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DEPARTMENT OF FINANCE AND POLICY MANAGEMENT

EFFECT OF FINANCIAL DEVELOPMENT, PRIMARY AND SECONDARY SECTORS ACTIVITIES ON ENVIRONMENTAL QUALITY IN SUB-SAHARAN AFRICA

THOMAS BLENYIGBAN SISONG

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DECLARATION

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Date:.....

Sign:.....

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DEDICATION

In memory of my father

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LIST OF ACRONYMS

ADF	Augmented Dickey-Fuller Test
ARDL	Autoregressive Distributive Lag
APEC	Asia Pacific Economic Cooperation
BRICS	Brazil, Russia, India, China, and South Africa
CD	Cross Sectional Dependency
CO_2	Carbon Dioxide Emission
DCPS	Domestic Credit to Private Sector
EKC	Environmental Kuznets curve
EC	Energy consumption
EPA	Environmental Protection Agency
EG	Economic Growth
EAGLE	Emerging and Growth- leading Economies
FD	Financial Development
FDI	Foreign Direct Investment
GFDR	Global Financial Development Report
GFSR	Global Financial Stability Report
GDP	Gross Domestic Product
GMM	Generalised Method of Moments
MEA	Middle East & African

MENA	Middle-East-North-Africa
M2	Money And quasi Money
PHH	Pollution Haven Hypothesis
PP	Philip Peron
PVEC	Panel Vector Error Correction
PVAR	Panel Vector Autoregressive
PS	Primary Sector
PMG	Pooled Mean Group
R&D	Research and Development
SSA	Sub-Saharan Africa
SS	Secondary Sector
SSEA	South and Southeast Asian
WEF	World Economic Forum

ABSTRACT

The study examines the effect of financial development, primary and secondary sectors activities on environmental quality. The study considers three distinct objectives. First, the study examines whether primary sector activities have positive effect on environmental quality in sub-Saharan Africa (SSA). Second, it assesses whether secondary sector activities have positive effect on environmental quality in sub-Saharan Africa, and the third objective investigates whether there is short and long-run bidirectional causal relationship between financial development and environmental quality. A panel of county-level data on twenty (20) selected countries from sub-Saharan Africa are obtained from the World Development Indicators (WDIs). Employing the Generalized Method of Moments (GMM), Random Effect (RE), and Autoregressive Distributed Lag (ARDL) techniques, the study finds that, one, primary sector activities affect environmental quality in sub-Saharan countries negatively. Two, secondary sector activities in sub-Saharan Africa have positive influence on environmental quality. Three, financial development has no influence on environmental quality in short and long-run in SSA. The directional causality suggests that these variables do not have effect on each other in short and long term for countries in sub-Saharan Africa (SSA). However, the coefficients of energy consumption, primary and secondary sector show bidirectional causality for long-run, but primary sector shows one way causality from primary sector to carbon emission in the short run. As a policy recommendation, SSA countries should enact and implement policies that would control and regulate the activities in the primary and secondary sectors, to prevent the use of environmentally unsustainable chemicals in factories and on the earth surface to improve the quality of the environment.

CHAPTER ONE

1.0 INTRODUCTION

Environmental degradation and worldwide warming (greenhouse fuel emissions) are presently most important global troubles. Since industrial existent, nations are doing best to improve on financial improvrment as lots as feasible. Environmental degradation has led to an unheard of upward thrust in greenhouse fuel emissions in standard and carbon emissions in particular, which led to global warming and ozone depletion. Some researchers argue that development in the financial sector contributes to environmental quality in different locations (Shahbaz *et al.*, 2018). This chapter discusses the introduction and followed by the background of the study, problem statement, justification, objectives, organization as well as the scope of the study.

1.1 Background to the Study

Environmental quality may be associated with several homes and difrent properties. Environmental quality refers to both the constructed environment and the natural environment which encompasses factors like air quality, water quality or pollution, noise levels and any potential consequences that these factors may have on one's physical and emotional well-being. A variety of energy elements contribute to the assessment of the quality of the environment. These properties are fromm local and international environment that are sustained through all living things. Measuring environmental quality relies upon the use of energy which is the primary contributor to destructive and maintaining the atmosphere. It is widely believed that human activities, such as the combustion of fossil fuels, felling of threes and cattle rearing, have negative impact on surroundings due to their emission of greenhouse gases, which reduce environmental quality. In Sub-Saharan regions, there is a significant potential for sustainable resources for the production of liquid biofuels. Various estimates have been refined and accumulated with a strong focus on the types of feedstock that can be

converted into biofuels. The primary goal is to promote the growth of environmentally and socially sustainable feedstock for bioenergy production while minimizing the release of harmful chemicals like Sulfur dioxide (SO2) and Carbon dioxide (CO2), which contribute to global warming. Numerous techniques exist for sourcing biomass feedstock, utilizing various methods that consistently contribute to the development of animals cells from materials obtained in forests areas and farms. The cultivation of food crops presents a promising approach not only for human welfare but also for the establishment of a quality environment (Ali *et al.,* 2019; Ridzuan *et al.,* 2017). Environmental quality exerts a strong impact on different aspects of life. Developing countries and international environmental protection agencies in the world, are particularly careful about the environmental aspects.

In recent years, many countries, particularly in Sub-Saharan Africa, have not yet implemented stringent environmental policies. There has been an increasing interest in studying the connection between long-term economic growth, socio-political factors, and various elements that pose risks to environmental quality. Given that the detrimental effects of environmental degradation extend beyond immediate and direct impacts on human health, livelihoods, and future generations, it necessitates significant attention and effective environmental pollution control measures. To prevent such losses, the focus on enhancing environmental quality began to gain momentum after the 1960s, drawing the attention of economists, environmental experts, and policymakers. The reasons of greenhouse gas emissions (GGEs) had been topical over time as a result of their impact on worldwide weather. Numerous nations have made calls to address global climate change, leading to the existent of international agreements such as Kyoto Protocol, and Paris Agreement in December 1997, which officially came into effect on February 16, 2005. These agreements primarily focus on

reducing greenhouse gas emissions (GHGs), with carbon dioxide (CO2) emissions identified as the leading contributor to climate change. Among GHGs, CO2 emissions are particularly concerning due to their significant impact on both human well-being and the environment (IPCC, 2019). According to the Environmental Protection Agency (2018), Carbon dioxide emission account for more than 60% of global GHGs. Sub-Saharan Africa (SSA) has the smallest share of global CO2 emissions, but it is one of the regions with most vulnerable to climate change. For instance, while sub-Saharan Africa (SSA) contributes only 4% of global CO2 emissions, Latin America and the Caribbean, Europe, North America, and Asia contribute 6%, 16%, 17%, and 49%, respectively (Ritchie & Roser, 2019). The low rate of CO2 emissions in sub-Saharan Africa (SSA) may be because of low utilization of energy or non-industrialization within this location. The nations with excessive percentages of CO2 emissions are all developed and industrial economics who are in energy productions and use excessive chemical compounds which can be dangerous to the environment.

Edmonds et al. (2020) have uncovered that a significant number of nations in the region face substantial risks associated with climate change. According to the 2015 Climate Change Vulnerability Index, seven Sub-Saharan African nations , namely Sierra Leone, South Sudan, Nigeria, Chad, Ethiopia, Central African Republic, and Eritrea, rank among the top 10 nations with the highest vulnerability to the impacts of climate change (Sarkodie, 2018). Adzawla *et al.* (2019) have observed that many SSA countries experience heightened weak to climate shift due to heavy reliance on natural resources for farming activities, limited economic development, inadequate infrastructure, and limited technological progress. Climate change has adverse effects on food production, leading to extreme climatic conditions and exacerbating poverty in SSA.

Alagidede *et al.* (2016) also contend that climate change could lead to reduced economic performance in SSA. Given this context, policymakers in SSA countries must

adopt proactive and pragmatic approaches to address climate change. One of the effective strategies is to enhance environmental quality, as emphasized in the 2015 United Nations (UN) sustainable development agenda, recognizing its vital role in sustainable development. The rapid economic growth and industrialization have exacerbated the challenges posed by climate change, not only affecting the atmospheric environment but also placing tremendous strain on the planet's ecology (Sharif et al., 2020). In 2017, the global ecological footprint reached 2.77 global hectares per capita (GFN, 2020), highlighting the pressure on available resources. It's noteworthy that if everyone were to live like an average citizen in a particular country or region, it would require 1.73 Earths to sustain such a human footprint (Ahmed & Wang, 2019). This underscores that the human population's footprint is surpassing the Earth's natural carrying capacity. Failure to reduce consumption and the exploitation of ecological resources result in a widening global ecological deficit, undermining the goals of sustainable development.

In the real world, various factors, including differences in economic and consumption patterns among regions, continually influence the Earth's environmental quality (Tawiah et al., 2021). Therefore, nations are formulating policies aligned with the Paris Agreement (COP21) to limit global warming below 2°C in response to the issues of increasing energy consumption and environmental degradation associated with economic development, as indicated in recent literature. The average rate of CO2 emissions in selected nations in sub-Saharan Africa is provided in fiqure 1. The graph plots country against their annual average CO_2 emissions trend in each country to ascertain which country has greater CO_2 emission within the sampled countries in sub-Saharan Africa region is below in figure 1.

Carbon Emissions (Measured in Kilotons) for 20 Countries in SSA, 1990–2020 is Below in Histogram.

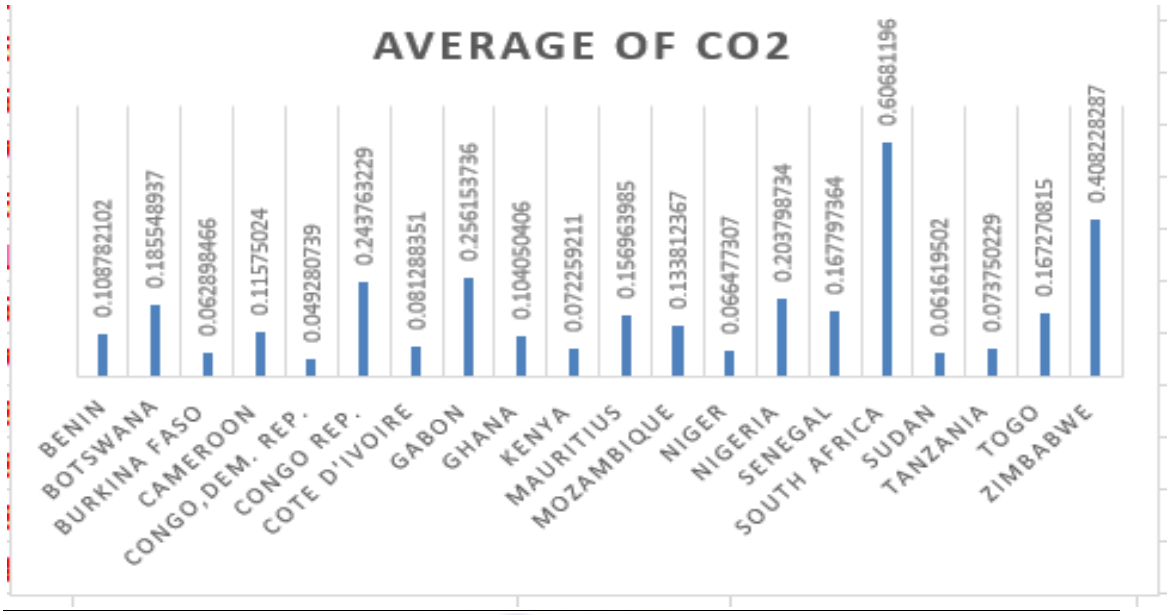

Figure 1 Carbon dioxide Emissions (CO2) for the 20 Selected Countries in SSA

Source: Authors' construct, from World Development Indicators (WDI) database, 2023.

Sustainable resources for liquid biofuels are readily available throughout the Sub-Saharan region. Various estimates are also being refined and accumulated by focusing on the feedstock that can be converted into biofuels. The emphasis lies in increasing the production of raw materials that are both environmentally and socially usageable for bioenergy manufacturing while minimizing the release of harmful chemicals such as Sulfur dioxide (SO2) and Carbon dioxide (CO2), which can contribute to global warming. There are numerous approaches to sourcing biomass raw materials , involving various methods. These methods consistently contribute to the improvement of biomass feedstock using materials generated in forestory and farmin activities .

Even though SSA has fairly low CO2 emissions, it's the most susceptible to climate change. More often than not, an increase in power usage has bad effect on environmental quality, especially when energy is derived from environmentally

unfriendly technologies. Considering the economic structure of Sub-Saharan Africa (SSA), most countries in the region face a significant disadvantage in promoting the taste of environmentally friendly or pure technologies and as a result of low level of economic improvement. The development of pure technologies relies heavily on Research and Development (R&D) activities, which receive limited support in nations with lower economic development. In spite of numerous reforms aimed at stimulating economic growth in SSA, it remains substantially lower compared to other regions on the globe (Aluko & Ajayi, 2018). Economic transformation plays a pivotal role in both causing and addressing environmental issues associated with greenhouse effects. Moreover, economic expansion stimulates lending creation, investments, and economic groth, leading to more energy consumption and subsequently result environmental degradation (Zhang, 2011).

A vibrant financial sector is essential for human and developmental activities. The assessment of financial development primarily relies on indicators such as the proportion of deposited financial institution assets to GDP, liquid liabilities, and domestic credit extended to the private sector, as highlighted in studies by Bilgili et al. (2020), Saud *et al*. (2019) . One strand of the literature shows that FD drastically complements environmental sustainability with the aid of reducing environmental degradation (Zaidi *et al*., 2019). The external supports such as Foreign Direct Investment (FDI) enhances environmental quality by reducing carbon emissions in BRICS countries - Brazil, Russia, India, China, and South Africa (Saud et al.,2018). However, an alternative line of research highlighted on relationship between FDI and environmental degradation, particularly in the case of India, and discovered that FDI exacerbates carbon emissions, contributing to environmental degradation (Anwar et al., 2021; Khan et al., 2021). Recent literature underscores various environmental implications of economic development. Based on regional information, Zhou *et al*.

(2020) demonstrate that green finance bolsters environmental quality in China. A good financial system provides access to capital, fostering economic activities and energy utilization, which leads to environmental issues (Anwar *et al.*, 2021; Khan *et al*., 2021).

Contrastingly, a robust and well workable financial system can allocate funds for advanced technologies and support the usage of power-efficient production methods, ultimately mitigating environmental degradation (Sharif et al., 2020; Sinha et al., 2021). Furthermore, financial and capital markets can fund research and development for reusable power and attract oversea companies, which are capable of sending green technology to recipient nations. Futher findings reveal that economic growth, urbanization, and inexhaustible power consumption negatively impact atmosphere, while reusable energy usage promotes environmental quality (Wang & Dong, 2019). To ensure effective and sustainable economic activities globally, the pressing needs for decarbonization from power sources, promoting low carbon and null carbon dicharges (Fankhauser & Jotzo, 2018). Avila *et al*. (2017) and Ispy (2018) emphasize Africa energy potential but noted the challenge of equitable resource distribution. They revealed that over 130 million people rely on kerosene, charcoal, lanterns, candles, and fossil fuels, while around 620 million lack access to power. However, despite abundant energy resources, Africa struggles to meet its energy demand. The World Economic Forum (WEF, 2016) reports that only 24% of SSA has access to electricity power, despite a capacity of twenty-eight gigawatts. The persistent energy shortage hampers sub-Saharan Africa's economic growth, sustainable living standards, and renewable energy investment due to inadequate infrastructure and financial resources (Avila *et al.* 2017). These challenges have forced sub-Saharan Africa to heavily rely on fossil fuels, hindering its economic development. The lack of consistent and affordable energy access poses a significant hurdle to Africa's rapid economic growth and advancement.

To address these issues, the World Bank (2018) recommends investing in technological innovations such as solar power to ensure a reliable energy supply, ultimately boosting economic activities and improving the quality of life for African citizens. Embracing technology not only enhances the economy but also enhances the well-being of the population through improved access to energy resources.

The alarming rate at which unlawful mining activities are getting into Africa ought to result environmental troubles going ahead proper measures should be installed in these areas to scale back this situation. Ghana in particular has been endowed with herbal resources along with land, wooded area and water bodies which are low-cost country wide improvement, however whilst those sources are not nicely made the most consequences are environmental degradation which affects human lifestyles and developmental activities.

1.2 Carbon Emission

According to Randy (2006), Carbon dioxide is a colourless and non-flammable gasoline at regular temperatures and strain. Although a bargain a good deal much less plentiful than nitrogen and oxygen in Earth's surroundings, carbon dioxide is a critical constituent of our planet's air. A molecule of carbon dioxide (CO2) is made up of 1 carbon atom and two oxygen atoms. Carbon dioxide is a crucial greenhouse gas that allows us to lure warmth into our environment. Without it, our planet might be inhospitably bloodless. However, an increase in CO2 concentrations in our surroundings is inflicting average global temperatures to upward push, disrupting unique components of Earth's weather. Carbon dioxide is the fourth maximum abundant factor of dry air. It has a consciousness of over four hundred ppm (elements in line with a million) in the surroundings. Before industrial hobby, there has been around 270 ppm in the environment. Carbon dioxide ranges in our surroundings have for this reason

risen approximately 40% since the reason that start of the Industrial Revolution, it really elevating international temperature.

Due to the devastating nature of CO2 while it exceeds normal requirement, nations all over the globe are growing techniques to curb its impact in the atmosphere on account that industries and human activities are the causes of this pollution at regional and global basis. This then called for the global collaborations to help alleviate the rate at which environmental pollutions is affecting herbal sources and environment amongst countries. There hadevidences confirmed that rising global issues which can be more industrialized purpose extra CO2 emission than the developing countries, however these advanced nations create Pollution Heaven in growing nations, main to pollution heaven hypothesis idea. This means that activities of the advanced nations have bad and good effect on the developing countries, hence there is a need for international combat to environmental quality.

1.3 Statement of the Problem

Literature suggests that financial development (FD) influences environmental quality with the levels of carbon emissions varying in different regions and countries worldwide (Destek & Sarkodie, 2019). In view of that, some scholars have attempted to investigate issues relating to the various economic activities and their effects on the environment. For example, Ritchie and Roser (2019) found that 4% of global Carbon dioxide emissions is from sub-Saharan Africa (SSA) as against to 6%, 16%, 17%, and 49% by Latin America, Caribbean, Europe, North America and Asia in that order, however sub-Saharan Africa is the maximum risk of the climate change. Further, Chandio *et al*. (2020), Rehman *et al*. (2020) and Khan *et al*. (2021) have examined the relationship between agriculture and the environmental pollution in different continents. Ali *et al.* (2022) also examined the impact of carbon emission on the various

sectors of the economy, and found that in the short-run, the industrial, agricultural and service sectors growth reduce the level of CO_2 emissions in Pakistan. Previous research such as Saud et al. (2019) and Shen et al. (2021) investigated the link between financial improvement and environmental quality without looking at bidirectional relation between the two variables. Sub- Saharan Africa is dominated with primary and secondary sector activities which are farming, chainsaw oprators, fishing and planting of trees, these activities are likely to degrade the environment leading to environmental pollutants.

However, despite some studies on the relationship between financial development and environmental quality and effect of carbon emissions on the various economic sectors in the literature, there is still sparse empirical literature on the effect of primary and secondary sector activities on environmental quality, particularly in sub-Saharan Africa (SSA). Indeed, to the best of the researcher's knowledge, no study has investigated the effect of financial development, primary and secondary sector activities on environmental quality in SSA, even though several sub-Saharan countries are faced with environmental pollution issues like water pollution, burning of fossil fuels, deforestation, and illegal mining activities which appear to be challenges for the next generations. These human activities damage the environment by discharging harmful substances into the atmosphere which affect the quality of the environment. Although, some countries in SSA such as South African, Ghana, Nigeria are adopting advanced technological equipment in their industrial operations, there are a lot more challenges that the activities of the primary and secondary sectors could cause to the quality of the environment. Based on the above discussion, the current study, therefore, investigates the effect of financial development, primary and secondary sectors activities on environmental quality in SSA.

1.4 Purpose of the Study

The study examines how the financial development, primary and secondary sectors activities affect the quality of the environment in sub-Saharan Africa.

1. 5 Objectives of the Study

1. To investigate whether primary sector activities affect environmental quality in sub-Sahara Africa.
2. To investigate whether secondary sector activities affect environmental quality in sub-Sahara Africa.
3. To examine whether there is bidirectional causal relationship between financial development and environmental quality in sub-Sahara Africa.

1.6 Research Questions

1. What effect does primary sector activities have on the environmental purity in sub-Sahara Africa?
2. What effect does secondary sector activities have on the environmental quality in sub-Sahara Africa?
3. Is there bidirectional causal relationship between financial development and environmental quality in sub-Sahara Africa?

1.7 Significance and justification of the Study

The investigation of the impact of financial advancement, primary and secondary sector activities on environmental quality has contradictory evidences in the finance literature making the relationship debatable. Some studies set up that financial improvement has poor effect on environmental quality both in advanced and growing countries, even as different studies discovered high relationship. However, to the best of the researcher's knowledge on this, few studies looked into consideration searching at how financial

development, primary and secondary sector activities impact on environmental quality, particularly in sub- Saharan Africa. Effect of secondary and primary sectors activities have not been personally researched to understand the unique impact that these sectors have on environmental quqlity. The current study seeks to assess how those sectors impact environment.

The secondary (manufacturing) sector is one of the areas that the study looks at addressing, on account that other research have little proof to that sector. The transformation of raw materials to finished products is the work of secondary sector , this is purposely executed to feature value to uncooked substances to fulfill global call and deliver value chain. This method has tendency to affect the quality of the environment due to the fact that some chemical compounds are added throughout the transformation process which might be dangerous to the environment. In addition, a few nations in sub- Saharan Africa together with South Africa and Nigeria are fast in adopting state-of-the-art technology gadget for industrial activities which serve as motivation to research on this area.

The knowledge on sectoral contribution within the financial system guides governments and policy makers in economic planning. The accurate findings from this adds to current literature and amplify the understanding in academia via the utility of scientific technique to regional and global environmental problems. The tstudy informs decision makers approximately the bidirectionality of financial improvement and environmental qualty linkages so that appropriate regulations are put in place to curtail environmental challenges that are alarming globally. Since living things rely on the environment for survival, human understanding on the herbal environment ensures right utilization of assets to avoid destruction of surroundings. The novelty of this examine lies in the generalizability of the coverage framework, which can function a

benchmark for the alternative rising industrialized economies facing the problems of carbon emission-led climatic shift. This might help Environmental Protection Agencies (EPA) in planning and implementation of destiny economic and environmental programs in Sub-Saharan region. The study affords information regarding which area of the economic system price range be allocated to mitigate environmental pollutants and sell green business. Although the findings are specially useful to sub-Saharan African region, other regions searching for records on the connection among financial development and environmental quality might find the results of the study useful.

1.8 Scope of the Study

The study considers primary and secondary sector activities of the economy and their impact on environmental quality in sub-Saharan African (SSA). The study is limited to SSA region because previous studies have not looked at bidirectional relationship between financial development and environmental quality, and effect of primary and secondary sector activities on environmental. In addition, from early 2000, a number of SSA countries commenced mining activities and industrial advancement which attracted foreign traders leading to financial boom and environmental problems (Ojewumi & Akinlo, 2017.

1.9 Organization of the Study

The study concerning financial advancement and environmental quality in sub-Saharan Africa is organized as follows: In Chapter one, it delves into background of study, present the problem statement, outline the research objectives, clarify the purpose of the study, pose research questions, and emphasize the significance of this research. Chapter two conducts a comprehensive literature review, encompassing both theoretical and empirical aspects, alongside the definition of key terms and the establishment of the conceptual framework. Chapter three talks on the development of

the models and discusses the raw fact used. Moving on to Chapter four, it delves into the presentation of results and provides a thorough discussion. Finally, Chapter five encompasses a summary, conclusions drawn from the study, and offers recommendations. This concluding chapter not only provides logical insights based on the study's findings but also addresses policy implications, limitations, and suggests potential avenues for future research in the studied area.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

The primary goal of financial development is to enhance the overall well being and living standards of the population. However, despise its positive impacts on quality of life, financial development can also have bad implications on atmosphere and surroundings. In the Environmental Kuznets curve literature, energy consumption is frequently employed as a control variable. Consequently, numerous researchers consider financial advancement a crucial factor influencing environmental performance. The most evident rationale for treating financial development as a key indicator in this relationship is that the presence of a developed economy enhances the efficient allocation of capital, fostering economic expansion and consequently, influencing environmental quality (Frankel & Romer, 1999). Theories underpinning environmental quality and financial development are necessary and guiding tools that allow the researchers to form their work in the problem basis, so as to avoid repetitions in the field of research. The relevant works by different scholars are checked out to facilitate the validity and consistency of the study.

2.1 Theoretical Review

The study makes use of a few theories to aide look into effect of financial improvement on environmental quality. Environmental system theories offer vital insights into the complicated relationships among human societies and the natural environment, and are often used in research and coverage evaluation to understand the elements that make a contribution to environmental degradation and sustainable improvement.

2.2 Environmental Kuznets Curve Theory

The Environmental Kuznets curve (EKC) has generated significant interest in environmental management, and numerous researchers have explored and substantiated its validity in their studies. Kuznets (1955) laid the foundation with Grossman and Krueger's (1995) pioneering work attracting a multitude of researchers and economists (Charfeddine & Khediri, 2015). The EKC hypothesis is examined by analyzing the relationship between GDP squared, financial development, environmental degradations and other economic variables. This theory posits that as nations advance economically, they will experience an inverted U-shaped relationship facing economic devlopment and environmental degradation. This means that environmental quality tends to be beter after a certain threshold of economic advancement, as measured by per capita income, economic progress, electric power usage, and other market factors that can impact environmental conditions.

Building upon Kuznets' (1955) work, Grossman and Krueger (1991) initiated empirical discussions on environmental quality by investigating the connection between income and environmental conditions, which led to the formulation of the EKC hypothesis. This hypothesis argues that income first contributes to environmental degradation but later improves environmental quality once a certain income threshold is surpassed. The well-known Kuznets curve is influenced by the relationship between economic improvement and unequal distribution of goods. During the infant stages of economic upgrade, the link between economic growth and pollution is right-wards, but beyond a certain income level, this relationship reverses (Stern, 2004). Indeed, the nexus between economic development and environmental quality has been a highly researched topic over the past few decades (Sardosky, 2011). In theory, economic development can impact environmental quality through domestic, industrial, and wealth-related channels (Acheampong, 2019). The EKC literature mostly employs energy consumption as a

preventive variable. Consequently, some researchers consider economic increanent as a crucial tool for environmental quality performance.

The empirical evidence from the EKC hypothesis serves as a guiding framework for the third objective of this study. Undoubtedly, one of the most compelling reasons for emphasizing economic growth as a critical factor in this connetivity is that a good economic sector enhances the efficient allocation of capital, thereby promoting economic growth and, consequently, influencing environmental quality (Frankel & Romer, 1999). This theory is a stepping stone to the current study's objective three, the financial development and environmental quality relationship and control variables used have been established in both theories and empirical studies and can back this study to investigate whether financial development and environmental quality have bidirectional relationship in SSA.

2.3 The Pollution Haven Hypothesis (PHH) Theory

The Pollution Haven Hypothesis (PHH) was initially proposed by Copeland and Taylor (1994) within the context of North-South trade. It was the groundbreaking study that first linked the stringency of environmental regulations and trade patterns to the level of pollution in a country. Under this theory, companies operating in highly regulated countries like the USA and Canada found themselves in direct competition with firms in less-regulated nations like Mexico. This theory stands that, due to international trade and foreign direct investment (FDI), devloping countries have become destinations for the pollution-intensive industries of great nations. According to the PHH, the shift of these industries from advanced to developing countries occurs through the exchange of goods and oversea investment. This trend is supported by the comparative cost advantage enjoyed by developing nations due to lower pollution control measures. Developing countries tend specializing in and export pollution-intensive products,

while advanced nations focus on cleaner products. Consequently, developing nations become pollution havens for the dirty industries of great nations.

This theory has regulatory implications for the present study, as countries in sub-Saharan Africa (SSA) import significant quantities of finished and raw materials to support their industries. This theory helps in addressing the study's objective two. Manufacturing industries in developing countries often rely on foreign assistance for modern technology and production equipment, leading to the importation of dirty and polluted goods into these countries. The empirical support for the PHH is mixed, while Jaffe *et al.* (1995) and Tobey (1990) find no evidence to support the idea that a country's environmental protection stringency affects the trade of pollution-intensive goods. Cole (2004) observed that pollution-intensive industries increase rapidly in developing nations during the time when environmental laws in OECD nations were stringent. However, Dinda (2004) argues that polluting entities locating in developing countries could also increase the earnings levels of the home nations, prompting the adoption of stricter environmental policies. Consequently, there would be no country left as a destination for relocating polluting industries, and all countries would eventually have similar environmental standards. Other studies suggest that environmental policies have varying effects.

Some early research on the relocation of polluting industries found that the tightness of environmental laws led to upwards net imports of eleven pollutants in advanced nations (Low & Yeats, 1992). The pollution haven impacts are expected not be permanent because pollution intensity has a substitute response to income growth in wealthy nations (Mani & Wheeler, 1998). Some nations lag pollution preventive efforts, promoting environmental defilement. Solarin *et al*. (2017) investigated the PHH in Ghana using CO_2 emissions as a measure of pollution from 1980 to 2012. They

established that economic growth is not always the result or solution to pollution, highlighting the complex nature of the relationship. Gross domestic product (GDP), FDI, city populace, financial development and worldwide alternative have high quality effect on CO2 emission, even as institutional quality decreases emissions in Ghana. The pollution haven hypothesis theory suprots the current study's objective two, that is, the effect of secondary sector activities on environmental quality, and helps organizations and policy makers know the kind of decisions to take, the nature of substances to import to feed industries in SSA and lessen excessive importation of polluted industries due to international trade and comparative benefit loved by developing nations. Sub-Saharan Africa countries are fast adopting advanced technology and morden way of doing things in their industrial production, as a result the guiding principle of Pollution Heaven Hypothesis theory is nececsaary to enable trade partners align comparative cost advantage among nations to check the mismatch between developed and developing countries interms of environmental pollution which the developing countries are designated to be pollution heaven for advanced nations.

2.4 Environmental Justice Theory

According to Schlosberg (2007) environmental justice is a prime movement and organizing discourse inside the environmental politics area, and each the movement and the concept have had big effect on the manner that climate justice has been conceptualized. Environmental Justice Theory is an environmental first-rate principle that posits that certain companies, mainly people who are economically or socially deprived, are more likely to exposed to environmental dangers and face negative health effects as a end result. The theory emphasizes the importance of promoting environmental fairness and reducing environmental racism. Schlosberg (2007) contends that justice goes beyond merely achieving an equitable distribution of goods.

Acting justly also entails acknowledging individuals' membership within the moral and political community, fostering the capabilities necessary for their well-being and development, and guaranteeing their involvement in political decision-making. According to Schlosberg, the concepts of distribution, recognition, abilities, and participation are interconnected and reliant on each other. One cannot pursue a single aspect of justice in isolation. Finally, Schlosberg stated that justice concerns not handiest people however additionally together that is, social agencies and ecological systems, treating humans fairly and harming other dwelling matters is unjust and hence there may be a climatic effect of this on human fitness.This theory supports current study's objective one, whether primary sector activities affect environmental quality in SSA. Knowledge on the negative consequences of environmental racism will direct people dealing with natural and artificial environment fairly without discrimination. Destroying natural environment for short term gains without replacement is unjust and will have climatic effect on human being, agricultural activities should not harm other ecological system like wild animals, fishing and deforestation. Sincen SSA nations are primary sector driven economy, this theory helps countries involve in primary sector activities understand the effect of primary sector activities on the environment which this study's objective one tries to achieve. Improper mining and farming activies are rampant in this region and PHH thory explains consequemces of these acts which is in line with the current study's objective one.

2.5 Empirical Review

Numerous studies have explored the linkages between financial development and environmental quality both developed and developing economies, yielding varying and conflicting perspectives that have turned this topic into a subject of debate. Besides, Grossman and Krueger (2008), other scholars have shown efforts at investigating the

link facing financial dewvlopment and environmental degradation. Some studies provide compelling proves that financial development is associated with increased CO2 emission (Ahmad *et al*., 2022 ;Saud *et al.*, 2018; Dar & Asif, 2017; Zaidi *et al*., 2019). Conversely, research suggests that finacncial and economic boom lead to a reduction in quality of ecosystem in Asia Pacific Economic Cooperation (APEC) nations. Zhao *et a*l. (2019), relying on information from 30 Chinese provinces, shows that economic intensity amplifies environmental quality, while economic effectiveenss is detrimental to the environment. Ahmad *et al*. (2022) conducted a comprehensive analysis of dynamic connections facing economic development, Ecological Footprint, the environmental quality in 18 great economies from 1984 to 2017. They discovered that economic development has an important positive impact on environmental quality, particularly when moderated by institutional quality. In contrast, Abid (2017) found that financial development is associated with a decrease in environmental quality across fourty-one European Union and fifty-eight Middle East & African (MEA) countries. However, the author noted that economic improvement can enhance environmental quality when supported by robust institutions. Furthermore, the development of inventry markets enables listed firms improve their financial capabilities, minimize monetary costs, mitigate operational risks, make new investments, and consequently improve power consumption and Carbon dioxide emissions (Acheampong, 2019).

Ali et al (2022) examined the impact of sectoral growth on CO2 emissions Pakistan from 1970 to 2019. Their findings indicate that industrial growth and agricultural growth promote CO2 emission in the case of Pakistan and service sector growth reduce CO2 emission. Kwakwa et al. (2023) also examined the effect of environmental degration in Ghana, and their fimdings show that the country's agricultural development is negatively affected by aggregate carbon emission while financial

development, labour and capital increases agricultural development. Further,industrial development and emissions from transport sector, industrial sector and other sectors adversely affect Ghana's agriculture development. The study on Pakistan is done on different continent and the one in Ghana considered effect of environmental degradation on agriculture. The current study considers bidirectional relations between FD and EQ, primary and secondary secotor activities on environmental quality in the context of SSA.

However, the studies discussed above so far, to the best of the researcher's knowledge do not examine the bidirectional relationship between financial development and environmental quality and the effect of primary and secondary sector activities on environmental quality in SSA region. The strong connection linking FD and environmental degradation has been substantiated by various studies. Baloch et al. (2019) extended this finding to encompass 59 Belt and Road Initiative (BRI) economies, and Saud et al. (2020) replicated it across 49 countries.

Sekali and Bouzahzah (2018) conducted an empirical examination of financial development and environmental quality in the banking sector, utilizing home credit to the private sector. Their analysis revealed a positive but not statistically significant link between bank financial development and Carbon emissions. Interestingly, the study found that bank loans were associated with a deterioration in environmental quality, as evidenced by increased CO2 emissions. However, when measuring the monetary development of the banking sector using another variable, namely money and quasi money (M2), they observed a negative and insignificant correlation between banking zone development and carbon dioxide emissions. Nasir *et al.* (2019) reported that economic expansion in five ASEAN nations (Indonesia, Malaysia, Philippines, Singapore, and Thailand) led a decline in environmental quality. Zafar *et al.* (2019)

demonstrated variations in environmental quality could be attributed to the development of the banking sector in G-7 nations, with the face to face trend observed in N-11 nations. On the other hand, Ozturk and Acaravci (2013) explored impact of FD on emissions in Turkey spanning from 1960 to 2007 and found that FD has no significant impact on environmental quality. Similarly, Destek and Sarkodie (2019) found no substantial linkage between FD and the environmental quality in their study.

Presently, there has been significant scholarly motivation in examining reasons that influence environmental quality in sub-Saharan Africa (SSA). For instance, Wang and Dong (2019) discovered that economic improvement, urbanization, and inexhuastible power intake have detrimental consquences of environmental quality, while the use of reusable power sources contribute positively to environmental well-being. In contrast, democracy and the adoption of renewable energy sources are associated with improvements in environmental quality. In spite of the abundance research on environmental quality, there remains limited understanding of how each sector of the economy affects environmental conditions as economics development advances in SSA. The available studies for ongoing debate regarding the relationship between financial development and environmental quality in SSA is distanced from being resolved. Based on the various contributions from the above, study integrates different findings and methodologies to obtain the study objectives.

2.6 Financial Development- Environmental Quality Connection

The literature reveals a dynamic relationship between financial development (FD) and environmental quality, but the empirical findings yield mixed results regarding the association between FD and CO2 emissions. For instance, Ulucak *et al.* (2020) examined financial development,economic growth on environmental quality and found a declined trend in carbon emissions attributed to FD. Sinha *et al.*(2021) explored the

links between FD and ncarbon emissions ,and found a negative relationship between these variables. Similar results were found for the South African economy by Nasir et al. (2021), and they also noted an adverse relationship between financial openness and carbon emissions in Indonesia. Utilizing a long-term cointegration econometric approach, Boutabba (2014) indicated a positive connection between FD and environmental quality in India.

Shahbaz et al. (2016) suggested an asymmetric impact of FD on emissions, using quartile data from Pakistan. Their study's results demonstrated that environmental quality deteriorates as FD increases in the long run. In contrast, Katircioğlu and Taşpinar (2017) investigated the Turkish economy with structural breaks and found that FD plays an ineffective role in mitigating carbon emissions. Huang and Zhao (2018) used province-level data from China and reported that FD significantly reduces CO2 emissions. However, the findings of Salahuddin et al. (2018) suggest a minimal relationship between FD and emissions in Kuwait over time. Jiang and Ma (2019) argue that since the theoretical literature indicates that FD has both positive and negative effects on environmental quality, the net impact depends on the relative significance of these positive and negative effects. They propose that establishing a green economy is a viable solution, which is currently a topic of interest among scholars and policymakers worldwide. Green finance aims to provide financial services, including financing and investment, for environmentally sustainable projects (Ren, S., & Zhong, 2020). They believe that implementing green reforms through financial policies could redirect more resources toward eco-friendly technological innovations, mitigating the negative impact of FD on environmental quality and reducing environmental degradation.

D'Orazio and Popoyan (2019) argue that due to climate-related economic risks, governments could play a crucial role in bridging the green financing gap and promoting a greener economy by introducing green macroprudential financial

regulations. In this context, Ren et al. (2020) analyze the impact of green finance on carbon intensity in China and demonstrate that improvements in the green finance development index are significantly associated with a reduction in carbon intensity. Therefore, developing a green financial system could be a pivotal strategy for Emerging and Growth-Leading Economies (EAGLEs) and the global community to sustain economic growth while curbing environmental degradation. For major European countries, research has examined the causal relationship between FD and carbon emissions. Saud et al. (2019) empirically established that FD has had a negative impact on the environmental quality of European economies. They employed dynamic seemingly unrelated regression to estimate the long-term connection between these variables.

A recent study on the Russian economy conducted by Bass et al. (2019) found a positive correlation between economic openness and carbon emissions. Shen et al. (2021) also reported a positive relationship between FD and emissions using province-level data in China. However, Zafar et al. (2021) identified a negative association between FD and carbon emissions in Asia-Pacific Economic Cooperation nations. Similar results were reported by Khan and Ozturk (2021) for 88 developing countries using panel methods.

2.7 The Connection Between Foreign Direct Investment (FDI) and Carbon Emission

The connection between Foreign Direct Investment (FDI) reciepts and carbon diioxide emissions is a widely looked topic in literature concerning environmental quality behavior. This association sparked debates among researchers and decision takers regarding the good and bad impacts of these variables. Foreign direct investment receipts have potential to provide direct capital for investment and stimulate economic

expansion through knowledge transfer, technology exchange, and spillover impact that encourage production (Ning & Wang, 2017). Jain (2016) suggests that there is substantial evidence indicating that multinational corporations, through FDI, tend to relocate pollutants to developing countries with less stringent ecological regulations rather than advanced countries with stricter environmental controls. Depending on the nature and intentions of these multinational corporations, FDI can lead to increased emissions in host countries (Li et al. 2018). Impact of FDI on greenhouse gas emissions has been a topical of rational discussion in the current literature (Rafindadi *et al.,* 2018). Salahuddin *et al.* (2017) conducted an analysis of the effects of economic increament, energy intake and FDI on CO2 trasmisssion in Kuwait, through time-series data and employing ARDL, revealed that FDI stimulates CO2 emissions. One of their studies through vector error correction model (VECM) unveiled that FDI, financial growth, and energy intake strongly Granger-purpose CO2 emissions.

Bekhet *et al*. (2017) investigated dynamic causal relationships among financial development, electricity usage, and carbon emissions for Gulf Cooperation Council countries. Employing the ARDL version, their research found long-term and causal relationships among those variables in all international bundries, besides in the United Arab Emirates (UAE), where a one-way causal relationship from financial growth to carbon emissions changed into recognized. Sarkodie and Strezov (2019) tested the good sized effect of FDI inflows, economic increase, and energy intake on carbon emissions from 1982 to 2016, that specialize in China, India, Iran, Indonesia, and South Africa as main carbon emitters in emerging economies. They discovered that energy usage has a good significantly effect on carbon dioxide discharging. Their ultimate findings indicated that FDI inflows can promote eco-technological advancements, labor force improvements, and efficient usage in great countries. Another examination by Ojewumi

and Akinlo (2017) investigated the dynamic relationships among foreign direct investment, economic growth, and environmental quality in sub-Saharan Africa (SSA). They employed panel vector error correction (PVEC) and panel vector autoregressive (PVAR) strategies and determined that dynamic relationships are obvious amongst monetary increase, overseas direct funding, and carbon emissions.

2.8 The relationship Between Economic Growth and Carbon Emission

The economic boom is an extension of the production of services and product execution over a particular period. Economic growth makes greater gain for companies and, as a result inventory price upward thrust gives entities assets to continue in the game. They suport and high greater workers and additional paintings possibilities made available in addition to reimbursement upward push. This makes critical to apprehend the link facing this financial increase and oxygen gasses. Through financial growth, severa foreign direct investment variables tend to boost up. Therefore, the economicians and scholars showed deep interest in dynamic linkages concerning the growing biger economic variables. The important variables are trade openness, electricity and FD.

According to Han *et al*. (2018), it's imperative having resonable understanding about the connection facing carbon dioxide explosion and economic boom to reveal the interfaces among human activities and the natural ecosystem to reduce greenhouse gases. The relationship among environmental detoleration and financial boom may be shown with EKC (Simon Kuznets, 1960s). He found that environmental infection goes up corresponding with economic growth. When there's a boom within the earnings stage, income ascends to a particular stage, at the defining moment, carbon discharge starts offevolved to lower. Accordingly, an inverted U-shape established correlation between environmental defilement and economic increase is made.

Cai *et al*. (2018) explored the causal relationship between economic growth, financial development and carbon emissions. They exerted boot strap ARDL bounds alongside structural break to analyze cointegration and causality for G7 international places. Their findings of causality discovered that renewable energy use causes real GDP to steady per capita for countries like Canada, Germany, and America and CO2 emissions purpose renewable energy use for Germany. Their findings gave a widespread coverage implications for G7 countries guidance powerful energy usage method to decrease CO2 emissions. Isik *et al*. (2018) in a few other explorations, determined the interrelationship among electricity consumption, environmental pollution, economic growth and financial increase in China provincial and found a mixed relationshitp amont the variables.

2.9 The Connection Between Energy Usage and Carbon Emission

The connection between energy usage and CO2 emissions has been a topic of ongoing debate within the energy consumption and environmental literature over the last decades. Alshehry and Belloumi (2015) investigated the causal connection among power charges, economic activities, in Saudi Arabia, and found an extended-term unidirectional causality from electricity intake to financial development and CO2 emissions. The effects additionally confirmed a bidirectional causality among carbon dioxide emissions and financial boom, with an extended time period of unidirectional causality jogging from energy fees to economic boom and CO2 emissions. In the short run, there is a unidirectional causality from CO2 emissions to power intake and monetary output, as well as from energy costs to CO2 emissions.

In Tunisia, Ben and Belloumi (2017) used ARDL method and Granger causality tests, uncovering a two way short-run causality between maritime shipping and CO2

emissions and a one way short-run causality from real GDP, reusable power sources, waste disposal, and railroad transport to carbon discharges. The prolonged estimates indicates that real GDP contributes to reduction in CO2 emissions, while the use of renewable energy sources, unwanted disposal, maritime and railroad transport positively influenced emissions. A research by Mirza and Kanwal (2017) indicated bidirectional causal relationships between electricity consumption, financial boom, and carbon emissions in both the short and long run. Their studies demonstrated that strength consumption led to elevated CO2 emissions. They additionally examined the causality between monetary increase, energy intake, and environmental pollution in Pakistan, the use of ARDL to investigate the long-run courting and VECM for Granger causality. Their findings indicate bidirectional causality amongst economic growth, strength intake, and carbon emissions. Based on their effects, they encouraged the Pakistan authorities to need to sell renewable strength sources.

Ahmad et al. (2018) employed the ARDL version to look at the impact of power intake, general population, and monetary growth on carbon emissions in China from 1971 to 2013. They found a link between financial increase and carbon emissions, indicating a protracted-time period connection. Granger causality tests confirmed one-manner causality from economic boom to carbon emissions. Their final results suggested that energy consumption and financial growth had a large ability to increase carbon emissions over time. Topcu and Payne (2018) tested the FD and energy use nexus in OECD nations from 1990 to 2015. They used panel statistics evaluation, accounting for heterogeneity and cross-sectional dependence. Their study discovered that the effect of exchange on electricity use exhibited an inverted U-formed pattern, indicating that the effect of carbon emissions on electricity use passed that of economic growth. Behera and Dash (2017) analyzed the interrelationship between urbanization, power intake, and

carbon emissions in 17 nations within the South and Southeast Asian (SSEA) region. They used cointegration and observed that both primary strength intake and fossil gasoline strength intake appreciably improved carbon emissions within the SSEA vicinity.

Adams and Klobodu (2018) suggest that financial improvement no longer affects environmental great. Acheampong *et al.* (2019) endorse that economic development worsens environmental fine, a stance supported by Avom *et al*. (2020). However, when summarizing the empirical research in Table 1, it becomes evident that the small available research on SSA often overlook sectoral aspect of economic development.

Table 1: Summary of Empirical Studies on Financial Development and Environmental Quality

Author(s)	Period	Sample	Methodology	Financial development	Findings
Abid (2017)	1990 to 2011	Fifty-eight Middle East & African and fouty European Union nations	Generalized Method of Moments (GMM) techniques	Domestic credit to private sector	Domestic credit to private sector increases CO_2 emissions
Paramati *et al.* (2017)	199 to 2012	G20 countries	Fully Modified Ordinary Least Squares strategy, Dumitrescu-Hurlin panel causality test	Stock market capitalization (% of GDP)	Stock market capitalization pushes CO_2 emissions in developing G20 nations while it reduces CO_2 emissions in developed G20 nations. A one way causality from stock Marketcapitalization to CO_2 emissions.
Cetin *et al.* (2018)	1960 to 2013	Turkey	ARDL Stratey VECM Granger causality	Domestic credit to private sector	Domestic credit to private sector increases CO_2 emissions. DCPS and CO_2 have no two way causality
Adams & Klobodu (2018)	1985 to 2011	Twenty-six SSA countries	Difference GMM estimation method	Domestic credit to private sector, liquid liabilities and individual credit by deposit cash banks and other financial institutions (all % of GDP)	Financial improvement measures do not react CO_2 emissions.

Shahbaz *et al.* (2018)	1955 to 2016	France	Bootstrapping ARDL modelling VECM Granger causality	True domestic credit to private sector	Real domestic credit to private sector diminishes CO_2 emissions. Again, there's a one way causality from real domestic credit of private sector to CO_2
Zafar *et al.* (2019)	1990 to 2014	Twenty-seven OECD countries	Continuously up to date Fully Modified Ordinary Least Squares (CUP-FM) and Continuously Updated Bias-Corrected (CUP-BC) estimators,	Money improvement index–aggregate of domestic credit, domestic credit to individual sector by banks (all % of GDP)	Financial improvement index reacts CO_2 emissions and there is a one way causality from CO_2 emissions to financial improvement index
Zaidi *et al.* (2019)	1990 to 2016	Eighteen APEC Nations	CUP-FM and CUP-BC techniques, Dumitrescu-Hurlin group causality test	Home credit to private sector (% of GDP)	Homecredit to private sector reduces CO_2 emissions and a two-way causality exists between home credit and CO_2 emissions
Acheampong *et al.* (2019)	1980 to 2015	Fouty-six SSA countries	Fixed and random effect estimation methods	Domestic credit to private sector (% of GDP)	Home credit to private sector promotes CO_2 emissions
Zhao *et al.* (2019)	1999 to 2017	Mainland China (30 provinces)	Spatial Durbin model, corrected maximum	Money depth (loans and deposits/gross regional product),	Money depth (efficiency) decreases (increases) SO2

			likelihood strategy	financial efficiency (loans/deposits)	emissions and industrial solid waste release
Nasir *et al*. (2019)	1982 to 2014	Five ASEAN Nations	DOLS and FMOLS techniques	Bank credit to bank deposit, number of listed firms, multi-nations debtissued (% of GDP)	Bank lend to bank reciepts and number of listed firms promotes CO_2 emissions
Zafar *et a*l. (2019)	1990 to 2016	G-7 and N-11 Nations	CUP-FM and CUP-BC techniques, Dumitrescu-Hurlin group causality test	Principal Component Analysis (PCA)-made up banking and stock market improvement index	Banking (stock market) improvement index decreases (increases) Carbon emissions in G-7 nations, but in N-11 nations, banking (stock market) improvement pushes (pulls) Carbon emissions. In both samples, two way causality exists between stock market improvement index and Carbon emissions, also a two way causality exists between banking improvement index and Carbon emissions in G-7 nations
Baloch *et al.* (2019)	1990 to 2016	Belt and Road nations	Driscoll-Kraay panel regression analysis	Home credit to individual sector, home	All monetary development measures increase

					credit to private sector by banks and home credit by financial sector (all % of GDP)	ecological footprint
Destek & Sarkodie (2019)	1977 to 2013	countries		Augumentet Mean Group	Home credit to the private sector/GDP	FD has no vital impact on Carbon emissions
Dogan *et al.* (2019)	1971 to 2013	Four MINT economies		ARDL, Granger causality	Home credits by the financial sector/GDP	FD reduces emissions
Acheampong (2019)	2000 to 2015	Four SSA countries		System GMM strategy	Home credit to individual sector, home credit to private sector by banks, domestic credit to private sector by financial sector, broad money and liquid liabilities (all % of GDP)	Home credit to individual sector, home credit to private sector by banks, banks and broad money promotes Carbon emissions and home credit to individual sector by financial sector and liquid liabilities do not affect Carbon emissions
Zhou *et al.* (2020)	2010 to 2017	Thirty China provinces and municipalities		Generalized least squares measure	Green monetary improvement index (constructed from Global PCA)	Green monetary improvement decreases waste and Carbondioxide pollution
Nguyen *et al.* (2020)	2000 to 2014	Thirteen G-20 Nations		Complet-Modified Ordinary Least Squares; Fixed effects and quantile	Bank credit to individual sector, inventory market capitalization, liquid liabilities (all % of GDP)	Every monetary improvement measures leads to Carbon dioxide emissions

			groupregression		
Acheampong *et al.*(2020)	1980 to 2015	Twenty-two advanced, twenty-three emerging, twenty-nine frontier and nine standalone monetary economies	Instrumental Variables-GMM Methodology	Financial market growth, depth, efficiency and availability indexes	Monetary development, depth, efficiency and availability decreases (increase) Carbon dioxide emissions in advanced and emerging (frontier) financial economies but they have no effect in standalone financial economies
Avom *et al.* (2020)	1996 to 2014	Twenty-one SSA nations	Fixed effects estimation methodology	Home credit to individual sector (% of GDP)	Home credit to private sector increases Carbon dioxide emissions
Saud *et al.* (2020)	1990 to 2014	49 Nations	Pooled mean group	Domestic credit to the private sector/GDP	FD improves Ecological Footprint
Aluko and Obalade (2020)	1985–2014	5 SSA countries	AMG	composite index of Monetary improvement	FD is both positive (negative) promoter of environmental greatness. A two way causal link between financial improvement and Carbon dioxide
Ahmad *et al.* (2020)	1990 to 2017	Ninety countries	DK	FD index	FD promotes EF
Nasir *et al.* (2021)	1980–2014	Australia	Causality, VECM	FD index	Two way causality exists between FD and EQ

Ahmad *et al.* (2022)	1984 - 2017	18 emerging economies	Cross-sectional autoregressive distributed lag (CS-ARDL)		FD degrades the ecological quality by raising the EF

Source: Author's construct, 2023

2.10 The Study Conceptual Framework

This section outlines the conceptual framework employed in the study to examine its objectives, specifically assessing the presence of bidirectional causal relationships, both in short and long-run, between financial development and environmental quality in sub-Saharan Africa.To assess whether primary and secondary sector activities have effect on environmental quality in sub-Saharan region. The variables for conceptualization in this study include environmental quality (EQ), economic growth (EG), financial development (FD), carbon dioxide emissions (CO2), foreign direct investment (FDI), the primary sector, and the secondary sector. Ravitch and Riggan (2017) defined a conceptual framework as a rationale for why the chosen topic is relevant and why the proposed method for studying it is appropriate and rigorous.

The narrative presentation of the framework elucidates the key components of the research and provides an understanding of the overall research within the context of existing knowledge in the field. In the literature, there may be a unidirectional and bi-directional relationship among a number of these variables. Chapter two of this thesis has reviewed the various literature associated with financial improvement and environmental best inside sub-Saharan Africa and other areas. Some of the factors scholars debate to be motivating for environmental degradation are energy intake, financial growth, overseas direct funding amongst others. In the literature, there is a unidirectional and bi-directional relationship amongst some of those variables. Financial improvement has a tendency to enhance environmental pleasant in a few areas

and at the same time lower EQ in different places for this reason having a power at the environmental quality (Zhao et al., 2019; Ahmad et al., 2022). Economic growth and economic improvement do sometimes pass inside the equal path, when the economic sector booms it consequences in financial growth and strength usage which intern affects the surroundings both definitely or negatively.

Literature suggests that economic increase has each terrible and nice impact on the environmental fine and overseas direct funding has high-quality relation with economic increase (Jianguo et al., 2019). Hence, in line with the available literature the conceptual framework, as illustrated in Figure 2 below, is presented to aid in the formulation and testing of research hypotheses. This framework aims to provide a clearer understanding of the relationships among the variables under investigation in the study.

Financial Development, Primary and Secondary Sectors with Control Variables Connetion with Environmental Quality

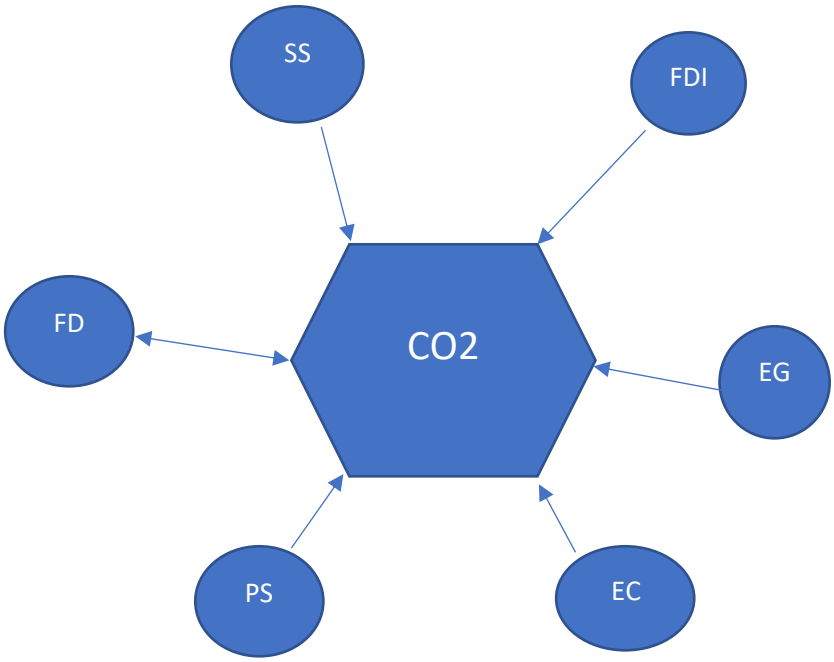

Figure 2: Conceptual Model ,

Source: Author's construct, 2023

It can be found from Figure 2 that FD and CO2 emission have bidirectional courting this means that that both variables can have an effect on each other. The key variable in this structured analysis is environmental quality (EQ), which is represented by CO2 emissions. The primary independent variables consist of financial development (FD), assessed through home credit to individual sector, with PS denoting the primary sector and SS representing the secondary sector. Additionally, the analysis includes various control variables such as foreign direct investment (FDI), economic growth (EG), and energy consumption., Economic boom is measured with GDP growth rate yearly at country level.

The reason for the inclusion of primary and secondary sectors as explanatory variables is to understand whether an improvement in those sectors impact on environmental quality considering that nations in SSA region are dominant in these sectors. Literature indicates that, financial improvement and environmental quality have unidirectional and bidirectional relationship in distinction regions. Sekali and Bouzahzah (2019) determined a bidirectional courting among financial improvement and environmental quality in Morocco. Some research concluded that FDI is promoter of environmental quality and monetary increase at the same time as other had otherwise. Energy consumption serve as control variable, FDI plays moderating function and EG is playing mediating role. SS and PS are explanatory variables to assess their effect on carbon emission in the selected nations.

2.11 Measurement of Financial Development

Financial sector improvement helps overcoming challenges in the financial system, assist states and business organizations control their investment activities. It includes the legal and regulatory framework that allow transactions to be made through the extension of lending credits. Different sorts and divergents of facts, transaction, and legal prices couppled with saparate rules, felony and tax systems have encouraged different kinds of agreements, linkages and markets across international bundles in exclusive times (Global Financial Development Report, 2014). According to Levine (2005) there are five key features of a economic device in a rustic: (i) statistics manufacturing ex ante approximately viable investments and capital allocation; (ii) tracking investments and the exercising of corporate governance after providing financing; (iii) facilitation of the trading, diversification, and management of threat; (iv) mobilization and pooling of savings; and (v) promoting the exchange of products and offerings. Financial development takes location while economic devices, markets, and intermediaries paintings collectively to lessen the expenses of facts, enforcement and transactions.

A strong financial sector is an effective engine at the back of financial increase. It gives rise to neighborhood financial savings, which flip cause productive business in local markets. In addition , powerful banks can pass through global streams of individual remittances. The financial area therefore gives the rudiments for income-boom and task introduction (the World bank ,2014). There are adequate evidence showing that banking area development performs a widespread position in monetary increase. It promotes monetary boom through capital accumulation and technological development by boosting savings price, handing over records approximately funding, optimizing the allocation of capital, mobilizing and pooling savings, facilitating and inspiring foreign

capital inflows (National Archives UK., 2005). A meta-analysis of sixty seven empirical research reveals that monetary development is robustly related to economic boom. Countries with better-advanced monetary structures have tendency to experience sustained power boom, and studies confirm the causal hyperlink among the two: economic improvement is not absolutely a result of financial boom; it's also the motive force for increase (Levine *et al*., 2000). Financial area development additionally assists the growth of small and medium-sized establishments (SMEs) giving them access to get entry to finance. Small and medium-sized SMEs are generally hard work-extensive and create greater jobs than massive companies, which add notably to financial improvement in rising economies.

The disaster challenged conventional questioning in financial sector policies and sparked the argument on how to achieve sustainable improvement. To successfully re-examine and put in force economic regulations, guides inclusive of World Bank and Global Financial Stability Report (GFSR) via IMF play a crucial part. The Global Financial Development Report, a brand new initiative by the World Bank, indicated troubles that came to the leading edge after the disaster and provides policy recommendation to reinforce systems and curbe comparable disaster in the future. By puting facts togeter and information on economic improvement around the sector, the GFDR document pursuits to place into spotlight challenges of financial development and hopes to offer analysis and professional views on current policy problems. In Malaysia, the Asian Institute of Finance became established via Bank Negara Malaysia and Securities Commission Malaysia to expand human capital within monetary offerings enterprise.

Top dimension of economic improvement is important in comparing the development of monetary sector improvement and expertise, the corresponding impact on financial growth and poverty reduction. However, in practice, it is hard to degree financial improvement given the complication and dimensions it envolves. The available work backing this point is usually based on popular quantitative signs available for an extended time frame for a large range of nations, the ratio of economic institutions belongings to GDP, ratio of liquid liabilities to GDP, and ratio of deposits to GDP (Global Financial Development Report, 2014). However, since the monetary area of a rustic contains quite a few financial establishments, markets and merchandise, these strategies serve as difficult estimate and do no longer completely cover all components of financial development. The World Bank's Global Financial Development Database (GFDD) advanced a comprehensive but pretty simple conceptual framework to degree financial improvement globaly. The framework set out four proxy variables characterizing a nicely-working economic system.

Table 2: The table shows indicatiors of assessing the Financial Sector

Indicators	**Financial Institutions**	**Financial Markets**
Depth	• Private Sector Credit to GDP • Monetory Institutions' asset to GDP • M2 to GDP • Receips to GDP • Gross value added of financial sector to GDP	• Stock market capitalization and owings home private debt securities to GDP • Private Debt securities to GDP • Public Debt Securities to GDP • International Debt Securities to GDP • Stock Market Capitalization to GDP • Stocks traded to GDP
Availability/ Access	• Accounts per thousand adults (commercial banks) • Branches per 100,000 adults (commercial banks) • % of people with a bank account (from user survey) • % of firms with line of credit (all firms) • % of firms with line of credit (small firms)	• Percent of market capitalization outside top 10 largest companies • Percent of value traded outside of top 10 traded companies • Government bond yields (3 month and 10 years) • Ratio of domestic to total debt securities • Ratio of private to total debt securities (domestic) • Ratio of new corporate bond issues to GDP
Efficiency	• Net interest margin • Lending-deposits spread • Non-interest income to total income • Overhead costs (% of total assets) • Profitability (return on assets, return on equity) • Boone indicator (or Herfindahl or H-statistics)	•Turnover ratio for the stock market • Price synchronicity (co-motion) •Private information buying and selling •Price impact •Liquidity/transaction charges • Quoted bid-ask unfold for government bonds • Turnover of bonds (personal, public) on securities alternate • Settlement performance

		• Volatility (fashionable deviation) of inventory fee index, sovereign bond index • Skewness of the index (stock fee, sovereign bond) • Vulnerability to profit manipulation • Price/earnings ratio • Duration • Ratio of quick-time period to general bonds (domestic, int'l) • Correlation with main bond returns (German, US) • Turnover ratio for inventory marketplace • Price synchronicity (co-movement) • Private information trading • Price impact • Liquidity/transaction prices • Quoted bid-ask unfold for authorities bonds • Turnover of bonds (non-public, public) on securities alternate • Settlement performance • Volatility (popular deviation / common) of stock rate index, sovereign bond index • Skewness of the index (inventory fee, sovereign bond) • Vulnerability to profit manipulation • Price/profits ratio
Stability	• Z-score • Capital adequacy ratios • Asset quality ratios • Liquidity ratios .Others (net foreign exchange position to capital etc.)	

	• Duration • Ratio of quick-time period to total bonds (domestic, int'l) • Correlation with essential bond returns (German, US)

Source: Global Financial Development Database (GFDD), 2014.

2.12 Justification and Hypotheses of Variables

Limited research exists on sub-Saharan Africa (SSA), and the available studies yield varying results. For instance, financial improvement has no impact on environmental quality (Adams & Klobodu, 2018). Acheampong (2019) indicates that influence of financial development on environmental quality is mixed. Some studies suggest that financial development eases credit difficulties and promotes investments in upper energy usage projects, ultimately leading to increased economic growth, energy consumption, and CO2 emissions (Boutabba, 2014; Aluko & Ajayi, 2020). On the other hand, Acheampong *et al.* (2019) argue that monetary improvement worsens surroundings , a viewpoint backed by Avom *et al.* (2020).However, previous studies did not look at sectorial impact that the primary and secondary sectors of the economy have on the environmental quality, even though, several sub-Saharan countries are faced with environmental pollution issues like water pollution, cutting down of trees and illegal mining which is an eye saw for next generations. From the literature, the following hypotheses are proposed;

Hypothesis 1: Primary sector activities have positive effect on environmental quality in sub-Sahara Africa.

Hypothesis 2: Secondary sector activities have positive effect on environmental quality in sub-Sahara Africa.

Hypothesis 3: There is bidirectional causal relationship between financial development and environmental quality in sub-Sahara Africa.

2.13 Chapter Summary

In this chapter, a review of the literature was conducted concerning the financial and environmental activities in specific nations of sub-Saharan Africa. Some historical accounts and developments of ways Financial improvement and Environmental quality activities had been occurring in those international locations and other areas have been recognized. The evaluate supplied insights of energetic involvement of financial improvement on environmental high-quality. The bankruptcy highlighted on issues regarding financial region improvement and environmental degradation from extraordinary contest of globe. Materials and different sources for this evaluate had been received from professional journals, financial improvement file, environmental, Environmental Protection Agency (EAP), Climate change record, the IMF and world development indicators.

While this chapter has uncovered intriguing statistical insights regarding the performance of monetary improvement and environmental nice activities, it's important to note that sub-Saharan African nations contribute the least percentage, accounting for only 4% of carbon emissions, compared to 6% in Latin America and the Caribbean, 16% in Europe, 17% in North America, and a substantial 49% in Asia (Ritchie & Roser, 2019). Nevertheless, despite their relatively lower emissions, this region bears the brunt

of the adverse impacts of these emissions. The chapter has also delved into related issues such as foreign direct investments, energy consumption, and economic growth on a global scale, examining their challenges within sub-Saharan African countries. The forthcoming chapter explores the methodological approaches, including the Generalized Method of Moments (GMM) and Autoregressive Distributive Lag (ARDL) techniques.

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This chapter describes the strategy and procedures that are used in the study. It contains sections that discuss the research design, population, sample and sampling procedure, instruments, data collection procedure, and data analysis procedure. The statistical tools and techniques require to analyze data are all explained in this section to direct the researcher the areas of accomplishment at a time.

3.1 Research paradigm

According to Gillani et al.(2016) a paradigm provides a conceptual framework nd make better understanig of the social world. The significant of paradigm is that it shapes how researchers perceive the world and are reinforced by those around them and the community of practitioners. Within the resarech process the belief a researcher holds will be reflected in the way research is designed, how data is collected and analysed, and how research results are presented, thus it is very crucial for the researchers to recognise their paragidm as it allows them to identify their role in the research prcess, determine the course of nay research project and distinguish other perspectives (Grosper et al., 2012). From the background, positivism was used as a paradigm in this study. Positivism is a philosophical stance that asserts that knowledge can be gained through empirical observation and the scientific method.

These philosophical foundations shape the key characteristics of quantitative research, including objectivity, generalizability, causality, reductionism, and deductive reasoning. However, it is important to note that while quantitative research provides valuable insights into many aspects of the social world, it has limitations and may not capture the full complexity of human experiences and social phenomena. Therefore, it

is often complemented by qualitative research approaches that explore subjective experiences, meanings, and contexts. Quantitative researchers adhere to positivism by seeking to uncover objective, verifiable facts about the world. Looking at the variables of the study, that is financial development, environmental quality, primary and secondary sectors, they can be quantitatively measured and for that reason the study used positivism paradigm which ensures that data collected is free from bias. This allows for more accurate and reliable results when testing hypotheses about the relationship between variables.

3.2 Research Design

It is commonly held by maximum individuals who interact within the research agency that the first problem that challenges a researcher is the selection and justification of suitable method to observe a particular problem. Particularly, what research layout, the form of statistics to collect, and analytical equipment or approaches to appoint (Borg & Gall, 1993). The research layout specifies how records regarding a given hassle must be amassed and analyzed. It gives the methods for the taken any research. Gay (1996) mentions that the studies designs imply the basic shape of a study, the studies questions and the variables under investigation. In view of this the study adopted correlational research design which enbles the researcher excute the study's goals.

3.3 Correlational Research Design

It attempts to decide the life of a statistical relationship between two or greater variables. According to Burke and Larry (2008) correlational studies design attempts to discover the connection among one quantitative unbiased variable and one quantitative dependent variable. This design is suitable for this study because it seeks to discover whether there is a relationship between financial improvement and environmental quality. In this study, financial development is the explained variable

and environmental quality is the dependent variable. The researcher has consequently opted for the correlational research design taking the motive of the study into consideration; it's an appropriate approach which can lead to the drawing of significant conclusions from the study and used positivism paradigm which ensures that data collected is free from bias

3.4 Population

The populace for the study is all forty-eight SSA countries. This region is chosen due to the fact it's one of the regions with environmentally challenged sustainable issues and a growing financial system. A sample of 20 international locations is chosen for the research. Countries with extractive sources are worried more than the ones with out extractive resources. The sample sizes are deemed adequate because (Borg and Gall, 1993) have indicated that correlational studies calls for a sample length of not fewer than 30 instances. The current study makes use of annual records on monetary improvement, primary and secondary sectors and environmental quality from twenty (20) sub-Saharan African international locations out of the possible 40-eight (forty eight) countries. Data became gathered from the world development indicators (WDIs). No statistical or mathematical methodologies are used in arriving at this quantity, and the twenty (20) nations are pattern representation of the place for generalization of the final results. The task of a few nations now not have information at the time of the study accounted for the deciding on the twenty countries. The sample chosed is basically totally on the availability of suitable data for the observation.

3.5 Sampling Technique

The judgmental sampling technique is used in selecting all eligible nations in the sub-Saharan region for the study. Data availability forms basis of the judgment about which nations should be chosen and which should not be chosen in the region. This did not require any form of statistical or mathematical procedures or estimations to arrive at. The frequency of all the data for the study is yearly data.

3.6 Data Sources and type

Secondary data are used for the study. Data on financial improvement and environmental quality are acquired from the world development indicators (WDIs). Data from 1990 to 2019 are used for the investigation.This period falls within the period of increasing global envioronmental issues of which SSA is also affected. Sub-Saharan Africa over the two decades has experienced financial growth due to mining activities which led to discharging of harmful chemical into the environment. From early 2000, some countries in this region began in mining activities and embracing of modern technology in the production process, these attracted foreign investors leading to financial growth and environmental sustainability issues.

The paramount advantage of using secondary data from this source is the ease with which data can be obtained and the authenticity of the source of the data, which motivates readers about the quality and reliability of the work. The use of secondary data in research seems easy, but it has some challenges like availability of data, the source of it and the likelihood of not getting the desire length of data needed especially within African regions, hence limiting the scope of study. The countries under study include Benin, Mauritius, Botswana, Burkina Faso, Cameroon, Kenya, Mozambique, Ghana, Gabon, Niger, Nigeria, Senegal, South Africa, Congo Dem. Rep, Congo Rep., Sudan, Tanzania, Cote D'Ivoire, Togo, and Zimbabwe.

Table 3: Variables used in the sstudy, their source and aprior expectations.

Variable name	Variable measure	Expectations	Source
Financial development (FD)	Home lending to the private sector (% of GDP)	+	WDI
Energy consumption (EC)	Power intake (kg oil equivalent per capita) World bank	_	WDI
Economic growth (EG)	Per capita/ GDP growth (annual %)	+	WDI
Environmental quality (EQ)	Carbon dioxide pollution (metric tons per capita)		WDI
Secondary Sectors (SS)	Manufacturing, value added (annual % growth)	+	WDI
Primary Sector (PS)	Agric value addition (% of GDP):	_	WDI
Foreign direct investment (FDI)	Oversea investment, net inflows (% of GDP)	+	WDI

Source: Global development indicators, 2023.

3.7 Data Analysis Procedure

The regression model is employed for parameter estimation, with reponse variable being environmental quality, and the primary independent variables comprising financial development (FD), the primary sector (PS) and the secondary sector (SS). Additionally, the study includes other control variables, namely foreign direct investment (FDI), economic growth (EG), and energy consumption (EC). In line with Han et al. (2018), economic upgrade is determined by gross domestic product, which reflects overall well-being of production activities and services rended within an economy and plays a pivotal role in understanding the per capita income of a country. They emphasize the critical need for a comprehensive understanding the network between carbon dioxide emissions and business increasing to unveil the connections between living things activities and the suprem environment, ultimately aiming to

mitigate oxygen gas emissions. Gross domestic product is used as a control variable to determine the rate at which the environment gets affected by neighborhood production. An increase in FDI leads to monetary increase but may have a poor impact ultimately on the environment (Salahuddin *et al.,* 2017). The data extracted form WDIs for 20 decided countries in sub Saharan Africa region which is made of 48 countries and overlaying the period 1990–2019. This duration is selected because from early 2000, maximum countries in this location commenced in mining activities and this attracted foreign traders leading to financial boom and environmental problems (Ojewumi & Akinlo, 2017). They conducted research to explore the characteristics and connections among oversea investment, economic improvement and surrounding nice in sub-Saharan region (SSA). Their investigation involved the application of panel vector error correction (PVEC) and panel vector autoregressive (PVAR) strategies, revealing the presence of dynamic relationships among GDP growth, oversea investment, and unfreiendly gasses emission. Adzawla *et al*. (2019) noted that many SSA nations face significant vulnerability to atmosphere patern change due to huge reliance on unartificial resources for agriculture, limited financial capital advancement, inadequate structures, and minimal levels of technology advancement. General method of moment(GMM) technique , constant effect technique and autoregressive disbursed lag (ARDL) method are hired for the observation. From the literature it's miles believed that sub-Saharan place is less contributor to worldwide warming however vulnerable to carbon two gasses (Edmonds *et al*., 2020). Bond *et al*., 2015, proposed utilization of system GMM estimators for group informtion regressions which results beter stable and smart parameter calculated. Typically, First-differenced GMM estimators rent lagged explanatory variables as instrumental variables, assuming that the idiosyncratic blunders term isn't always serially correlated and that the explanatory variables are weakly exogenous. However, as cautioned by Borrego and Arellano (1996) and

Blundell and Bond (1999), the instruments to be had for the primary-distinction equation become weak gadgets when the indpendent variables exhibit persistence for time being. The examine has diagnosed environmental first-class as a structured variable while monetary improvement in number one and secondary sectors are used as predictors.

3.8 Estimation Technique for Objective one; Random Effect Estimation Technique

To achieve objective one, which investigates whether primary sector activities have positive effect on environmental quality, the study assesses the appropriate estimation method using the Hausman test through pooled OLS, random effect, and fixed effect tactics. Employing the fixed effect model (FEM) has a primary advantage in that it controls for time-invariant omitted variables. However, analysts encounter challenges when choosing between these models, particularly in deciding whether fixed effect (FEM) or the random effects strategy (REM). The REM assumes that the unobserved time-invariant variables are uncorrelated with independent variables, while fixed effect permits these variables to freely correlate (Mundlak, 1978). To address this, the Hausman test, as proposed by Hausman (1978), helps researchers determine the most appropriate model for their study. The rule of thumb is as follows: if the p-value of the Hausman test exceeds 5%, researchers accept H0, and REM deemes appropriate. Conversely, if the p-values are below 5%, H0 is rejected, and the fixed effect model is considered appropriate. In this study the p-value 0.9348 which is more than 5%, leading to not rejecting H_0 and indicating that the RE model is suitable. Sibuea *et al*. (2021) employed the random effect technique to investigate the impact of renewable energy and economic development on environmental quality of ASEAN Countries and found negative implication on the environment.

3.9 Random Effect Model Specification

The random-effect regression model is specific as:

$$Y_{it} = \beta_O + X_{it} + \beta 6\, K_{it} + \mu_{it} + \varepsilon_{it} \quad (1)$$

In the equation provided, "i" stands for individual countries "t" stands for the year, "Y" is reponse variable denoting environmental quality (measured by CO2 emissions). "X" signifies every explanatory variable namely, primary sector (PS), financial development (FD), and secondary sector (SS), while "K" stands for vector of guiding variables, including economic growth (EG), energy consumption (EC), and foreign direct investment (FDI). The "β0" represents the intercept, and "β1" to "β6" correspond to the sequential coefficients of explanatory variables and guides. Additionally, "μi" represents nations particular effect, and "ε" denotes random errors component. In baseline analysis, study utilizes random-effect regression estimator to estimate Equation (1).

The full specification of model 1 is shown using equation (2):

$$CO2_{it} = \beta o + \beta 1 PS_{it} + \beta 2\, FD_{it} + \beta 3\, EG_{it} + \beta 4\, FDI_{it} + \beta 5 SS_{it} + \beta 6\, EC_{it} + \varepsilon_{it} \quad (2)$$

3.10 Estimation Technique for Objective Two

To investigate whether secondary sector activities affect environmental quality in SSA, the study employs panel data analysis and utilizes the Generalized Method of Moment (GMM) estimation technique. Dynamic panel estimation techniques like (GMM) handles three key estimation problems: omitted variables, error measurement, and the endogeneity of regressors (Alege & Ogundipe, 2013; Sala & Trivín, 2014). To reduce endogeneity problems with explanatory variables, Arellano and Bond (1991) propose using instrumental variables to implement the Generalized Method of Moments of

corresponding moment conditions. Essentially, this technique ambitions to get away with specific fixed results by way of taking the primary difference of the regression equation. Subsequently, the lagged variable is regarded because of the corresponding instrumental variable for endogenous variables within the differenced equation. However, in finite samples, Arellano and Bond may be afflicted by weak instrument resulting in decreased precision (Bond et al., 2001). To deal with this, Arellano and Bover (1995) and Blundell and Bond (1998) recommend a solution by combining extra regulations with those in Arellano and Bond, presenting a system-GMM estimator. In this technique, GMM is used to a system of equations: one in differences instrumented by lagged ranges and another in stages instrumented by means of lagged variations. Hoeffler and Temple (2001) with improved precision and reduced bias as compared to first-difference GMM estimators (Arellano & Bover, 1995; Blundell & Bond, 1998). Roodman (2009) shows that system GMM, by using default, can also generate a wide variety of instruments because the number of periods will increase, potentially leading to overfitting endogenous variables and weakening the model specification exams. To ensure that moment conditions aren't over-recognized, the number of instrumental variables should now not exceed the endogenous variables. For lagged endogenous variables and weak exogenous variables to be legitimate model, it's important that the short disturbances within the base model, εit, are free from autocorrelation (Blundell & Bond, 1998). This implies that the disturbances in the differenced moldel show off enormous first-order correlation and insignificant 2d-order autocorrelation. To determine the validity of second conditions, the study employs Arellano–Bond tests for first-order (AR (1)) and 2nd-order (AR (2)) serial correlation in the first-differenced residuals (Arellano & Bond, 1991). Rejecting the null hypothesis of no serial correlation in first-differenced errors at order one does not always suggest model misspecification because the primary models is independently and identically

distributed idiosyncratic errors may be serially correlated. However, rejecting the null hypothesis at higher orders suggests that moment situations are not valid. The validity of moment situations may be tested by the use of Sargan and Hansen tests in which the null hypothesis posits that each units together are exogenous, and for this reason, no longer rejecting the null hypothesis implies model validity. It's crucial to be aware that the Sargan test's behaviour is widely understood whilst disturbances can be assumed as homoscedastic (Iqbal & Daly, 2014), and it can have low potential to reject the null hypothesi whilst the sample size is small (Bowsher, 2002). Due to the limitations associated with the Sargan test and the truth that the Hansen test is more notably commonplace in exercising, the study opts for the Hansen test to assess the validity of the model. Prior studies, which include the works of Okofo-Dartey and Kwenda (2019), Ali et al. (2019), Zhang et al. (2015), and Sibuea (2021), have efficiently used GMM estimation strategies in panel data assessment.

3.11 Dynamic System GMM Model Specification.

In the observation, how financial development, the primary sector and the secondary sector activities influence environmental quality across 20 SSA nations is the reason. To ensure a comprehensive analysis, the researcher considers financial capital expansion, electrtic power consumption , and economic growth and oversea investment as control variables. The dynamic model for CO2 emissions includes a lagged response variable to accommodate partial adjustments. To assess the intended goal, that is to analyze whether secondary sector activities affect environmental quality in sub-Sahara Africa.

The following model is designated;

$$CO2_{it} = \alpha oi + B_0\, LCO2_{it-1} + \beta 2\, SS_{it} + \ +\beta 1\, FD_{it}\, \beta 3 X_{it}\ + \eta_t + \lambda_i + \varepsilon_{it} \qquad (3)$$

where CO2 stand for carbon dioxide emission, B_0CO2_{it-1} represents lagged established variable of carbon dioxide emissions, FD signifies Financial development, SS denotes secondary sector improvement, and **X** represents control variables (oversea investment (FDI), economic growth (GDP), primary sector (PS) and power or energy consumption ((EC). While term ηt stands for definite fixed effect, λi indicates nation definite impact, i denotes nation, and t represents the time period.The complete specification of the model 2 is presented in equation (4) underneath:

$$CO2_{it} = \alpha 0 + B_0CO2_{it-1} + \beta 1\ FD_{it} + \beta 2\ SS_{it} + \beta 3\ GDP_{it} + \beta 4FDI_{it} + \beta 5PS_{it} + \beta 6EC_{it} + \varepsilon_{it} \quad \textbf{(4)}$$

$\beta 1, \beta 2 \ldots . \beta 6$ are slope coefficients of the estimates. *i.*= Country; *t* = time period; ε_{it} is the error term for country *i*. at time *t,* $\alpha 0$ is intercept.

The variables and their a prior expectation are as follow: Financial development (FD), Economic growth (EG), Secondary sectors (SS) and Foreign direct investment (FDI) are expected to be positive whilst Energy consumption (EC), Environmental quality (EQ) and Primary sector (PS) are expected to be negative.

3.12 Estimation Technique for Objective ;Three Autoregressive Distributed Lag (ARDL)

The third research objective is to examine short and long-run relationship between financial improvement and environmental quality in sub-Saharan Africa, the study relies on the ARDL estimation proposed by Chudik and Pesaran (2015) in conjunction with the Pooled Mean Group (PMG) estimator. This model has been widely employed by various researchers and is robust not only in addressing cross-sectional dependency and heterogeneity but also non-stationarity and endogeneity issues. Additionally, the

cross-sectional autoregressive distributed lag (CS-ARDL) method is used to search short-run and long-run empirical estimatios.

Cross-sectional dependence (CD) is everywhere encountered issue in panel time series analysis, often arising due to unchecked suprises that can potentially bias the result. Tackling this challenge, the study employs the approach introduced by Pesaran (2004) to test for cross-sectional dependency. Previous research, such as Sarkodie and Adams (2018), utilized the ARDL model for the period 1991–2016 in South Africa and identified a good network between monetary boom and surrounding purity. Similarly, Hongo *et al*. (2019) applied ARDL model to investigate the connection among environmental pollution, fianancial capital growth, power usage, and oversea investment in six chosen sub-Saharan African nations, revealing bidirectional causality between environmetal quality and financial development. Given aforementioned context, the study explores the relationship among carbon emissions, economic growth, energy usage, primary and secondary sector activities and oversea investment. The variables are presented in percentages and shown in **model 3;**

$$CO2_{it} = \beta o + \beta 1\, FD_{it} + \beta 2\, SS_{it} + \beta 3\, GDP_{it}$$

$$+ \ \beta 4 FDI_{it} + \beta 5 PS_{it} \ + \beta 6 EC_{it} \ + \varepsilon_{it} \qquad (5)$$

In this context, the variables are defined as follows: GDP_{it} represents economic growth, ECit stands for energgy usage, FDI_{it} denotes foreign direct investment investment net reciepts, $CO2_{it}$ represents carbon emissions, PS_{it} is the primary sector, and SS_{it} is the secondary sector. βo stands for constant unit, and εit is the error component.

To determine the stability of various varialbes, it is essential to elaborate on the panel data characteristics. This will facilitate the use of appropriate and robust panel unit root estimates. The tipical panel unit root estimates like IPS, LLC, and Hadri exams yield inconsistent and inaccurate results when the group interval-series data is cross-sectionally non reliance. Therefore, to assess whether the group interval-series data in

this study exhibits cross-sectional independency, a cross-sectional independence test propounded by Pesaran (2004) and Frees' are employed.

Under the null hypothesis of the Pesaran CD test, the error phrases of the individual collection in the panel are uncorrelated (indicating cross-sectional independence). Conversely, under the opportunity speculation, the error term of character series in the panel are correlated (indicating cross-sectional dependence). Subsequently, the study proceeds to analyze the stationarity of the variables. Taking into attention the capacity cross-sectional independence in the panel time-collection records, the study applied Philip Peron (PP) and cross-sectional augmented Dickey-Fuller (CADF) panel unit root checks. These assessments are primarily based on the null hypothesis that each series within the panel is stationary, even as the opportunity hypothesis posits that as a minimum one character collection within the panel is non-desk bound. To estimate each short-run and long-run relationship amongst carbon emissions, economic increase, energy intake, and overseas direct funding, the study employed the Autoregressive Distributed Lag (ARDL) version through the Pooled Mean Group (PMG) estimator. The ARDL approach is favoured due to several advantages, which include its applicability no matter whether or not the series is I(1) or I(0), simultaneous estimation of short-term and long-time effects, and versatility in specifying the wide variety of lags for every variable. The ARDL (p, q) version incorporates lag p for the response variable and lag q for the explanatory variables, bearing in mind a complete evaluation of the relationships.

$$Y_{it} = \sum_{j=1}^{p} \mu_{ij} Y_{it-j} + \sum_{j=1}^{q} \Omega_{ij} X_{it-j} + \varepsilon_{it} \quad (6)$$

n this context, where i = 1, 2, 3, ... , N stands for number of nations underdiscusion, t = 1, 2, 3, . . , T signifies duration in years. The response variable denoted as Y_{it}, while X_{it-j} indicates an m × n vector including un artificial logarithm of the explanatory

variables. The scalar vector represented as μij, the coefficient vector as Ωij (m × 1), and εit denotes the error with zero mean and definite variation (Ssali et al., 2019).

Using highest of one lag for all variables, utoregressive istributed ag strategy with lag specifications (1,1,1,1) brought out by Pesaran and Shin (1999), can be represented as follows: $\mathbf{\Delta y}_{it} = \mu_{Ii} Y_{it-I}$ **Y it-I** $+ \sum_{j=0}^{I} \acute{\Omega}_{ij} X_{it-j} + \varepsilon_{it}$ **(7)**

The error reduction presentation is written as $\Delta Y_{it-1} - \Theta_{it} X_{it}$

$\mathbf{\Delta y}_{it} = \psi i + (y_{it\text{-}I} - \Theta\, i^{x} x it) + \sum_{j=I}^{p-I} \mu_{ij}\, \Delta y_{it\text{-}j} + \sum_{j=0}^{9-I} \acute{\Omega}_{ij} + \Delta x_{it} + \varepsilon_{it}$ **(8)**

Where $\psi_i = -(1-,\sum_{j=I}^{p} \mu_{ij})$, and $\Theta = \frac{\sum_{j=o}^{q} \acute{\Omega}_{ij}}{\psi i}$. Θ stands for long-term connection between the dpendent and indpendent variables (y_{it} and x_{it}), where Ω*ij signifies short-term impacts of X_{it}, variables Y_{it}, variables. The ψi, on the other hand, represents the mistake correction term, measures speed at which response variables move towards their long-term equilibrium as the explanatory variables change (Ssali et al., 2019). A negative and significant mistake correction is supposed to indicate the presence of long-term equilibrium.

The adapted model with carbon emission as response variable from equation (1) is expressed in ARDL as follows:

$\Delta CO_2 = B + \psi i\, (\Delta CO_{2it\text{-}1} - \Theta_{1i}\, FD_{it} - \Theta_{2i}\, GDP_{it} - \Theta_{3i}\, FDI_{it} - \Theta_{4i}\, SS_{it} - \Theta_{5i}\, PS_{it} - \Theta_{6i}\, IEC_{it})$

$+ \sum_{j=I}^{p-I} \mu_{ij}\, \Delta CO_{2it\text{-}j} + \sum_{j=o}^{q-I} \tilde{\Omega}_{Iij}\, \Delta FD_{it-j} + \sum_{j=o}^{q-I} \tilde{\Omega}\, 2ij\, \Delta lGDP, it-j + \sum_{j=o}^{q-I} \tilde{\Omega}_{3ij}\, \Delta FDI_{it-j}$

$+ \sum_{j=o}^{q-I} \tilde{\Omega}_{4ij}\, \Delta SS_{it\text{-}j} + \sum_{j=o}^{q-I} \tilde{\Omega}_{5ij}\, \Delta PS_{it\text{-}j} + \sum_{j=o}^{q-I} \tilde{\Omega}_{6ij}\, \Delta EC_{it\text{-}j} + \varepsilon it$ *(9)*

Similar equation for financial development been response variable is stated below:

$$\Delta FD = {}_{B} + \psi i\ (\Delta FD_{2it\text{-}1} - \Theta\ {}_{1i}\ LCO_2\ it\text{-}\Theta_{2i}\ lGDP\ it - \Theta_{3i}\ FDI\ {}_{it} - \Theta_{4i}\ SS\ {}_{it} - \Theta_{5i}\ PS\ {}_{it}\text{-}\Theta_{6i}\ EC\ {}_{it})$$

$$+\sum_{j=I}^{p-I} \mu_{ij}\ \Delta FD_{2it\text{-}j} + \sum_{j=o}^{q-I} \tilde{\gamma}\Omega_{1ij}\ \Delta CO_2\ it\text{-}j + \sum_{j=o}^{q-I} \tilde{\gamma}\Omega\ 2ij\ \Delta GDP\ it - j + \sum_{j=o}^{q-I} \tilde{\gamma}\Omega_{3ij}\ \Delta FDI\ {}_{it\text{-}j}$$

$$+\sum_{j=o}^{q-I} \tilde{\gamma}\Omega_{4ij}\ \Delta SS\ it\text{-}j + \sum_{j=o}^{q-I} \tilde{\gamma}\Omega_{5ij}\ \Delta PS\ it\text{-}j + \sum_{j=o}^{q-I} \tilde{\gamma}\Omega_{6ij}\ \Delta EC\ it\text{-}j + \varepsilon it \qquad (9.a)$$

Equations (9) and (9.a), are estimated using the ARDL estimator through polled mean group. In comparison to other estimation methods, ARDL has various advantages. For example, this estimator enforces stability in long-term estimates through all cross-sections in panel but permits intercepts, quick-term attachments, errors to vary among nations. Furthermore, its applicable regardless of integrated of order 1 (I(1)) or integrated of order 0 (I(0)) and allows for inference of short and long-run causal relationships even when cointegration is not formally identified.

3.12 Chapter summary

This section highlghts strategies used and incorporates sections that talk the studies design, populace, pattern and sampling technique, units, records series system, and statistics evaluation procedure. To ensure the reliability of results, various techniques are employed, including two-step system GMM, fixed effect estimation, and Autoregressive Distributive Lag (ARDL). The use of system GMM offers the advantage of providing additional sets of moment equations, including orthogonal deviations, which enhances estimation efficiency. System GMM is capable of addressing the issue of unchecked national-level unequal variances (Bond, Hoeffler & Temple, 2001). This technique is explored for objective one of the thesis. Autoregressive allotted lag (ARDL) is used to estimates short and long-run coefficients of dependent and impartial variables in the examination and is particularly used for

objective three. The ARDL method has been favored for several advantageous reasons. It is applicable irrespective of integration of I(1)) or (I(0)). Additionally, it can accommodate varying numbers of lags for each variable in the analysis. The result of the whole work, dialogue at the various goals and interpretations are accompanied in the next chapter.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Introduction

This section discuses analysis of results for the study. These results obtained from the analysis are presented in detail and discussed in the chapter,

4.1 Unit Root Tests

Proceeding with any econometric approach to gain reliable effects, it is vital to conduct unit root assessments to determine the order of stationarity for the variables under investigation. This step is critical because all the three estimation techniques used in this observation assume that the variables are incorporated of order I(zero) or I(1). If a variable is found to be integrated with the order I(2), the calculated F-records produced may not be valid (Pesaran et al., 2001). The maximum commonplace and extensively used test in this regard is the Augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1979; 1981). However, Phillips and Perron (1988) proposed a nonparametric correction for Dickey-Fuller (DF) records to account for heteroscedastic mistakes.

Table 4 shows that not all variables are integrated in levels, leading to the rejection of the null hypothesis of stationarity for all collections in levels The application of the same test for the data expressed as a first difference leads to not rejecting at the 1% threshold, the non-stationarity hypothesis for all the variables used. It is also possible to conclude that some of the variables are integrated in order I (1) and others are in levels I (0). Moreover, since no series is integrated in order two I (2) or more, the use of the estimations techniques are justifiable.

Before proceeding with any estimation technique to reap reliable effects, it's mile crucial consider unit root test to decide the order of stationarity for the variables under investigation. This step is vital because all three estimation strategies hired in this

invetigation expect that the variables are incorporated in the order I(0) or I(1). If a variable is observed to be integrated of order I(2), the calculated F-facts produced might also not be legitimate (Pesaran et al., 2001). The most common and extensively used test in this regard is the Augmented Dickey-Fuller (ADF) take a look at (Dickey and Fuller, 1979; 1981). However, Phillips and Perron (1988) proposed a nonparametric correction for Dickey-Fuller (DF) statistics to account for heteroscedastic mistakes.

Table 3 shows that not all variables are stationary in degrees, leading to the rejection of the null hypothesis of stationarity for all series in tiers. When the identical test is applied to the information expressed as first variations, the null speculation of non-stationarity is not rejected at the 1% significance level for all variables. This indicates that a number of the variables are included in order I(1), even as others are stationary at stage I(0). Furthermore, as no collection is integrated of order I(2) or higher, using fixed and random effect estimations, system GMM, and ARDL techniques are applicable.

the study opts for the Philip Peron and Augmented Dickey-Fuller (ADF) panel unit root tests instead of typicall per root tests like Breitung, IPS and LLC panel unit root assessments (Gengenbach et al., 2009). The reason for the choice is traditional panel unit root tests have limitations dealing with cross-sectional independence. Importantly, the ADF and PP per root tests can provide reliable results even in the presence of cross-sectional independence, as evidenced by Dogan *et al.* (2017). The results of the ADF and PP tests are kept in Table 4, which is reproduced from page 64 of this chapter for better clarification of objective 3. Both tests indicate that not all observations in question exhibit stationarity at levels, but some turned stable after undergoing their initial differenciation. Consequently, it suggests that observations CO2, GDP, FD, EC, SS, PS, and FDI do not share the same order of integration; instead, either I(0) or I(1) in both tests.

Table 4: Results of ADF and PP

	ADF			Philip Perron		
Variables	Level	1ST DIFF	Prob.	LEVEL	1ST DIFF	Prob.
C02EM	-0.3433	-11.584***	0.000	41.0566	550.226 ***	0.001
SS	-6.958***		0.002	237.461***		0.000
PS	-0.243	-13.134***	0.000	74.263***		0.003
FD	-1.063	-10.867***	0.001	42.845	392.843 ***	0.000
GDP	-6.153***		0.000	274.051***		0.000
FDI	-2.519***		0.013	109.785***		0.002
EC	**5.857**	**-10.034***	0.000	14.611	489.072***	0.000

Source: Author's construct, 2023.

Note: *, **, and * denote the rejection of the null hypothesis at the 1%, 5%, and 10% significance levels and FD PS SS EC EG FDI and CO2 represent financial development , Primary sector secondary sector, Energy consumption, Economic growth, Foreign direct investment and carbon dioxide emission repectively.

Table 5: Descriptive Statistics

VARIABLE	**OBSERVATIONS**	MEAN	STADARD. DEVIATION	MINIMUM	MAXIMUM
CO2	600	.1645	.137	.022	.703
Secondary Sector (SS)	600	5.604	8.412	37.933	72.632
Primary Sector (PS)	600	20.200	11.952	0	56.544
Financial Development (FD)	600	21.053	26.343	0	142.422
Energy Consumption (EC)	600	544.047	1049.152	0	6183.987
Foreign Direct Investment (FDI)	600	2.611	4.788	-11.197	39.811
Economic Growth (EG)	600	3.729	4.307	-17.005	21.452

Source: Author's construct, 2023

Note; FD, PS, SS, EC, EG, FDI and CO2 represent financial development , Primary sector, secondary sector, Energy consumption, Economic growth, Foreign direct investment and carbon dioxide emission repectively.

Table 5 presents descriptive analysis for all observations, including the dependent variable and the main explainatories (financial increament, primary sector, and secondary sector). It also includes other variables such as foreign direct investment, power intake, and financial capital for the selected sub-Saharan African nations from 1990 to 2019. The study has 600 observations from an unbalanced panel data of selected 20 developing nations in sub-Saharan Africa.

It is evidenced from the Table 5 that there is more varation in financial development and energy consumption values as shown by their high standard deviations of (26.343) and (1049.152) respectively relative to their means of (21.053) and (544.047). The descriptive statistics also show that there is high variation in secondary sector variable as shown by the high standard deviation (8.412) relative to its mean (5.604). GDP, FDI and Primary sector variables exhibited low variations as shown by the relatively low standard deviation (4.4581), (4.032) and (12.199) respectively compared to their means of (3.810568), (2.333) and (21.02). This is evidenced by the CO_2 which is one of the measures used in this study to evaluate the environmental quality. An inspection of the table also shows less variation in CO_2 emission as is shown by low standard deviation of (0.141) relative to its mean of (0.166).

Table 6: Correlation Matrix

Variables	CO2	SS	PS	FD	EC	EG	FDI	VIF
CO2	1.000							
SS	-0.083	1.000						1.26
PS	-0.571	0.052	1.000					5.51
FD	0.634	-0.074	-0.454	1.000				4.44
EC	0.745	-0.038	-0.567	0.820	1.000			5.19
EG	-0.089	0.444	0.022	-0.064	-0.046	1.000		1.26
FDI	-0.051	0.053	-0.037	-0.039	-0.050	0.193	1.000	1.05

Source: Author's construct, 2023

Note, FD PS SS EC EG FDI and CO2 represent financial development , Primary sector secondary sector Energy consumption Economic growth Foreign direct investment and carbon dioxide emission repectively.

Table 6 contains correlation matrix encompassing all variables employed in this study. Response variable utilized as a proxy for environmental quality is CO2. The primary independent variables include home lending to the private sector, serving as a proxy for financial development, as well as the primary sector and secondary sector. These correlations are computed to assess the presence of multicollinearity. Upon reviewing Table 6, its apparent that the highest correlations observed are 0.634, -0.571 and 0.745, reflecting the network mediating financial development and primary sector values. However, these variables do not exhibit a significant correlation with each other. Instead, they display correlations concerning the response variable, CO2 emissions but energy consumption variable shows highest correlation among all which correlates with

FD variable on the tabe, with the help of VIF values the two variable are within the threshold of not droping one.

It is noteworthy that all other correlation values fall below 0.5, indicating the absence of multicollinearity among the independent variables. Furthermore, the correlation table reveals undesirable network between CO2 emissions and all the independent variables, except for financial development. A closer examination of the data in the table also suggests an adverse relationship between financial development and both primary and secondary sector variables.

Table 7 : Cross Sectional Dependency (CD) Tests

Pesaran (2004) test		Frees' test Q distribution
Statistics	1.460	1.986
P values	0.144	0.166

Source: Author's construct, 2023.

The Pesaran (2004) and Frees' CD tests are shown in Table 7. The outcome of the CD check, calculated by using Pesaran (2004) CD) and Frees test depict no presence of CD in selected nations with the aid of not rejecting the null hypothesis that no cross sectional dependency exists in these nations, which means that surprise in one nations in SSA hase no effect on different country.

Table 8: Fixed and Random Effect Results for Objective One

Co_2 | -	Fixed Effect	t- value	LL	UL	Random effect	t- value	LL	UL
Primary Sector (PS)	.004*** (.000)	| 9.78	-.005	-.003	-.004*** (-1.042)	-10.39	-.001	-.000
Financial Development . (FD)	.001*** (.000)	4.45	.0001	.002	.002*** (0.000)	5.12	.001	.002
Secondary Sector (SS)	.001** (.000)	-2.15	.001	0.000	-.001** (0.000)	-2.18	.0002	-.000
Foreign dict. Invest. (FDI)	.002*** (0.001)	2.56	003	.000	-.002*** (.001)	-2.89	-.003	-.001
Economic growth (EC)	-.000 (9.482)	0.79	002	.000	.000 (.001)	0.54	.001	-.002
Energy consumption (EC)	-.001 (.001)	0.53	.001	.001	-.000*** (8.840)	-4.80	.000	-.000
Constant.	.257	.0120	.233	.281	.245 .021	.11.83	208	.291
Hausman test	1.83		Sample period			1990-2019		
Chi2(6) =	160.95		Over all R-square =			0.1956		
Prob Chi2 =	0.9348		R-squr Betwn. =			0.1859		
R-squr within =	0.2151		Number of Obs. =			600		

Source: Author's construct, 2023. Note: standard errors are in parenthesis and *, **, and * shows level of significance at 10%, 5%, and 1%, LL and UL denote lower and upper limits in that order.**

4.2 Discusion of Results for Objective One

The present study ivestigates the effect of primary sector activities on environmental quality using random effect (REM) estimation strategy, and the results show that primary sector activities, financial development, energy consumption, secondary sector activities and foreign direct investment have a negative association with carbon emission or a positive association with the environmental quality of the SSA countries. The R square value is 0.1956, highlighting that 19.6 percent changes in CO2 are due to primary sector activities, financial development, energy consumption, secondary sector activities and foreign direct investment.

The result shows significant negative coefficient for the primary sector (PS) activities at 1% level, indicating that primary sector activities have adverse effect on environmental quality on SSA. An improvement in investment opportunities in SSA's primary sector could potentially harm the environment. This finding disagrees with Ali et al. (2022), Senturk et al. (2022) who conducted sectoral effect on environmental quality in Assian countries and established that agricultural growth and globalization are reducing CO2 emissions but this relationship is insignificant over the selected time. In the short-run agricultural growth, and service sector growth are reducing the level of CO2 emissions. This outcome indicates that primary sector activities negatively affect environmental quality on the sampled sub-Saharan African nations, Adzawla *et al.* (2019) also highlighted vulnerability on most SSA nations to climatic influemce as result of over reliance on agriculture, low economic development, inadequate structures, and limited technology progress.This may suggest that human activities such as feeling down of threes, illegal mining and improper farming practices degrade the surroundings and can supply upward thrust to global warming on the sampled countries in SSA. This findings afrims the environmental justice theory whic possits that treating

human being fair and harming other ecosystem is unjust and will have climatic effect on human health , hence justice must apply to both human and natural environment equally to avoid climatic effect on all living things.

Moreever, the coeeficient of financial development is positive and statistically significant at 1% level, implies that an increase in FD will have positive relation with environmental quality in SSA. This result is contral to existing theories and empiricals sources that highlights the detrimental effec of financial development on environmental quality (Godil *et al*., 2020; Ulucak *et al*., 2020; Vo & Zaman, 2020; Zaidi *et al*., 2019). Saud et al. (2020) posit that finance upgrade is linked to increased financial capital expansion, potentially leading to higher power consuming and carbon dioxide emissions, thereby reducing environmental quality. Le *et al.* (2020) investigate an impact of economic inclusion on Asian nations and find that financial inclusion negatively affects CO2 emissions due to increased electric power consumption emissions. FD in SSA eases financial barriers for firms and investors, providing people with better access to money. This, in turn, allows households and businesses to acquire modern equipment for agricultural production, which may have detrimental environmental consequences, thereby diminishing environmental quality in these countries.

The coeeficients of energy consumtion (EC) and FDI are negative and statistically significant at 1% level, implies that an increase in EC and FDI will have negative implications on environmental quality in SSA. This shows that energy consumption is negatively linked with environmental quality, possibly due to increased energy demand in industries and the use of environmentally unsustainable chemicals and equipment, contribute to CO2 emissions. This result matches with the outcome of Behera and Dash (2017) and other studies that link power consumption to environmetal degradation.

Sarkodie and Strezov (2019) tested the good sized effect of FDI inflows, economic increase, and energy consumption on carbon emissions from 1982 to 2016, that specialize in China, India, Iran, Indonesia, and South Africa as main carbon emitters in emerging economies. They discovered that energy usage has a good significantly effect on carbon dioxide discharging and can promote eco-technological advancements, labor force improvements, and efficient usage in advanced countries. To ensure a comprehensive analysis and comparison, this study calculates standard errors for coefficients using random-effect estimation strategy.

Table 9: Regression Results for Model 2

Variable		**Dynamic panel estimation, two-step system GMM**
Constant		.0194 (.0438)
L$CO2_{it\text{-}1}$	α_1	1.0188*** (.0947)
FDI	$\beta 1$	-.0013*** (.0008)
SS	$\beta 2$	**7.5721 *** (.0002)**
EG	$\beta 3$	-.0001 (.0004)
FD	$\beta 4$	.0000 (.0004)
PS	$\beta 5$	-.0007 (.0016)
EC	$\beta 6$	-.0000 ***(0.0000)
Diagnostics		
AR (2)		0.423
Hansen P- value		0.4010
Observations		580
Number of instruments		I4

Source: Author's construct, 2023.

Note: * Significant at the 10% level, ** Significant at the 5% level and *** Significant at the 1% level, standard errors are in parentheses and FD PS SS EC EG FDI and CO2 represent Financial development, Primary ector, Secondary sector, Energy consumption, Economic growth, Foreign direct investment and Carbon dioxide emission repectively.

4.3 Discussion of Results for Objective Two

The current study investigates the effect of secondary sector activities on environmental quality in SSA, the two steps system GMM estimation approach. All production activitis as percentage of GDP is to measure secondary sector activities. Domestic lending to private sector is used for financial development, CO2 extensively utilized as proxy for carbon dioxide emission and different control variables which include financial growth, electricity consumption, and overseas direct investment had been used to resource the evaluation. To verify the reliability of the model, AR (2) and Hansen checks were completed. AR (2) tests for autocorrelation and Hansen test for over-identification of the instruments. The check of 2nd-order serial correlation AR (2) suggests that each estimation has no problem with 2nd-order serial correlation for the purpose that AR (2) is unable to reject the null of no second-order serial correlation (p-values .0423). The Hansen test for over-identity shows the null of exogenous devices is not rejected with (p-values 0.4010). The diagnostic of the model is connected to model 2 in Table 9.

The study presents the results obtained through dynamic GMM tecnnique fromt Table 9. The system GMM is believed to be beter robust consistent compared to difference GMM, and the current study's analysis uses system GMM. Finding based on this technique indicates that financial improvement promotes carbon dioxide emission. In Model 2, the coefficient $\alpha 1$ is statistically significant at the 1% level ($\alpha 1 = 81.0188$, $p < 0.000$), denoting that previous secondary sector activities have positive impact on environmental quality. This shows that development in the earlier secondary sector improves environmental quality for the chosen sub-Saharan countries. The coefficient of lag indicates a good connection facing secondary sector activities and environmental quality. This aligns with evidences of (Saud *et al*., 2019 : and Zhou *et al*., 2020) who reported a good correlation between economic growth and environmental quality.

In Model 2, the coefficient β1 is negating and analytically significant at the 1% level (β1 = -.0013, $p < 0.004$), suggesting that an advancement in foreign direct investment (FDI) may lead to a decrease in environmental quality. This could be attributed to FDI inflows provide capital for investment but potentially leading to environmental degradation due to technology transfer and increased production. This outcome backs the findings of Ojewumi and Akinlo (2017). Li et al. (2018) also argued that depending on the nature and intentions of multinational corporations, FDI can lead to increased emissions in host countries. Rafindadi *et al.* (2018) also conduted research on effect of FDI on greenhouse gas emissions and established that FDI has negative effect on environmental quality. Salahuddin *et al.* (2017) also conducted an analysis of the effects of economic increament, energy intake and FDI on CO2 trasmisssion in Kuwait, through time-series information spanning from 1980 to 2013.

The coefficient β2 is positive and represents the effect of secondary sector (SS) activities on environmental quality, it is statistically significant at the 1% (β2 =**7**.5721 , $p < 0.013$), indicating that an improvement in secondary sector activities have postiv implications on environment. Considering other variables such as foreign direct investment, power consumption, economic booms and financial development. This means that transformation of raw materials into finished products and the importaiotn of finished product from abroad to feed home industries, adoption of technological strategies in processing and the use of chemicals do not have nmegative effect on the environment in this region. This finding is inline with that of Ali et al. (2022) who found that industrial growth and time trend are positively and significantly contributing to CO2 emissions in Pakistan. The result also does not support the pollution heaven hypothesis (PHH) theory which argues that industrial production and import from

advanced countries make the developing countries pollution heaven due to trade and comparartive advantage that developing nations enjoy for lower pollution control.

Finally, the coefficient β6, representing energy consumption (EC), is significant at 1% (β6 = -.0000 , $p < 0.000$) in Model 2. This shows that energy consumption is negatively linked with environmental quality, possibly due to increased energy demand in industries and the use of environmentally harmful methods and equipment, contributing to CO2 emissions. This result matches with the outcome of Behera and Dash (2017) and other studies that link power consuming to environmental degradation.

Table 10 : Results of the ARDL Through PMG Estimator.

Dependent variable	C02 (5)	FD (5.a)	FDI (5.b)	SS (5.c)	PS (5.d)	EC (5.e)	EG (5.fS)
LR							
LC02		.0001872	.0013155***	-.000348***	.0040943***	-.000554***	-.0024446***
FD	-46.67184		-.4925784	.4524436 ***	3.432143 ***	.058664***	-1.577264***
FDI	7.958703	-.0078504		-.006862	-.087694 ***	.0020804***	.0342673
EG	-1.945479	-.0255536	.0444237	.1856127***	-.1505726 ***	-.000509	
EC	-.0000985 ***	22.21566***	7.996731	-4.717017	37.6082		-98.79385 ***
PS	.0028523 ***	-.008859	-.626993	.0886243		-.0008963**	.6590787***
SS	-.0012282 ***	-.113058***	.2859884**		-.2486219***	.0012447	.8039773***
ECT	**-.1922391**	.110111	.5629618	.7185549	.1533618	.0198825	.6459081
SR							
LC02		**.0001659**	**-.000844**	**.0001232**	**-.0009223**	**.0002561**	**-.0004489**
FD	-.7468487		-.0204709	-.1412436	-1.608109	-.0254292	.3140889
FDI	-10.41801	-.244042 **		-.0315684	-.0403704	-.01625	.0135262
EG	-9.069138	-.231863***	-.225652	-.2318636 ***	.2621087**	-1.28106	
EC	-833.7212	4.063975	13.26965	.2228665	-3.118133		3.117689
PS	-21.64887	.2015349	.0119626	-.012295		.0184438	.1390516
SS	51.09772	.1463739	-.3625701		-.2671697	.0237833	.7395027***
Hausman Test	P -Value		0.0003				

Source: Author's construct, 2023.

Notes: *, **,** and *represent statistical significance level at 1%, 5%, and 10%, FD, PS, SS, EC, EG, FDI and CO2 represent financial development , Primary sector secondary sector, Energy consumption, Economic growth, Foreign direct investment and carbon dioxide emission respectively.

4.4 Discussion of Results for Objective Three

The study assesses the birectional relation between financial development asnd environmental quality in SSA through Autoregressive Distributed Lag (ARDL. This method maintains constant long-run coefficients across all cross sections while allowing for variation in short-run coefficients between countries. The ARDL estimation technique accommodates idiosyncratic heterogeneity by calculating specific equations for each nation and then averaging the parameteric estimation. Importantly, ARDL estimator is applicable either values integrated at the same order or not, enabling the study to draw conclusions on short- and long-run causality even when cointegration is not previously identified (Ssali et al., 2019).

Table 10 presents PMG cointegration estimation for the 20 SSA countries. The long run multipliers in equation 5 reveal the contraction of CO2 concerning some illustrative variables (PS, SS and EC),except for FD, FDI and EG proved to be statistically insignificant on carbon emission in the long run. This implies that energy usage, primary and secondary sector variables have bidirectional relationship with CO2 in the long run, confirming Isik *et al.* (2018) and Ahmad et al. (2018), which argue that increase in energy consuming motivates environmental distruction. To mitigate CO2 emissions, a focus on improving power efficiency, raising public awareness, and promoting energy-saving practices, such as turning off lights when not in use, checking of primary and secondary sector activities also will be a good strategy to promote environmental quality in SSA.

The ARDL model indicates unidirectional causality from primary sector to carbon emissions in the short run, as well as two way relationship among FDI, economic growth, primary sector (PS), secondary sector (SS), and energy consumption (EC), with no significant relationship between FD and CO2 emissions in the long run. The error

correction terms (ECTs) for carbon dioxide emissions, energy usage, foreign investment, financial growth and secondary sector are notably large, corresponding to 19.2%, 19.8%, 56.3%, 64.5% and 71%respectively. This suggests that these variables adjust fast to changes from their long run equilibrium. Hausman pool ability test shows restriction of homogeneous multipliers for all in long run is unrejectable at 1% significance level, indicating the effectiveness and suitability of the PMG estimator.

Table 11: Summary of outcomes primarily considering causality

Sample nations	Short period causality	Long period causality
SSA	CO2∘FD	CO2∘FD
	CO2∘FDI	CO2 FDI
	CO2∘EC	CO2↔EC
	CO2∘SS	CO2↔SS
	CO2← PS	CO2↔PS
	CO2∘EG	CO2∘EG

Source: Author's construct, 2023

Notes: SSA approach sub-Saharan Africa, FDI, FD, GDP, EC, SS, PS and CO2 To represent various relationships between the variables, specific symbols are used: Foreign direct investment (FDI), financial development (FD), economic growth (EG), electricity consumption (EC), secondary sector (SS), primary sector (PS), and carbon dioxide emissions (CO2) are represented as such. ↔, ←, and ∘ are denotinng a two way causality, one way causality, and null causality, in that order.

The study implemented ARDL method via PMG, with records ranging from 1990 to 2019 for all the variables involved. The variables included in this investigation are carbon emission, power intake, financial improvement, foreign direct funding, economic boom, primary and secondary sectors. From the summarised consequences

in table 11, it's miles clean that financial improvement in the selected nations does not have impact on environmental quality in short and long-run. The causality test suggests that both variables do not affect each other in short run and long period. This end result is contradicting with that of Sekali and Bouzahzah (2019) who observed significant result in the short run and insignificant in the long run in morocco. They concluded that one way causality exist from financial advancement to environmental quality in Morocco for short-run, with time series data from country level.

Nonetheless, there exists a two-way causality relationship within the long-term for several key factors: electricity consumption, the primary sector and the secondary sector. The negative coefficient associated with the EG variable validates the EKC hypotheses for the sampled nations. Specifically, GDP per capita has an initially positive but analytically insufficent influence on carbon dioxide pollution. This implies that carbon dioxide emission per capita tend to rise initially with GDP per capita but eventually stabilizes. Any subsequent add up GDP per nation is likely to reduce per nation carbon dioxide pollution. This results confirms the argument of Environmental Kutznet Curve (EKC) which tests the relationship between financial development, economic growth, energy consumption and environmental degradation and established that as nations become economically advanced, they may experience an invented U-shape eelationship between economic growth and environmental degradation with improvement in environmental quality after a ceratin threshold of economic growth is achieved. This theory is inline with the study's objective, whether thers is bidirectional relationship between financial development and environmental quality in SSA both short and long-run.

Table 12 : ARDL Results on Country Bases

VARIABLES COUNTRIES	FD	SS	PS	EC	ED	FDI
BENIN	**.0015436*** **	**.0001262**	**.0015436** **	**.0047904*** **	**-.0003655**	**.0024674* **
BOSWANA	**-.002475**	**-.0002987**	**.0039714**	**.0000311**	**-.0008921**	**.001428**
BURKINA FASO	**.0020036** **	**.0001479**	**-.000468**	**.0000189*** **	**.0000458**	**.0082115*** **
CAMEROON	**-.0019223** **	**-.0000207**	**-.0027051**	**-.0001494**	**.0018959** **	**-.0000164**
CONGO, DEM. REP.	**.0012321**	**.0001458**	**-.0000885**	**-.0003512**	**.0005433**	**-.0001912**
CONGO REP.	**.0013568**	**.0001738**	**-.0000175**	**-.0003566**	**.0005461**	**-.0001908**
COTE D'IVOIRE	**.0040912**	**.001314**	**.0091812**	**-.0002629**	**.0008154**	**-.0008873*** **

GABON	**-.0012646**	**.000258**	**-.0000114**	**.0000799**	**-.0000691**	**-.0065292**
GHANA	**-.0004717**	**.0003935**	**-.0089741**	**.0000122**	**-.0009809**	**-.0007108**
KENYA	**-.000114**	**-.0004505**	**-.0013597**	**-.0000507**	**-.0015198**	**-.0012739**
MAURITIUS	**-.0000216**	**.0004282**	**-.0009698**	**-.0003278**	**-.0001402**	**-.0005356**
MOZAMBIQUE	**-.0004344****	**.0008288**	**-009110*****	**.0001109****	**-.0008522**	**.0001308**
NIGER	**-0040015*****	**-.0001235**	**.000481**	**.0001692**	**.0004759**	**-.0017884*****
NIGERIA	**.0005869**	**.0003454**	**-.0007626**	**.0003281**	**.000039**	**-.0000953**

SENEGAL	**-.0002572**	**.0003583**	**-.0021155**	**-.0003402**	**-.0014729**	**-.0039283**
SOUTH AFRICA	**.0011156**	**.0005354*** **	**.0024082*** **	**.0002372**	**.0003209**	**.001614**
SUDAN	**.0003569**	**.0012765**	**.0142077**	**.000022**	**-.0053971**	**.0015505**
TANZANIA	**-.0005774**	**-.0002123**	**.0008542** **	**.0004125** **	**.0013072**	**-.0009918**
TOGO	**-.0042552**	**-.0009078*** **	**-.0030079** **	**.0020703*** **	**-.0003598**	**-.0002947**
ZIMBABWE	**.000794**	**-.0004655**	**.0034399**	**.000392**	**-.0022793**	**-.0180361*** **

Source: Author's construction, 2023.
Note: ***, **, and *represent statistical significance level at 1%, 5%, and 10%, respectively; and FD PS SS EC EG and FDI represent financial development , Primary sector secondary sector, Energy consumption, Economic growth and Foreign direct investment repectively.

4.5 Discussion Base on Individual Country Effect

The table 11 contains the various variables specific effect on individual countries. The outcome denotes that financial improvement has impact on five countries, which are Benin, Burkina Faso, Cameroon, Mozambique and Niger and further reveals that FD has undesirable implication on environlmental greatness in Benin, Burkina Faso but has desirable impact on surrounding quality in Cameroon, Mozambique and Niger. Result in Benin and Burkina Faso are in line with that of Baloch *et al.* (2019) they also used pooled mean group estimation (PMG) techniques from 1990–2016 for 59 Belt and Road countries and concluded that FD deteriorates environmental quality, but this contradicts the findings in Cameroon, Mozambique and Niger for the current study.

The secondary sector (SS) activities lead to carbon emission in South African but reduces carbon mission in Togo with no sufficient effect on remaining nations. This result implies that improvement in secondary sector may promote carbon emission in South African but reduce carbon emission in Togo. Primary sector (PS) development also promotes environmental quality in Mozambique and Togo but reduces environmental quality in Tanzania and Benin.

The electric power consuming (EC) has sufficient damaging impact on environmental quality in Benin, Burkina Faso, Mozambique, Tanzania, and Togo. This result backs (Ozcan *et al.* 2018: Khan & Hou ,2021 : Zhang *et a*l., 2021) who established a clear link facing electric power consumption and environmetal degradation. On average, a 1% upwards in electric power consuming leads to a short-term gain in environmental degradation by 0.124% and a long-term increase by 0.255%. In emerging nations, energy consumption emerges as a pivotal factor contributing to environmental degradation. This detrimental effect of electric power consuming on the environment is

evidencial given over 75% of energy mix in these regions is comprised of fossil fuels, which have damaging effect on ecosystem (BP, 2020). However, the results do not exhibit a significant impact on other countries.

Foreign direct investment (FDI) significantly damage ecosystem in Benin and Burkina Faso, promotes environmental quality in Cote D'Ivoire, Niger, and Zimbabwe. This outcome is backed by Salahuddin *et al*. (2017). Their study used ARDL approach and , demonstrated that oversea investment stimulates green gasses.

Economic growth (EG) variable also exhibits damaging impact on environmental quality in Cameroon but has no significant effect on the other countries under consideration. The network facing surrounding damage , economic boom, energy usage, and oversea investment for six selected nations in SAA, reveals that boom of economic contributes to greengass trasnmission in some countries and promoting it in others (Ssali *et al*., 2019). In contrast, Cai *et al.* (2018) employed bootstrapped ARDL with structural break analysis in G7 nations and concluded that economic boom does not result carbon emissions in G7.

4.6 Chapter-Summary

This chapter presents the findings derived from various estimation techniques areemployed for the work. It provides deep evidences and discussion of results obtained through the available alternatives. To assess the stability levels of the observations and gain insights into their relationships, unit root tests (ADF and PP tests), as well as a Cross-Sectional Dependency test, were applied. Additionally, explanatory analyticall and correlation matrices of the observations are established. The results from the dynamic system GMM reveal a positive effect of secondary sector activites onn the studied nations.When employing random effect estimation, it becomes evident that primary sector activities negatively affect environmental quality. The results obtained from ARDL estimation, on the other hand, indicate that monetary boom in the selected nations has no sufficient effect on the quality of environment in both periods. The next section provides brief outcomes, conclusions, offer suggestions, identify areas for further research, and discuss policy implications.

CHAPTER FIVE

SUMMARY, CONCLUSIONS, RECOMMENDATIONS AND POLICY IMPLICATIONS

5.0 Introduction

This section encompasses findings, conclusions, recommendation, areas for further research and policy implications.

5.1 Summary

The study delved into factors driving environmental quality in twenty sub-Saharan African nations, spanning five chapters. First chapter primarily addressed introduction, background of study, the significamt of study, problem statement, objectives, research questions, hypotheses, and the rationale behind conducting this research.

Chapter two conducted a comprehensive review of existing literature relating to financial development and environmental quality, focusing on effect of primary and secondary sectors activities on environmental quality, as well as the trends in monetary increase and ecological activities on selected SSA countries under investigation. The review shed light on the active involvement of developing countries in global environmental issues and highlighted the domestic and cross-border financial and ecological consequences of these developing nations. The chapter also discussed various key factors such as foreign direct investments (FDIs), electric power consuming and economic boom, providing a comparable review of multiple studies on financial development and environmental quality from various geographical and methodological perspectives.

Chapter three detailed the methodologies employed to achieve the study's objectives, including the dynamic two-step system GMM model, fixed and random effect models, and the ARDL model.

Chapter four constituted the core of this thesis, where the specific research objective is thoroughly investigated. To ensure the robustness of objectives, the study utilized the dynamic two-steps system and random effect models. These strategies were employed to examine the positive or negative roles played by primary and secondary sector activities on environmental quality. For objective three, the study employed the ARD model by Chudik & Pesaran (2015). This model, previously used by various scholars, is robust in addressing cross-sectional dependency, heterogeneity, non-stationarity, and endogeneity issues.

5.2 Summary of Findings

The study examined the relationships among variables in twenty selected sub-Saharan African nations using various estimation techniques, including dynamic panel system GMM, random effect and ARDL estimators. The study yielded significant findings that contribute substantially to understanding of the subject matter.

The empirical results from the different techniques applied in this study revealed contrasting and valuable insights compared to previous research, underscoring the dynamic nature of connection facing financial development and carbon dioxide discharges through different countries.

Objective one examined whether primary sector activities influence environmental quality in sub-Saharan Africa, considering other factors. Random effect regression analysis demonstrated statistically significance at 1% level and revealed a negative coefficient for primary sector activities, indicating that primary sector activities have

adverse effect on environmental quality in the sampled sub-Saharan African countries. This suggests that practices such as deforestation, unsustainable farming methods, and illegal mining which are prevalent in these countries contribute to carbon emissions. This finding disagrees with Ali et al. (2022), Senturk et al. (2022) who conducted sectoral effect on environmental quality in Assian countries and established that agricultural growth and globalization reducing CO2 emissions.

Objective two investigated whether secondary sector activities have positive influence on environmental quality on sub-Saharan Africa, considering factors such as oversea investment, power consumption, economic booms and financial development. The result indicates postivtive effct of secondary sector (SS) activities on environmental quality on selected nations. This means that transformation of raw materials into finished goods, do not involves the use of harmful chemicals to the environment. Additionally, the process of manufacturing products in the secondary sector often requires advanced technology and high energy consumption, assumed to contribute to greenhouse gas emissions and environmental distruction but this result shows no harm of these activites on the environmental quality in SSA. Current result disagrees with the work of Baloch *et al.* (2019), who found that an improvement in financial capital leads a decline in environmental quality among nine Belt and Road nations.

Objective three examined the short and long run causal connectivity facing financial development and environmental quality in sub-Saharan African nations, employing ARDL approach. The search incorporated variables such as carbon discharges, electric powe consuming, economic boom, oversea investment primary and secondary sectors. The summarized results on causality indicate that financial development in these countries has no significant implications on environmental quality either in the short or long period. Causality tests revealed that these variables did not influence each other in

either period. These findings contrasted Sekali and Bouzahzah (2019), who identified significant short-term causality from financial growth to environmental quality in Morocco based on country level information.

Furthermore, the coefficients of energy consumption, the primary sector, the secondary sector, and foreign direct investment display a two way causality in long run, and economic growth and CO2 emission exhibited one way causality spanning economic growth to carbon pollution. The negative coefficient of GDP variable supports validity of (EKC) hypotheses for countries in question. These results revealed no causality among the variables in the short except primary sector variable with one way causlality from PS to CCO2, but identified one way and two way causality in the long run.

In brief, random effect estimation indicate that primary sector (PS) activities have a detrimental effect on environmental quality in sampled sub-Saharan African nations. This suggests that activities within the primary sector, such as deforestation, improper farming practices, and illegal mining (Galamsey), which are prevalent in these countries, contribute to carbon emissions. The GMM estimation also reveals that secondary sector (SS) activities have no negative effect on environmental quality in the selected countries. The ARDL causality check indicates that financial improvement in selected countries has no sufficient impact on environmental quality in short and long periods. Furthermore, the ARDL causality test for individual countries highlights that financial development has varying effects. Financial development negatively impacts environmental quality in Benin and Burkina Faso, but has a positive influence in Cameroon, Mozambique, and Niger.

5.3 The Origional Contribution to the Study

The study established a distinguished findings from the existing literature which can be used for decision making within SSA and beyong. The results obtained through random effect estimation indicate that primary sector (PS) activities have detrimental impact on environmental quality in sub-Saharan African nations. Additionally, findings based on system GMM estimation reveal that secondary sector (SS) activities have no negative effect on environmental quality on SSA countries. The output from ARDL causality test indicates that financial development in SSA countries has no sufficient impact on environmental quality in short and long-run.

5.4 Study Limitations

The study sourced data from annual reports encompassing financial, sector-specific, and environmental quality variables from various international locations within sub-Saharan Africa. It is presumed that these annual datasets effectively capture each nation's economic development, primary and secondary sector activities, environmental quality, and other related control variables. Environmental quality, proxied by CO2, economic development measured by home lending to the private sector, primary sector activity indicated by annual agricultural production as a percentage of GDP, secondary sector activities measured by value-addition activities as percentage of GDP, economic bomom indicated by per capita/GDP annual percentage growth, power consuming (in kg oil equivalent per capita), and oversea investment (net inflows as a percentage of GDP) were sourced from Global or World Development Indicators (WDI) database for the selected countries. The World Development Indicators database gives comprehensive, real-time repository of economic and environmental data, widely accepted and utilized in academic and business sectors. It is expected that all countries within the sub-Saharan African region report their annual economic and environmental

data to reputable databases like WDI. Therefore, annual data from the choosen countries in this search accurately reflect their respective annual records.

Nevertheless, this study encountered certain limitations. The primary constraint was the availability of data across sub-Saharan African countries. Data collection relied on country-level information from annual reports, and not all countries within the region possessed the requisite data for the study. Consequently, only countries with up-to-date data were included in the analysis. Furthermore, some initially selected countries faced challenges related to missing data for certain years and specific sectors covered by the study, resulting in their exclusion, which affected the study's sample size. Additionally, the study was restricted to 20 sub-Saharan African countries due to limitations related to data availability, management, time, and financial resources. Consequently, the generalization of the study's outcome to the full region may not be feasible. The cautious approach is taken to restrict the applicability of the results to the countries selected for the study. Nevertheless, these findings may still hold relevance for other developing countries with similar political, cultural, and socio-economic characteristics.

5.5 Conclusion

Empirical research has consistently emphasized the need of finacial improvement as significant factor influencing environmental quality. However, in the context of SSA, discussion regarding relationship facing financial improvement and environmental quality has been limited and contentious. This knowledge gap and the associated controversies served as motivation for investigating the relationship between financial development and carbon emissions, sectoral effccts on environmental quality in SSA. The study focused on examining various objectives, including variables suc as foreign

direct investment, financial improvement, economic booms, energy intake, primary and secondary sector activities.

Study assessed the presence of cross-sectional dependence Pesaran's CD test, PP and ADF panel unit root tests are used to account for cross-sectional dependence which yields beter outcome. These tests indicate stationarity at levels and first differences for several of observations under study. The research employed a combination of methods, including dynamic system GMM, random effect models, and the ARDL approach. Panel causality analysis is utilized to discern causal connections among variables investigated. The ARDL technique, developed by Chudik and Pesaran (2015), helps to calculate short and long-run causality coefficients and provides satisfactory outputs. The ARDL panel causality test unveiled two way causality among energy usage, secondary sector, primary sector and carbon dioxide. A one way causality observed from primary sector to carbon emissions. These findings suggest that both primary and secondary sector activities have influence on environmental quality in sub-Saharan African, demanding a need for stringent measures to check consequences of agricultural and manufacturing activities. In light of these findings, it is vivid that primary and secondary sector activities have negative (positive) effect on environmental quality in SSA. Further investigations show that financial development and environmental quality do not have bidirectional relationship both in short and longrun.

5.6 Recommendations

The recommendations are summarized as follows:

Base on the finding from objective one and two, the study recoments that attention from states in SSA be given to primary and secondary sector activites as these activities have negative (positive) effect on environmental quality in SSA. The SSA governments and stakeholders should pay attention to primary and secondary sector activbities, since

these activbites are dominant in SSA, by checking industries and agricultural activities to prevent the use of environmentally unsustainable chemicals in factories and on lands. Motivaing the use of atmostpheric friendly power, low-sulfur diesel and environmentally sustainable tools be encouraged as preventive measure to mitigate the likelihood of pollution that may emanate from industries and financial support from donnors in future.

5.7 Recommendations for Further Studies

Scope of this study is confined to twenty sub-Saharan countries, and it encompasses a few set of variables. Furthermore, the time frame for this analysis is restricted to a 29-year period. Future research endeavors have the potential to enhance the model by incorporating additional variables and extending the time span. Given the study's focus on SSA, its generalizability may be limited.

Additionally, future research should delve into tertiary (service sector) which the current study could not look at due to insufficient data at the time of the study. This could yield valuable insights into environmental sustainability literature.

5.8 Policy Implications

In light of the study's findings, sub-Saharan African countries should consider strengthening their current economic framework, as economic growth exerts a catalytic influence on all sectors, ultimately contributing to environmental degradation. As a policy recommendation, SSA countries should enact and implement policies that would control and regulate the activities in the primary and secondary sectors, to prevent the use of environmentally unsustainable chemicals in factories and on the earth surface to improve the quality of the environment. In addition, the float of funds to polluting establishments should be prevented and extra environmentally-friendly initiatives be supported.

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