform flow of air throughout the kiln. This even distribution of airflow facilitates the necessary chemical reactions to take place consistently, leading to the transformation of wood into charcoal. Time is also a critical consideration in traditional charcoal production. Sufficient duration is required for the reactions to occur gradually and for the wood to be converted into charcoal effectively. Rushing or insufficient time allocated for these reactions can compromise the quality and quantity of the final charcoal produced. It is worth noting that the correct operation of the kilns is essential for achieving optimal yields. If the kilns are not operated with precision, such as inadequate control of temperature or poor airflow, the resulting charcoal yields can be significantly lower than the desired and achievable levels. In fact, suboptimal kiln operation can lead to yields as low as half of the maximum potential output (Practical Action, 1926).

Background

Charcoal production for Brazil's steel industry ranks second in importance after agriculture in the cerrado region, and the two sectors are closely linked. As land is cleared for agriculture, the trunks and roots of trees are often utilized in charcoal production, generating income from clearing activities. Traditionally, the Brazilian steel industry has relied on cerrado's trunks and roots for charcoal, but with the steel mills in Minas Gerais becoming the world's largest, the impact on the cerrado has intensified. However, recent conservation efforts and the declining vegetation in the cerrado have led to an increase in the sourcing of charcoal from eucalyptus plantations, signaling a growth in these initiatives (Ratter & Dargie, 1992).

The significance of wood fuel and its byproduct, charcoal, in meeting the energy demands of developing nations cannot be overstated. It serves as the primary source, fulfilling approximately 95 percent of domestic

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and commercial cooking energy requirements in these countries. Charcoal is essentially wood that has undergone combustion without oxygen. This can be achieved by either heating the wood in a sealed environment or igniting it and then depriving it of air, preventing complete combustion and leaving behind a lightweight and porous carbon structure. This process removes most other components of the wood, resulting in a nearly pure carbon product that is easily transportable (Lurimuah, 2011).

According to Oriola et al. (2013), the consumption of fuel wood and charcoal is believed to have a significant impact on the decline of tree stock in Africa. For example, the Food and Agriculture Organization's 1990 forest assessment reported a substantial increase in global fuel wood and charcoal production, rising from 362.4 million cubic meters in 1970 to 1,875.9 million cubic meters in 1993 (FAO, 1995). Deforestation resulting from the production of firewood and charcoal is driven by overpopulation and the growing demand for these wood-based energy sources. This large-scale deforestation can be considered one of the primary global changes caused by human activities, as evidenced by the approximate 50% reduction in global forest area (D & Omofoyewa, 2013).

In Sub-Saharan Africa, the rise in population pressure, agricultural expansion, and unregulated harvesting of fuel wood, including inefficient charcoal production methods, have led to widespread deforestation and degradation. The FAO (2000) reported that the consumption of charcoal and fuel wood in 1998 was approximately 15.9 million m3, and it was projected to rise to 20.6 million m3 within a 10-year period, representing an estimated increase of about 30 percent (Ansah, 2022).

In Togo, the demand for firewood and charcoal accounts for over 80% of the country's total domestic energy needs. This traditional energy consumption amounts to an average annual usage of approximately 419,964 tons nationwide. The growing demand for traditional energy is met through domestic production efforts (Kouami et al., 2009). Unfortunately, the significant consumption of charcoal has had severe ecological consequences due to outdated production methods employed by producers and households' inefficient charcoal usage practices. The production yield is relatively low, ranging from 15% to 20%, meaning that only 150 to 200 kg of wood is produced per ton of woody material (Girard & Girard, 2002).

In Nigeria, there has been a significant increase in the rate of deforestation over the past two decades. According to Ibrahim (2005), it is estimated that approximately 400,000 hectares of land are lost to deforestation annually, while reforestation efforts cover only around 1.043 hectares. The report further highlights the escalating rate of deforestation, with an average annual increase from 0.7% in the period of 1980-1990 to 0.9% in 1990-1995, and a significant jump to 2.6% in 1990-2000. This trend has contributed to the transformation of forested areas into woodland savannas in the region. Woodland savanna refers to areas that were originally characterized by forests but have been altered into savannas due to human activities such as logging, agriculture, grazing, and favorable climatic conditions (D & Omofoyewa, 2013). Thus, the opening up of forests has led to the evolution of woodland vegetation.

For many decades, and possibly even centuries, Somalia has experienced ongoing ecological changes that have consistently led to a reduction in vegetation cover. However, in the past three decades (1974-2004), the rate of deforestation has accelerated, primarily driven by the growing demand for charcoal, wood for construction, and thorn fencing. This heightened demand has exerted significant pressure on the remaining acacia woodland in the region. Biomass remains the primary and, in fact, the only traditional source of energy for the population of Somaliland. Charcoal is the predominant fuel used for cooking and heating in urban areas, while firewood is commonly used in rural settlements (MoPD&E, 2004).

By reducing the amount of land that can be used for farming or grazing and by evicting residents from areas that have become uninhabitable after charcoal producers have felled all the trees, the production of charcoal hastens desertification. Urbanization, which allows people to fall down trees for habitation, also hastens desertification. Because species that depend on tree groves are unable to survive without them, deforestation also diminishes biodiversity. In Somalia, rangelands have been damaged due to the removal or cutting down of trees to meet the increased demand for charcoal. According to a recent FAOSWALIM report in Puntland state, Somalia, acacia plant species are losing 5% of their population annually. Another SWALIM study predicted a short-term (2011–2013) drop in plant cover in the Jilib Area, middle Juba, a pattern that is pervasive throughout Somalia.

Problem Statement

Since the collapse of the central government of Somalia in 1991, the Somali population has endured a prolonged period of civil conflict, extreme poverty, frequent droughts, and floods. However, one critical issue that has not received sufficient attention is the lack of awareness among Somalis regarding the value of the environment and the detrimental effects of conventional charcoal manufacturing in urban areas. In the specific case of Mogadishu, the capital city of Somalia, the Daynile area has witnessed the unfortunate establishment of traditional charcoal producing locations by businesspeople. Compounding this issue, internally displaced persons (IDPs) in the Daynile district of Mogadishu, particularly in the hamlet of Iga-Horkeen, find themselves in close proximity to these traditional charcoal-producing sites. In order to comprehensively evaluate the environmental impact of traditional charcoal manufacturing in the Daynile area of Mogadishu, Somalia, it is imperative to undertake extensive research that investigates the effects of this practice.

The revised problem statement highlights the complex socio-environmental challenges faced by Somalis due to the collapse of the central government, poverty, and natural disasters. It emphasizes the lack of awareness regarding the environmental consequences of traditional charcoal manufacturing in urban areas and the specific concern of IDPs residing near these production sites. The statement underscores the necessity for thorough research to assess the environmental impact of traditional charcoal manufacturing in the Daynile area of Mogadishu, Somalia.

The proposed study holds significant importance and benefits for multiple stakeholders in Somalia and specifically in the Daynile area of Mogadishu. The following points outline the significance of the research: Community Impact: The study's findings will directly benefit the community of Somalia citizens. By evaluating the effects of conventional charcoal production on the environment in the Daynile area, the research will raise awareness among the local population about the detrimental consequences of this practice. This knowledge can empower the community to make informed decisions and take necessary actions to mitigate the environmental impact of traditional charcoal manufacturing. Ministry of Environment and Climate Change: The study will provide valuable information to the Ministry of Environment and the Climate Change in Somalia. By understanding the specific environmental challenges of traditional charcoal production in the Daynile area, the ministry can develop targeted policies and regulations to address and regulate this issue effectively. The research findings will serve as a crucial resource for policy development and decision-making processes aimed at minimizing the negative effects of traditional charcoal manufacturing sites. Foundation for Policy Development: The study's contribution to the body of knowledge surrounding traditional charcoal manufacturing in the Daynile area will serve as a foundation for policy development. Policymakers, government institutions, and NGOs can utilize the research findings to design and implement strategies that promote sustainable alternatives to charcoal production, reduce environmental degradation, and enhance community's overall well-being of the. The study's comprehensive analysis will aid in creating evidence-based policies that target the specific challenges faced by the Daynile area. Researchers: The research will benefit researchers and scholars working in the field of environmental studies, sustainability, and policy development. By adding to the existing body of information, the study will contribute to the academic field, helping researchers gain insights into the environmental impacts of traditional charcoal manufacturing in urban areas. It can also inspire further research and investigations on related topics, ultimately leading to a more comprehensive understanding of environmental challenges in Somalia and beyond.

The primary objective of this study is to evaluate the environmental effects of traditional charcoal producing sites in the Daynile area of Mogadishu, Somalia. The specific objectives are as follows; firstly, is to assess the effects of traditional charcoal manufacturing sites on internally displaced persons (IDPs) in the Daynile area of Mogadishu, Somalia. This objective aims to understand the impact of charcoal production on the well-being and living conditions of IDPs residing in proximity to these sites. Secondly, is to observe the physical impacts of traditional charcoal manufacturing sites on the soil in the village of Iga-Horkeen, located in the Daynile district of Mogadishu, Somalia. This objective focuses on examining the changes in soil color, resulting from the presence of traditional charcoal production activities. Thirdly, is to determine the physical impacts of traditional charcoal manufacturing sites on plants and trees in the village of Iga-Horkeen, situated in the Daynile district of Mogadishu, Somalia. This objective aims to analyze the effects of charcoal production on the health, growth, and biodiversity of local vegetation. To propose effective mitigation strategies and hubs to address the environmental issues associated with traditional charcoal manufacturing in the village of Iga-Horkeen, particularly concerning the IDP population. This objective seeks to provide practical recommendations and solutions to minimize the negative environmental impacts and enhance sustainability in the affected area.

LITERATURE REVIEW

Due to the potential for deforestation, land degradation, and climate change effects, large- scale charcoal manufacturing has become a significant source of concern, particularly in sub- Saharan Africa. Despite rising per capita income, higher electrification rates, and significant renewable energy potential, charcoal continues to be the primary source of cooking and heating energy for 80% of households in Sub-Saharan Africa (SSA) (Rembold et al., 2013). It is cited as the most environmentally destructive phase of this traditional energy supply chain. It provides a lifeline for the region's rapidly expanding urban populations as well as possibly substantial segments of the rural population as a traditional fuel that has been utilized for hundreds of years. Despite the best efforts of proponents of modern energy, the demand for charcoal is anticipated to continue increasing dramatically in the coming decades due to its low cost compared to other fuels like kerosene and liquefied petroleum gas (LPG) as well as other factors that will be covered in the following sections (Barnes & Floor, 1996). By 2030, it expected that SSA will use charcoal twice as much, with over 700 million Africans utilizing it as a reliable, dependable, and affordable energy source (Jones, 2015). There is a critical need to distinguish between real and perceived energy since consumption is expected to raise futures pertaining to charcoal. Other studies have revealed that even with significant gains in earned income, most SSA nations continue to use charcoal; despite research showing that large-scale transitions to modern energy sources will only occur after a particular income level is reached.

Impacts of Charcoal Production on Human Health

In addition to the negative consequences of charcoal manufacturing on the environment, problems pertaining to human health (Eniola, 2021), These include a variety of illnesses that charcoal makers frequently endure, such as cough, fever, and backaches. Moving heavy trees repeatedly when making charcoal causes lumbar discomfort and muscle stiffness in the producers (Idowu et al., 2023). It is important to note that some charcoal producers pass away while working. Accidents might also happen while clearing trees, setting up kilns, or putting charcoal onto trucks. Additionally, producers breathe in gases and smoke, and the heat generated during the creation of charcoal is a cause of illnesses such respiratory conditions and coughs. They also complain of weariness, chest ache, and aching hands. The producers also experience hemoptysis, dyspnea, and sputum production (Eniola, 2021).

The Food and Agricultural Organization of the United Nations (FAO) published a draft document outlining the risks relating to the precautions that producers should take while producing industrial charcoal in underdeveloped countries. The severity and possible risk of these working circumstances are shown by the sheer number of regulations that were written over thirty years ago. However, in most regions that manufacture charcoal for residential use,

these safety procedures are not implemented due to a lack of appropriate knowledge, institutional capability, or financial resources, which increases the likelihood of moderate to severe injury and sickness (Kahan, 2013).

The effects of wood fuels on health have been centered on as a result of their usage. Given the high amounts of smoke and particle matter emitted during wood fuel combustion, indoor air pollution (IAP) is the main cause for worry. In the poor world, found trends in respiratory disease among disproportionately more women and children due to IAP from wood fuel burning (Ubaid et al., 2021). The health effects faced by charcoal manufacturers throughout the extraction and manufacturing phases, however, are not well understood (Ubaid et al., 2021). For instance, pyrolysis, the method used to create charcoal, is known to release sizable amounts of gaseous byproducts, such as carbon monoxide, sulfur dioxide, and others (Eniola, 2021), which are known to be fatal to humans at moderate concentrations when used in dose-response studies. Rural farmers are known to operate close to high-temperature kilns that emit these extremely hazardous substances, raising the possibility of poisoning. Additionally, the usage of ad hoc instruments may result in moderate to severe injuries that may be deadly in remote regions without access to competent medical treatment.

Physical Impacts of Charcoal Production on Soil

There have been publications expressing concerns about the deforestation and forest degradation that accompany the manufacturing process of charcoal in practically all countries where it is produced (Bolognesi M et al., 2014). Deforestation, which is frequently linked to clearing forests, is the more or less total loss of forest cover, whereas forest degradation refers to less evident changes in the woody canopy cover (Ecology, 2011). Therefore, degradation is the short- or long-term decline in the cover's density, structure, species diversity, or productivity (Chidumayo, 2014).

To manufacture CC in Ghana, earth is used as a barrier against oxygen and to protect the carbonizing wood from excessive heat loss. When the temperature of the wood is increased to roughly 300 °C, thermal degradation of the wood begins. Once it has begun, the pyrolysis process continues on its own and generates a lot of heat, reaching a maximum temperature of around 500°C for high efficiency and product quality. However, inefficiency may result in greater temperatures. Depending on the time period and the amount of wood in the piles, the amount of heat emitted during pyrolysis is comparable to that from bushfires or shifting-cultivation (slash and burn) fires. The manufacturing of charcoal affects soil qualities by heating and improving it (Ayinde et al., 2018). While shifting-cultivation fires have been documented to reach temperatures >500°C (Sertsu and Sanchez, 1978), detected surface temperatures up to 400°C in a ground fire (litter and duff), (Oguntunde et al., 2008). Research has indicated that on soil structure, color, mineralogy, and other soil attributes, intense burning has a profound impact (Sertsu and Sanchez,

1978; Ketterings et al., 2000; (Oguntunde et al., 2008). According to (Oguntunde et al., 2008) , highly burned soils exhibit a significant loss in clay fraction and an increase in sand fraction, which may eventually result in a reduced ability to store water (Ulery and Graham, 1993). High-severity burns (>600°C) generated noticeable reddening of the topsoil, along with a rise in both Munsell value and chroma (Ulery and Graham, 1993; Ketterings and Bigham, 2000). Low to medium fire severity resulted in darkening of the topsoil (Oguntunde et al., 2008)

Physical Impacts of Charcoal Production on Plants and Trees

Around the world, 55% of the wood that is removed from forests is utilized to make electricity. In Africa, this percentage increases to 90% (Oguntunde et al., 2004). Fuel wood consumption has increased almost twofold in Sub-Saharan Africa (SSA) since 1990, and some estimates suggest that it might account for which account for 30% of local anthropogenic emissions (Njenga et al., 2023). The effects of using wood fuel on forest resources and carbon emissions are still not fully understood and measured, despite their importance (Njenga et al., 2023). There are several sources of wood fuel, each having its own manufacturing processes, stakeholders, and effects on forestry resources. Nearly 80% of the population uses charcoal as part of their cooking energy mix in twenty-one SSA nations, where it is the primary energy source for urban households (UNEP, 2019). Trees are felled, chopped, piled, and covered with dirt in earth kilns where they burn in a low-oxygen environment to produce charcoal. It is the favored option for urban families since it is convenient to carry and contains a lot of energy. Since 2000, the demand for charcoal in SSA has increased at a pace of around 4% per year. According to predictions, charcoal will continue to be a significant source of energy until 2040 as the region's urban population grows quickly (Njenga & Mendum, 2018)

Although there are still significant knowledge gaps, there is growing agreement that the manufacture of charcoal is a major factor in the degradation of forests in SSA (Sedano et al., 2016). A loss in a forest's ability to provide products and services including biomass, carbon sequestration, water management, soil protection, and biodiversity preservation is known as forest degradation (FAO., 2011).

Due to the potential for deforestation, land degradation, and climate change effects, large- scale charcoal manufacturing, particularly in SSA, has drawn increasing attention. Despite rising per capita income, higher electrification rates, and significant renewable energy potential, charcoal continues to be the primary source of cooking and heating energy for 80% of households in SSA. It is considered to be the most environmentally damaging stage of this traditional energy supply (Chain, 2007); Zulu and Richardson (2013); Arnold et al. (2006). Charcoal made using better technology and resources that are managed sustainably. The fact that it is a low net emitter of GHGs, however, contributes to reducing climate change while also improving access to food and energy and creating chances for earning money (Iiyama et al., 2014b; Schure, Levang, and Wiersum, 2014).

Somalia is one of the African nations where the manufacturing of charcoal is a big issue, causing the country's woody resources to be depleted (FAO SWALIM, 2018). The nation has been embroiled in civil war for more than 30 years, which has led to increased resource exploitation by militant organizations, primarily in the center and southern regions of the nation that are under their control. The UN Security Council has continued to reiterate the restriction in succeeding resolutions, but the ban has been broken and the trade has continued (UN Security Council, 2013, 2014, 2015, 2016, and 2017). 20% of the charcoal generated in Somalia is used domestically, while 80% is sold to the Gulf States. An estimated 4.4 million trees are cut down each year to make the 250,000 tons of charcoal that are thought to be shipped from Somalia to the Gulf nations of Saudi Arabia and Yemen (Brown, 2013). Due in part to the vast forest degradation and deforestation, the nation is currently experiencing environmental issues like flooding and drought. The nation loses around annually 72,900 hectares of woodland (Brown, 2013). The majority of the charcoal produced is not recorded because the trade is illegal and some places are inaccessible, such as those under Al Shabab's control, underestimating the degradation brought on by the production of charcoal in the nation.

METHODOLOGY

The study population for this research consists of farmers, charcoal producers, and residents of Iga-Horkeen internally displaced persons (IDPs) who live near the traditional charcoal production sites in the Deynile district of Mogadishu, Somalia. In terms of inclusion criteria, all residents of Iga-Horkeen IDPs who are above the age of 15 and available during the study period are eligible to participate. On the other hand, individuals who are not available during the study period and those who are not residents of Iga-Horkeen IDPs in the Deynile district are excluded from the study. The study design is described as a descriptive design with a qualitative approach, employing convenient sampling to select participants. Data collection will primarily involve interviews conducted with the target population in the designated area to gather detailed and accurate data. The researchers will utilize a GPS camera to capture photographs of the traditional kilns, affected plants and soils, and any relevant issues in the IDP areas, with captions and geographical locations (latitudes and longitudes) added to the captured photos. Voice recorders will be used to capture respondents' voices, which will later be transcribed into written form for analysis. Notebooks will also be used to document answers from structured questionnaires.

RESULTS AND DISCUSSIONS

This study aims to assess the impacts of traditional charcoal production sites on the environment in the Daynile district Mogadishu Somalia. Following this study objectives, the researcher interviewed a number of IDPs residents of Iga-Horken village, Farmers and Charcoal sites workers.

Impacts of Charcoal Production on Human Health

Iga-Horkeen village IDPs' environmental status was good

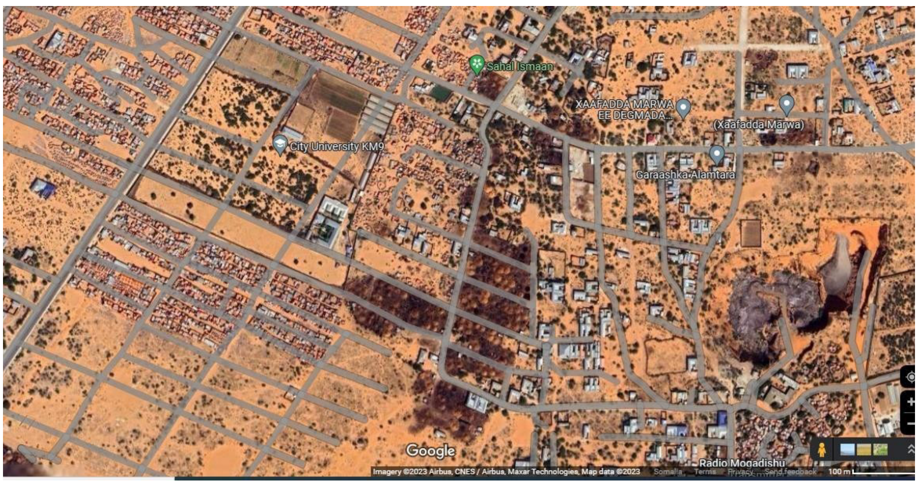

Figure 1: Map photo of Iga-Horkeen village showing the kilns in the residential area

before the traditional charcoal producing sites were built, according to the respondents. Additionally, they stated that the fumes from the kilns are nearly causing toddlers and elderly people to cough more severely. Furthermore, the respondents claimed that the smoke and foul odor coming from the locations are causing ongoing diarrhea, particularly in toddlers. In addition to that interviewees mentioned that there is an increasing memory loss issues to the elders. Tragically, several of the interviewees discovered that two traditional charcoal producing workers had passed away. Unfortunately, according to the respondents, there are no MCH centers in the camp, and the IDP inhabitants' quality of life is below that of survival. In the figure 1; describes the exact life in Iga-Horkeen village.

Physical Impacts of Charcoal Production on Soil

In Iga-Horken village, where the traditional charcoal production sites are dominating the entire region, kilns are almost being built, as the researcher observed and the interviewees among site employees suggested. According to interviews, a single kiln may take approximately 6 M2. In order to use the dirt as a cover for the kiln, the site workers dig a 1M hole in the earth, as the researcher perceived. Additionally, it has been found that all trees on the ground must be cut and that causes soil erosion. Without plants, there won't be any rain, and there won't be any rain implies droughts, and other types of natural calamities. The soil is under extreme fire for seven days due to the kiln's fire, which changes the soil's color and any other biodiversity that may reside there. As the interviewees subjects said, the kiln area used to be green with natural color soil (sandy soil), but at the moment, around 1 KM^2 of space in the hamlet of Iga-Horken is in a dark color of soil like charcoal color with foul smell. The researcher compared the kiln soil to nearby open field soils and discovered that there are significant differences between them in terms of color, smell, and biodiversity (plants live there).

The soil in kiln sites is totally dark like charcoal, smells awful like fumes, and has no physically discernible biodiversity while the nearby soils in the open fields are in nature even though the biodiversity is negatively impacted. The researcher utilized a drone to analyze the soil damage and discovered that around 25 kilns were in the fire stage, five kilns were in the beginning stage, and between 31 and 38 kilns was in the harvesting (finishing) stage. In the figure 2 below shows the impact.

Figure 2: Physical impacts of traditional charcoal production sites on Soil at Iga-Horkeen village in Deynile district, Mogadishu-Somali

Physical Impacts of Charcoal Production on Plants and Trees

According to interviewees (Agriculturists), green-house farming plants used to generate above-average yields, but subsequently, when the village's kilns began operating, 50% of the plants there were aborted, became yellow, and eventually died. According to the respondents, the trees used to produce charcoal in the Iga-Horkeen village sites come from areas outside of Mogadishu. The respondents also mentioned that the majority of the trees removed include Acacia Bussei (Galool), Hagar, Terminalia_ orbicularis (Bisiq), Shilan, Cordia sinensis (Mareer), Aqab, Adad and Algroba-trees (Cali-Garoob) in the regions of Banaadir, Bay, Bakool, Hiiran, Lowe-Shabeel, Middle-Shabelle, and Middle-Jubba. Additionally, both dry and wet trees are used by the makers. In Mogadishu, the wet trees are primarily Algroba-trees, which are chopped down and used as a cover for the kilns. According to the interviewees, the kiln environment was once a green area with trees and plants, but after the kilns began operating, it changed to an area without trees and plants as a result of the traditional charcoal production sites' negative

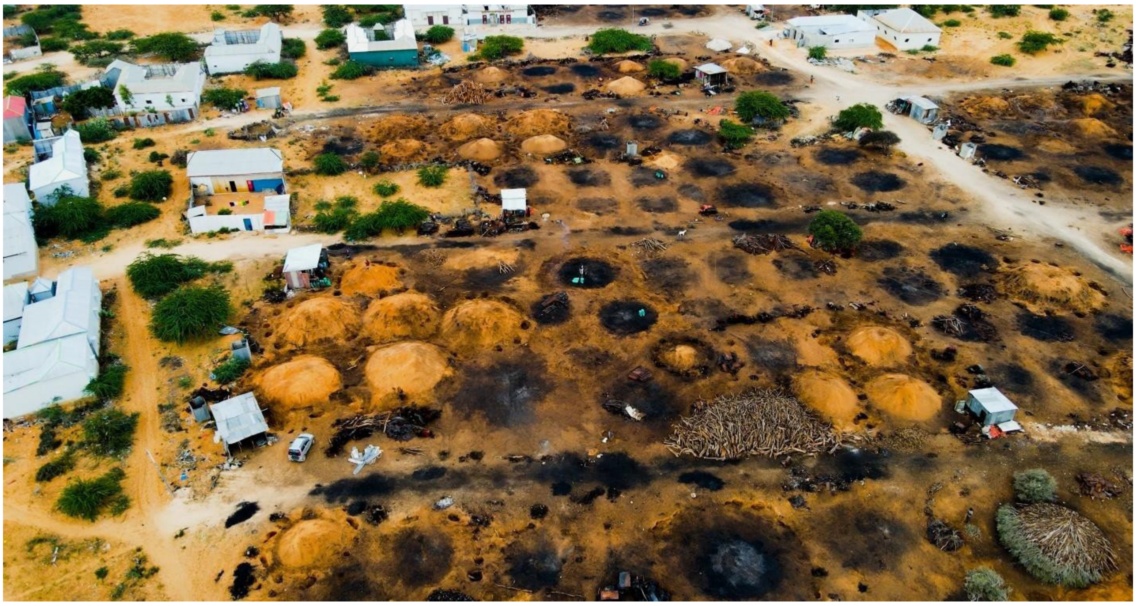

Figure 3: Physical impacts of traditional charcoal production sites on plants and trees at Iga-Horkeen village in Deynile Mogadishu Somalia

effects, such as carbon monoxide fumes, hot weather, and polluted air. Only Algroba-trees survived to thrive close to the manufacturing region, since the researcher noticed there were no other plants or trees in the vicinity of the kilns. Additionally, examples of plants whose color changed to yellow due to air pollution and dust disturbing their photosynthetic process are recorded. Look figure 3; showing the impact.

DISCUSSIONS

The study reveals that traditional charcoal production sites are associated with adverse health effects, including cough, diarrhea, and even fatalities. Disturbingly, interviews indicate instances where workers at charcoal production sites suffered from skin problems and, tragically, lost their lives. Similar reports of workers in Nigeria's charcoal production sites experiencing fatalities have been documented (Eniola, 2021). The occurrence of cough and diarrhea primarily affects children, while memory loss is commonly observed among adults.

The interviews indicated that the environment ecosystem was nice before the arrival of the kilns in Iga-Horkeen village camp. The soil was in its natural color and smell. Unfortunately, the kilns are established in Iga-Horkeen village and site workers cut the trees and plants from the ground leads to soil erosion. In addition to that, the interviews shot light on the negative impact of kilns on soil and the researcher observed that the soil structure is damages and soil in the field turned to black color with bad smell. The researcher observed by using drone that they are roughly 1 KM^2 of polluted and dominated by kilns. Furthermore, the are about 50 kilns in the area contained some on fire and others in finishing stage. The same cases are reported from Lusaka Zambia that cutting tress results deforestation and kilns cause degradation (Gumbo, 2012).

The interviewees pointed out that 96% of trees for making charcoal are from outside of Mogadishu. The sources of the dry trees for charcoal making are; Lower-shabelle, Middle- Shabelle, Bay, Bakool, Hiran, and Middle-Jubba. 4% of the trees are from Banaadir region, these wet trees named Algroba and Adad. Most used trees for making charcoal are Acacia Bussei (Galool), Hagar, Terminalia_ orbicularis (Bisiq), Shilan, Cordia sinensis (Mareer), Aqab, and Algroba (Cali-Garoob). The wet trees are Al-groba and Adad where they use as the cover of the kilns.

CONCLUSION

The purpose of the study is to evaluate the environmental implications of traditional charcoal-producing sites in the Daynile area of Mogadishu, Somalia. Iga-Horkeen is a village in Finland. IDPs have environmental issues as a result of traditional charcoal manufacturing sites, which include coughing, diarrhea, memory loss, and the eviction of traditional personnel. The problem is exacerbated by a lack of MCH facilities and a low level of life. In the village of Iga- Horken, where traditional charcoal production facilities prevail, kiln construction is nearly complete. A single kiln takes up 6 M2 and requires 1 M holes to be excavated around it. This disrupts rainfall and droughts while also promoting soil erosion. The earth around the kiln is dark and smells like charcoal. The color, smell, and biodiversity of the soil are compared to those of nearby open field soils, finding significant differences. The researcher assessed soil damage using an aerial vehicle and observed that there are presently 25 kilns in the burning stage, five in the beginning stage, and 31-38 in the harvesting stage. Yields from greenhouse farming in Iga- Horkeen village areas fell by half once kilns were turned on. Acacia Bussei, Hagar, Terminalia orbicularis, Shilan, Cordia sinensis, Aqab, Adad, and Al-groba trees, all endemic to locations outside of Mogadishu, were the majority of those felled. The surrounds of the kiln were initially lush, but elements such as carbon monoxide emissions, searing temperatures, and unclean air led to the degradation. Only Al-groba trees survived near to the industrial area.

Based on the study's findings, several recommendations are proposed to improve the environmental quality of Iga-Horkeen hamlet in Daynile, Mogadishu, Somalia:

1. In cases of emergency, the charcoal-producing sites in Iga-Horkeen village should be immediately shut down to prevent further environmental degradation and health risks.
2. The village's (IDPs) should receive a brief health checkup to assess any immediate health issues resulting from the proximity to charcoal production sites.
3. Free medical assistance should be provided to the IDPs based on the descriptions and diagnoses provided by the site's physicians. This will help address any health issues and provide necessary treatment.
4. Disaster management experts should be engaged to assess the long-term effects of charcoal production on human health and other environmental aspects. Their expertise will aid in developing effective mitigation and management strategies.
5. The government of Somalia needs to enforce basic environmental regulations that prohibit traditional charcoal manufacturing and deforestation. This will discourage further environmental degradation and protect the local ecosystems.
6. The Mogadishu community should develop an afforestation strategy for Iga-Horkeen hamlet, focusing on planting a sufficient number of trees. Afforestation will help restore the ecological balance, mitigate soil erosion, and enhance biodiversity.
7. The government of Somalia must take clear steps and fulfill its responsibilities to restore and replant the regions affected by deforestation caused by charcoal production. This will aid in the regeneration of natural habitats and promote sustainable land use practices.
8. Further research is necessary to delve into specific aspects, such as:

I. Investigating the impact of charcoal production kilns on soil productivity.

II. Assessing the biological and chemical effects of charcoal production kilns on plant life.

III. Identifying suitable afforestation methods and plant species for the restoration of the affected areas.

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