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THE EFFECTS OF FOREIGN DIRECT INVESTMENT ON ENVIRONMENTAL QUALITY IN WEST AFRICA

BY

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DECLARATION

I, Francis Ekow Bediako, hereby declare that with the exception of ideas borrowed from the existing scholarly literature of which has been duly cited, the research presented in this thesis "THE EFFECT OF FOREIGN DIRECT INVESTMENT ON ENVIRONMENTAL QUALITY IN WEST AFRICA" was solely conducted by me under the supervision of my able supervisors Prof. Daniel Kwabena Twerefou and Dr. Emmanuel Codjoe in the Department of Economics, School of Social Sciences, University of Ghana, Legon from August 2019 to October 2020.

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DEDICATION

To the glory of God, this thesis is dedicated to all orphans, widows, the disabled, the barren, the voiceless, prisoners, the rejected and most importantly the unbelief that God's perpetual light shine on them.

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ABSTRACT

Foreign direct investment (FDI) has played a key role in the growth and development of developing economies. However, one prominent opposing question about foreign direct investment is whether it is a blessing or a curse to the natural environment of the host country. While some argue that the positive spillover of FDI especially through green technologies improves the natural environment of the host country, opponents argue that it deteriorates the natural environment through an increase in carbon dioxide emissions level of the host country. Despite the existing theoretical ambiguity on FDI-environmental quality nexus in West Africa, few studies conducted in the area have also not considered all the sixteen West African Countries. Again, these studies did not extend the argument to cover the pollution haven hypothesis to determine whether emission in the sub-region is attributed to domestic industries or pollution-induced multinational companies. This research examined the effect of foreign direct investment (FDI) on environmental quality in West Africa and also test empirically the existence of the pollution haven hypothesis. Using carbon dioxide emission as a proxy for environmental quality, this study employed the random effect model on ten-year panel data from 2005 to 2014 from all the sixteen countries in West Africa. The study revealed that foreign direct investment has a positive and significant impact on the environment which confirms that FDI is detrimental to the natural environment in West Africa Again, the study proved empirically that carbon dioxide emission in West Africa is attributed to the influx of multinationals into the sub-region. Thus, validating the pollution haven hypothesis (PHH). Inasmuch as FDI is encouraged in West Africa, environmental standards in the sub-region should be strengthened to regulate its effect on the natural environment.

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LIST OF ABBREVIATIONS

ARDL	Autoregressive Distributed Lag
BRICS	Brazil, Russia, India, China and South Africa
BITs	Bilateral International Treaties
CAIT	Climate Analysis Indicators Tool
CFCs	Chlorofluorocarbons
CH_4	Methane
CIM	Common Investment Market
CO_2	Carbon Dioxide
EC	European Commission
ECOWAS	Economic Community of West African States
EIF	ECOWAS Investment Forum
EKC	Environmental Kuznets Curve
EPA	European Partnership Agreement/ Environmental Protection Agency
ERP	Economic Recovery Programme
FDI	Foreign Direct Investment
FEM	Fixed Effect Model
FMOLS	Fully Modified Ordinary Least Squares
GDP	Gross Domestic Product

GE	Government Effectiveness
GHGs	Greenhouse Gases
GLS	Generalised Least Square
ILO	International Labour Organisation
INSCR	Integrated Network for Societal Conflic Research
IPCC	Intergovernmental Panel on Climate Change
LUCF	Land Use Change and Forestry
MENA	Middle East and North Africa
MNCs	Multinational Companies
O_3	Ozone
OECD	Organisation for Economic Cooperation and Development
OHADA	Organisation for the Harmonisation of Corporate Law in Africa
PHH	Pollution Haven Hypothesis
REM	Random Effect Model
SNEPCO	Shell Nigeria Exploration and Production Company
TNC	Transnational Corporations
UNCCC	United Nations Conference on Climate Change
UNCTAD	United Nations Conference on Trade and Development

UNEP	United Nations Environmental Programme
UNICEF	United Nations International Children Education Fund
US	United States
WA	West Africa
WAEMU	West Africa Economic Monetary Union
WB	World Bank
WDI	World Development Indicators
WMO	World Meteorological Organisation
WTO	World Trade Organisation
WRI	World Resource Institute

CHAPTER ONE

INTRODUCTION

1.0 Background

The quest to preserve the quality of the environment has become a necessity in the 21st Century. This is due to numerous adverse effects of increased levels of carbon dioxide, the main constituent of greenhouse gases (GHGs) which causes global warming (Danso-Mensah, 2015). Global warming causes temperature rise and results in negative effects of climatic conditions. Though natural occurrence poses a threat to the environment, the alarming rate of environmental challenges arguably stems from human activities (Kula, 1998). Studies show that the destruction of the environment by human activity dates back to ancient times; around 800 B.C, when massive deforestation was recorded in China during terracing for rice farming. But this challenge did not pose greater environmental problems to the people at the time, hence less attention was given to it (Hähnel et al., 2010).

According to Zugravu-Soilita (2017), the activities of multinational companies (MNCs) through foreign direct investment (FDI) predominantly contribute to the increased level of environmental pollution. The study of Mehta (2002) posits that the activities of multinationals in the extractive sector play a key role in the environmental pollution, contributing to increased emissions level of greenhouse gases and other pollutants that causes climate change. Specifically, FDI increases carbon dioxide emissions level of host countries endowed with natural resources but with lax environmental rules and regulations. This put the host country into a mess with numerous health challenges.

Recent increases in greenhouse gases could be attributed to foreign direct investment inflow, specifically in the extractive and manufacturing subsectors where the activities of the multinationals has caused numerous global climate change effects, hence, the need to create awareness on climate change mitigation (Sarkodie, 2018). Spangenberg (2007) opined that greenhouse gases (GHGs) and ozone-depleting gases in the environment which are the sources of climate change problems have increased due to economic development. The study also predicted that GHG emissions could rise from 25% to 90% between the years 2000 and 2030. This will increase global warming leading to the continuous effect of climate change on the environment. The World Bank (2007) noted that carbon dioxide is responsible for 58.8% of GHGs emission that causes global warming. Also, Ciais et al. (2013) revealed that carbon dioxide is a noticeable gas that causes global warming.

In these current environmental challenges, research by Fankhauser and Mcdermott (2014) has suggested that developing countries, especially in Africa are at a high risk of climate change effects as compared to the developed industrial countries. It is observed that though Africa releases the least amount of carbon dioxide, contributing only 3.6% to global emissions, its impact will more be in Africa (Collier et al. 2008). The factsheet presented after the United Nations Climate Change Conference in Nairobi, 2002 reported that Africa is already experiencing a temperature rise of approximately 0.7°C from 1990 to 2000. The report further revealed that this will have various adverse effects on the continent like a reduction in food production, floods, drought, and loss of biodiversity.

In consonance to the above is the Third Assessment Report of the World Meteorological Organisation, United Nations Environmental Protection (WMO/UNEP) and the Intergovernmental Panel on Climate Change (IPCC) in 2001 which reported that an increase in drought seems to have already deepened in West Africa (Sokolov et al. 2009). The West African region has suffered a reduction in the total availability of water due to climate change variations. Accordingly, Stern (2008) revealed that the concomitant effect of global warming as a result of increased greenhouse gases has caused the major rivers in West Africa such as the Senegal River basin, Niger River basin and Volta River basin reduced by 40–60 percent between 1990 and 2014.

West Africa Greenhouse Gas emission represents 2.03% of global emissions. Whilst the global average GHG emissions increased by 45% between 1990 and 2014, that of West Africa increased by 17% (World Resource Institute, 2015). According to Olivier and Peters (2019), global average GHG emissions in 2018 stood at 56.6 gigationnes of CO_2 equivvalent (56.6GtCO_2eq) and this is expected to increase or decrease by 1% in 2019 with Africans being the most vulnerable group to the effects of climate change. The World Bank (2013) noted that average measures of carbon dioxide from the year 1965 to 2009 by the ECOWAS sub-region follow that Nigeria recorded 0.6 as the leading emitter in West Africa followed by Cote d'Ivoire 0.48. Liberia and Senegal recorded 0.46 and 0.42 respectively. Sierra Leone had 0.33 whilst Ghana had 0.29 with Togo contributing 0.21. Benin and Gambia each recorded 0.19. Niger, Burkina Faso, and Mali contributed 0.09, 0.06, and 0.05 respectively. Despite the relatively low emissions rate in the sub-region, West Africa has not been spared of climate challenges. However, existing literature on environmental quality such as Demena & Afesorgbor (2020) has revealed that West Africa's CO_2 emission could be attributed to the influx of multinationals that invest in the sub-region.

There has been a steady movement of multinationals into West Africa since the emergence of the economic recovery of the sub-region in the 1980s. Consequently, the improved governance stability among serene business climate in West Africa in the 1990s has resulted in an increased flow of foreign direct investment into the sub-region (Gangi & Abdulrazak, 2012). In line with this, UNCTAD (2020) statistics show that the FDI-inflow to West Africa as December 2019 was US$10870.43million. According to Maza (2012), foreign direct investment is recognized as one of the basic tools for economic development, reducing the development gaps among nations. This has necessitated that developing regions like West Africa map up strategies to attract more investors. In line with this understanding, the West African state has adopted the Reformation of International Investment Agreements (IIAs) in the 21st Century and also reviewed their treaties to suit the Reform package of UNCTAD since 2012 to achieve sustainable development (UNCTAD, 2019).

It is also noted that for many decades West African countries have not saved enough, making private foreign capital the main source of capital for investment (Kamara, 2013). Foreign direct investment inflow to West Africa has increased consistently recording US$13,373million between 2010 and 2020(UNCTAD, 2020). Foreign direct investment has numerous positive effects on the host country; providing direct capital financing, job creation, and positive externalities like managerial skills and technology transfer (Lee, 2013). Though West Africa attracts only five percent (5%) of global FDI inflow (World Bank, 2017), capital realization from FDI inflow have improved since 2004 and the resultant effects have positively affected West Africa (Fauzel et al., 2016).

Despite the positive effects of FDI inflows, mostly by multinational companies who are found in almost every sector of the economy including the extractive, transport, manufacturing, agriculture, etc. the activities of these enterprises emit various greenhouse and ozone-depleting gases like carbon dioxide, sulfur dioxide, chlorofluorocarbons (CFCs), etc, which are the source of global warming in West Africa (Brown, 2014). In line with this, Fauzel et al. (2016) reiterated that human and industrial activities of multinationals have significantly given rise to CO_2 emissions in the past century. Increased global warming causes a rise in temperature above the normal level which results in climate change effects. Though there is an inconclusive view on environmental effect of FDI, it is empirically proven that FDI significantly affects carbon dioxide emissions (Jayanthakumaran et al., 2012) and as such, the intensity of CO_2 emission captured in the activities of extractive and manufacturing sectors FDI cannot be overlooked.

In analyzing the FDI-environmental quality relationship, Elliott & Shimamoto (2008) have revealed that to increase FDI inflows in developing countries, such countries have to leverage their stringent environmental regulations. This makes them havens of pollution from multinational companies (MNCs). While some schools of thought argue that the environment will only experience betterment when a country develops through opening up of the economy (Antweiler et al., 2001), others posits that the increase in production and other economic activities generates a larger quantity of waste products that deteriorates our environment (Meadows et al., 1972).

The quest of West Africa to catch up with the developed world through industrialization is in part the reason for the sub region's increasing greenhouse gas emission specifically carbon dioxide

(Ameyaw & Yao, 2018). This agendum taken as a lighter issue by West Africa has heinous effects on our environment, threatening its future sustainability. Policies, regulations, and actions to protect the environment should be treated with urgency as the economy thrives through financial development (FDI inflow).

1.1 Problem Statement

Investment plays a vital role in the development of every economy. According to Kowalewski and Weresa (2008), developing nations need new sources of capital inflow to stimulate the growth they seek to achieve. This places importance on foreign direct investment (FDI) as a major determinant of economic growth and sustainability(World Bank, 2017). Maza (2012) noted that foreign direct investment is recognized as one of the basic tools for economic development, reducing the development gaps among nations. However, the activities of multinational companies especially in the extractive and manufacturing sectors degrade the quality of the natural environment by increasing carbon dioxide emissions of the host country (Dumrul & Kilicarslan, 2017).

There has been an increasing trend in both global and Africa FDI inflow. According to the United Nations Conference on Trade and Development (UNCTAD, 2020), the average global FDI inflow between 1970 and 2019 is US$643, 999 million. Out of this, Africa's average share of the global FDI between 1970 and 2019 is US$18, 081.01million representing 2.81% of the global share.

The first FDI inflow to West Africa recorded in 1970 was US$385.26million. In the 1970s, the sub-region had political and economic instability, full of diseases and natural disasters, hence,

unattractive for multinationals to invest in (UNCTAD, 1999). This made West Africa lose FDI inflow by USS$ 434.38million in 1980. Various positive adjustment in economic and business climate made the sub-region attractive to multinationals again in the 1980s (Kimani, 2009). In the year 1990, West Africa recorded an FDI inflow of US$1,553.428million. The shift from an autocratic military regime to a democratic election by most West African countries also had a positive impact on the business environment in the 1990s (UNCTAD, 1999). FDI inflow increased to US$2,131.062million in 2000 and US$12,024.28million in 2010 respectively. In the year 2019, West Africa's FDI stood at US$10870.43million. The remarkable improvement in FDI inflow could be attributed to an understanding of economic liberalization which in turn led to a greater trade openness (Zaman et al., 2018).

West Africa is endowed with extractive resources and this has attracted multinationals into the sub-region. According to Ning & Wang (2017) and Ndeffo et al. (2018), the impact of FDI on the host economy is found to be inconclusive. That is FDI positively affect the host country and at the same time also harms it.

On one hand, foreign direct investment has numerous positive effects on the host country; providing direct capital financing, job creation, and positive externalities like managerial skills and technology transfer (Lee, 2013). Again, literature has posited that multinational companies from developed countries adopt environmentally friendly practices and thus, improves the natural environment through a reduction in carbon dioxide emissions (Pazienza, 2015).

However, studies like Danso-Mensah (2015), Dumrul & Kılıçarslan (2017), Twerefou et al. (2017) and Abokyi et al. (2019) have shown that FDI also leaves the host country in a mess through increased carbon dioxide emissions. This has increased global warming leading to climate change challenges. West Africa is agriculture-dominated of which most farmers depend on the weather for agricultural activities. The variations in climate and its negative effects on agriculture have reduced crop production in the sub-region. UNICEF (2014) noted that rising temperatures increase the spread of malaria to unaffected areas and this affects those in developing countries the most. Again, towns and cities near extractive multinational industries suffer from air pollution.

The influx of FDI in the sub-region is a blessing should the operations of the multinational industries be environmentally friendly, but when the activities of the multinationals increase the emission level of the extractive industry then the Pollution Haven Hypothesis(PHH) exists in the sub-region. The existence of the PHH in West Africa is found to be inconclusive (Gill et al., 2018).

While scholars like Assamoi et al. (2020) and Riti et al. (2016) found the existence of PHH in Cote d'Ivoire and Nigeria respectively stating that the multinational industries pollute the natural environment, Twerefou et al. (2015) rejected the PHH.

Though some recent works on FDI-environment nexus have used updated data and also extended the relationship to analyze the existence of PHH empirically, most of them are either at the global level (Cai et al. 2018;Yoon & Heshmati 2017) or at the sub-regional level (Gharnit et al. 2020). This is very little on the topic in the case of West Africa. One study that focused on West Africa is Awodumi (2020). However the study focused on eight out of the sixteen West African countries and did not test for the existence of the pollution haven hypothesis. This study adds to the literature

by taking into consideration all the sixteen countries in West Africa as well as testing comprehensively for the pollution haven hypothesis (PHH).

The study uses carbon dioxide as a proxy for environmental quality because of its significant contribution to global warming which causes climate change.

1.2 Research Questions

1. What is the effect of FDI on environmental quality proxied by CO_2 emissions?
2. Is the Pollution Haven Hypothesis valid for West Africa?

1.3 Research Objectives

The main objective of the study is to investigate the effects of FDI on environmental quality in West Africa.

Specifically, this research seeks to: -

- Investigate the effect of FDI on carbon dioxide emissions in West Africa.
- Examine the validity of the pollution haven hypothesis in West Africa.
- Provide recommendations that will lead to the attraction of FDI while reducing carbon dioxide emissions.

1.4 Significance of the Study

The burgeoning interest in literature on FDI-environmental quality nexus stems from two opposing sides. While some scholars consider the key positive role played by FDI in economic development (Atici, 2009; Ayu, 2014) others like Shahbaz et al. (2015) opined that FDI leads to environmental

quality challenges such as the emissions of carbon dioxide that causes climate change. Understanding the implications of FDI inflow to West Africa will help in three ways:

First, according to Azomanhou et al. (2006), FDI increases carbon dioxide that forms the greatest constituent of GHGs that causes global warming with its health implications. On the other hand, FDI improves the natural environment when multinational companies adopt environmentally friendly technologies during production. Understanding FDI-environmental quality nexus by policymakers and stakeholders will give more insight into assessing the potential impact of FDI (both positive and negative environmental effects) on the economy to guide FDI-inflow policies.

Secondly, the study will contribute to the attainment of the Sustainable Development Goal 13, which aims at taking urgent action to curb climate change and its impacts. According to Rafaj et al. (2018), recent environmental policies in West Africa are weak to preserve the quality of the environment and that global carbon dioxide emissions will increase by 0.4% annually from the year 2020. Their study suggested that this increase in environmental pollution will results in 40% more premature death than the current rate. In consonance with this, the study will inform governments, experts and policymakers about the need to tighten the current environmental policies with effective supervision to preserve the quality of the environment, promote sustainable growth development and save human lives. This will also help in achieving the Sustainable Development Goal 3which indicate that people at all levels enjoy healthy life and general well-being.

Examining the Effects of FDI on environmental quality will also inform the general public on the need to reduce carbon dioxide emissions.

Again the findings from the PHH will enlighten the government to better monitor the activities of multinationals in West Africa, especially those in the extractive and the manufacturing subsectors to comply with environmental standards.

1.5 Organization of the study

The study is organized into five major chapters. This chapter focuses on the introduction of the study. It covers the general background of the study, the problem statement, the research questions, the objectives of the study, and finally the significance of the study. The second chapter is subdivided into three major sections, the overview of FDI inflow, an overview of Greenhouse gases, and the overview of climate change effects on West Africa. Chapter three will cover both theoretical and empirical review. The theoretical review will consider the various environmental theories that underpin the hypothesis employed. The empirical review will examine the existing literature about the study. Thus, the study will discuss previous papers on FDI-inflow, CO_2 emissions as well as the impact of FDI-inflow on environmental quality (CO_2 emission).

The fourth chapter will take into consideration the methodology that underpins the study. This consists of the description of the data used and also the data analysis method. This will also outline any assumptions held in the course of the analysis. The chapter five will then present the findings of the study. In the nutshell, the chapter five will empirically contribute to the inconclusive result of the effects of FDI on environmental quality in West Africa. Chapter six will outline the summary of the study, findings, limitations, and also make recommendations based on the empirical results.

CHAPTER TWO

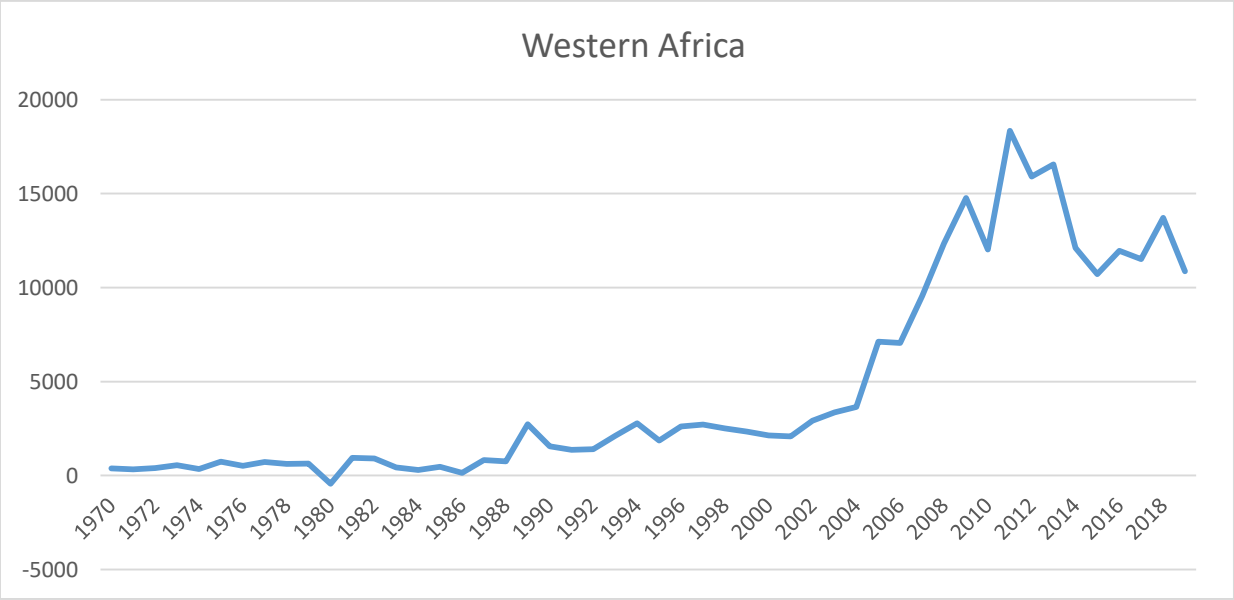
OVERVIEW OF FDI AND ENVIRONMENTAL QUALITY IN WEST AFRICA.

2.0 Introduction

The FDI-environment relationship is a topic that has received attention in the literature since the 1990s. Thus, it is prudent to highlight the FDI trends ,overview of greenhouse gas and climate change in West Africa that determines the quality of the environment. Chapter two comprises three subtopics, Trends in FDI inflows to West Africa and overview of greenhouse gas emissions in West Africa as well as an overview of climate change in West Africa.

2.1 FDI Trends in West Africa

Figure 2.1. Trends in FDI Inflows to West Africa from 1970 to 2019 (US$million)



Source: Author's computation using data from UNCTADstat 2020 dataset.

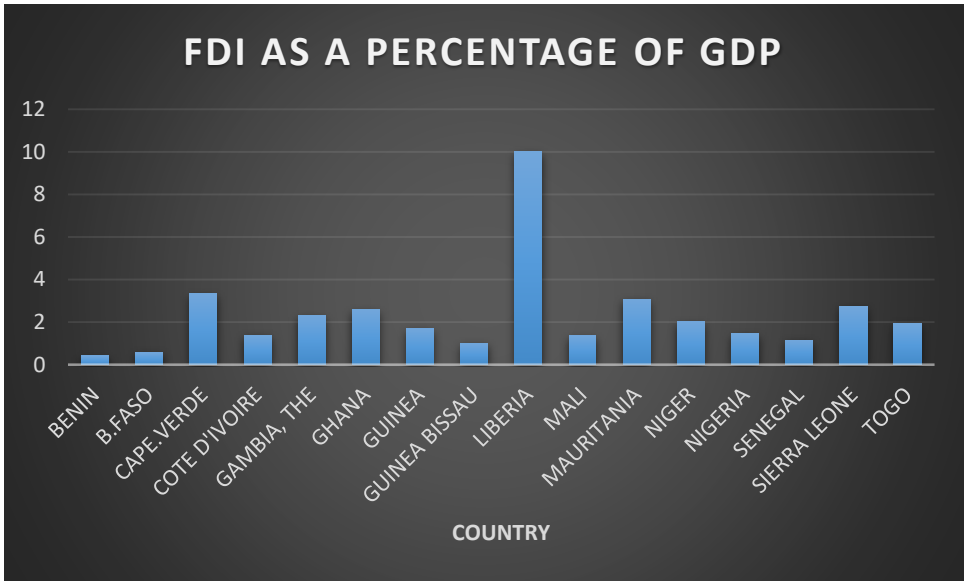
Foreign direct investment in West Africa has played a major role in the development of West Africa since its inception in 1970 (UNCTAD, 2020). Foreign direct investment inflow improved during the 1980s when most of the countries embarked on structural adjustment programme to stabilize their economies. This positive economic plan sought that the average FDI-inflow realized between 1970 and 1980 increase from US$433.2825million to US$903.9251 between 1980 and 1990. FDI-inflows further improved in the 1990s becoming one of the major sources of finance to close the development gap between West Africa and the developed world (Kamara, 2013).

Consequently, the improved governance stability and business climate in West Africa in the 1990s resulted in further improvements in the flow of foreign direct investment into the sub-region (Gangi & Abdulrazak, 2012). According to data from UNCTAD (2020), the average FDI inflow into the sub-region between 1990 and 2000 was US$2126.991million. West Africa's average investment inflow between 1990 and 2000 is US$2126.991million but this value tripled to US$6498.796million between 2000 and 2010 as a result of investment strategies mapped up by West African countries in the early 2000s through the adoption of the Reformation of International Investment Agreements (IIAs). Though the sub region's trend of FDI inflow in the 2000s was affected by the global economic crisis in 2007-2008, it was a short-lived shock. The sub-region regained its investment trend and recorded a peak value of US$18341.17million in 2011. West African countries adopted the UNCTAD reform package in 2012 to attract more investment and also to strengthen the sustainable development agenda (UNCTAD, 2019). FDI inflows into West Africa as of December 2019 was US$10870.43million.

There is a school of thought that FDI inflow to West Africa is triggered by the sub-region's numerous natural resources. This in part, explains the reason why West African countries endowed with many natural resources have high FDI inflow than those with few natural resources. By this, Anyanwu et al. (2015) disaggregated FDI inflow to West Africa based on specific characteristics. First, FDI inflow to the sub-region is based on country dissimilarities. That is countries endowed with natural resources are known to receive a high amount of FDI inflow against countries with less natural resources. Nigeria, Ghana, Cote d'Ivoire, Liberia, and Mauritania were the top five recipient countries from 1970 to 2014. Nigeria recorded 57.5% of the total inflow to West Africa followed by Ghana, 12.4% and Cote d'Ivoire, 4.8% because of the natural resources like oil production in these countries which attracted multinational corporations (MNCs) from the United Kingdom (Royal Dutch Shell) and the United States (Exxon Mobil), China (China National Offshore Oil Company and China National Petroleum Corporation) and others from India and Thailand from the year 2003 to 2007. Again, gold, diamond and manganese in these countries attracted Anglogold, Golden Star, Newmont and other multinationals into the aforementioned countries. The production of metal and fossil fuel by Liberia and Mauritania enabled them to receive 4.7% and 3.4% of FDI respectively.

A study by Anyanwu & Yameogo (2014) provided information on FDI as a share of gross domestic product. Their study revealed that Liberia's FDI inflows form 20% of its GDP share while countries like Burkina Faso and Guinea-Bissau has less than 1% share of their GDP coming from FDI inflow.

Figure 2.2: West Africa: FDI inflows as a share of GDP by country, 1970–2019



Source: Author's computation using WDI dataset.

From Figure 2.2, Liberia's average FDI inflow forms 10% of the country's gross domestic product followed by Cape Verde and Mauritania generating around 3.5% of its GDP from FDI inflow. Ghana, The Gambia, Niger and Sierra Leone recorded between 2% and 3% of their GDP from FDI-inflow. It could be seen that countries like Senegal, Togo, Guinea, Guinea Bissau, Mali, Nigeria, Cote d'Ivoire and Senegal have their FDI inflow as a percentage of GDP between 1% and 2%. Benin and Burkina Faso had less than 1% of their GPD coming from FDI inflow.

The trends in foreign direct investment (FDI) to West Africa could also be classified based on the number of projects inflow. According to Ernst and Young (2013), Nigeria, Ghana and Cote d'Ivoire's experienced new FDI projects growth of 24.2%, 50.8% and 43.1% respectively between 2007 and 2012. Burkina Faso's new FDI projects growth between 2007 and 2011 was 41.4% whilst Benin recorded 100% increase in new FDI projects from 2011 to 2012(Ernst & Young, 2013). It

is believed that despite the important role that FDI plays in the West African economy, it also impedes sustainable development due to its negative impact on the natural environment.

Though trends in FDI inflow in West Africa is encouraging as it spread across various sectors, it is worth noting that its implications on the environment in the sub-sector is worrisome. This mostly emanate from the extractive sectors like the gas flares in the oil industry, land degradation and air pollution in the mining sector so as depletion of the forests. Baumuller et al. (2011) stated that the implication of gas flares in West Africa's extractive industry harms the natural environment. The study noted that the implication of the burning of waste gas (gas flare) in Nigeria is increased from 27.09billion cubic metres in 1995 to 27.19billion cubic metres in 2000. Though measures are put in place to curb such a challenge, Nigeria's gas flare implication stood at 15.18billion cubic metres. Ghana and Cote d'Ivoire have not experienced many challenges from their oil industry, however, the two recorded 0.02 and 0.09 in 2010 respectively.

According to Okafor-Yarwood (2018), the industrial machinery failure of Shell Nigeria Exploration and Production Company(SNEPCO) in 2011 at the Bonga Oil Field had negative implications on about 168,000 people from 350 communities around the Niger Delta.

Mensah et al. (2015) indicated that multinationals in mining communities in West Africa contribute immensely to the sub-regions high level of air pollution, water pollution and increased erosions.

2.2 Greenhouse Gas (GHG) Emissions and Climate Change in West Africa

This section presents an overview of greenhouse gas emissions in West Africa and how this has induced climate change effects on the biodiversity of the sub-region.

2.2.1 Overview of Greenhouse Gas Emissions in West Africa

Greenhouse Gases comprise any atmospheric gaseous compound that has the ability to absorb the earth's net heat energy (infrared radiation) aiding in the holding of heat in the atmosphere. This occurs through a process known as the greenhouse effects. Some examples of gaseous compounds that cause greenhouse effects are Carbon dioxide ($CO_{2)}$, methane (CH_4), nitrous oxide, and ozone (O_3). An Increase in CO_2, chlorofluorocarbons (CFCs), and other pollutants in the atmosphere results in a gradual increase in the earth's surface temperature, known as global warming. Though greenhouse gas emission in West Africa compared to the developed world is less, the sub-region is obliged to keep emissions below the global standards after signing various environmental treaties like the Paris agreement, Kyoto Protocol, Montreal Protocol etc. Countries in West Africa emit only 2.03% of global emissions. Out of this, Nigeria contributes about 50% of the region's greenhouse gases. From 1990 to 2014, West Africa's GHG emission increased at a decreasing rate. West Africa's greenhouse gas emission mainly comes from land-use change and forestry (LUCF), energy, and agriculture according to world resource institute climate analysis indicators tool (USAID, 2017).

Table 2.1: Greenhouse Gas emissions in the West African sub-region: 2014

Country	Total GHG Emissions ($MtCO_2e$)[1]	Percent of Global Emissions[2]	Population	tCO_2e per capita	GDP (Million US$)[3]	tCO_2e/ million US$ GDP	Change in GHG emissions (1990–2014) ($MtCO_2e$)
Benin	23.54	0.05%	10,286,712	2.29	8,576	2,745	3.32 (+16%)
Burkina Faso	32.60	0.07%	17,585,977	1.85	10,908	2,989	10.13 (+45%)
Cameroon	196.56	0.40%	22,239,904	8.84	28,770	6,832	8.11 (+4%)
Cape Verde	0.48	0.001%	526,437	0.91	1,774	271	0.67 (+357%)
Chad	52.67	0.11%	13,569,438	3.88	13,123	4,014	27.67 (+111%)
Cote d'Ivoire	39.21	0.08%	22,531,350	1.74	31,204	1,257	21.53 (+122%)
Equatorial Guinea	25.94	0.05%	1,129,424	22.97	17,903	1,449	20.45 (+373%)
Gabon	-86.90[4]	-0.18%	1,875,713	-46.33	17,835	-4,873	-94.01 (-1322%)
Gambia	7.44	0.02%	1,917,852	3.88	1,020	7,298	4.01 (+117%)
Ghana	38.57	0.08%	26,962,563	1.43	44,752	862	5.45 (+16%)
Guinea	30.18	0.06%	11,805,509	2.56	5,254	5,744	8.60 (+40%)
Guinea-Bissau	3.50	0.01%	1,725,744	2.03	939	3,723	0.74 (+27%)
Liberia	3.51	0.01%	4,390,737	0.80	1,654	2,122	-12.72 (-78%)
Mali	38.70	0.08%	16,962,846	2.28	11,972	3,233	15.36 (+66%)
Mauritania	9.68	0.02%	4,063,920	2.38	5,389	1,797	2.33 (+32%)
Niger	29.52	0.06%	19,148,219	1.54	7,372	4,004	11.65 (+65%)
Nigeria	492.44	1.01%	176,460,502	2.79	452,285	1,089	98.22 (+25%)
Sao Tome & Principe	0.19	0.00%	191,266	1.00	237	804	0.10 (+102%)
Senegal	30.45	0.06%	14,546,111	2.09	14,838	2,052	9.20 (+43%)
Sierra Leone	12.85	0.03%	7,079,162	1.81	3,987	3,222	3.14 (+32%)
Togo	13.57	0.03%	7,228,915	1.88	3,840	3,534	3.31 (+32%)
Regional Total	**994.70**	**2.03%**	**382,228,301**	**1.08**	**683,629**	**2,579**	**147.24 (+17%)**
World	**48,892.37**	**100%**	**7,268,986,176**	**6.73**	**73,478,536**	**665**	**15,068.90 (+45%)**

Source: World Resources Institute Climate Analysis Indicators Tool (WRI CAIT 2.0, 2017).

From table 2.1, it is realized that as of 2014, West Africa contributes only 2.03% of global greenhouse gas emissions. Out of this, Nigeria contributes 1.01%. Ghana, Cote d'Ivoire, and Mali contribute 0.08 respectively while Burkina Faso contributes 0.07%. This is followed by Guinea, Niger, and Senegal who also contribute 0.06%. Whilst Benin contributes 0.04% of the sub-region's greenhouse gas emission, Togo and Sierra Leone contribute 0.03% respectively. The Gambia and Mauritania contributed 0.02% followed by Guinea Bissau and Liberia with 0.01%. Cape Verde contributed only 0.001% of the total greenhouse gas emission in West Africa.

2.2.2 Climate Change in West Africa.

Adedeji et al. (2014) defined climate change as the variations in the current state of the climate on spatial scales above the ordinary individual weather events. This occurs from the changes in the natural environment or due to human-driven external forces. Shove (2010) suggested a rapid change in the climate, adding that this will hurt people and the ecosystem. In the West African sub-region, Sarr (2012) noted that temperature variations have already affected many countries. An example is the 26000 homeless Burkinabes and 350 dead Nigerians during the 2007 and 2012 flood in the two countries respectively.

West Africa keeps on being warm; increased global warming is causing a rise in temperature variations with its concomitant effects. The Gulf of Guinea (Atlantic Ocean) is increasingly becoming acidic(Adejimi Osinowo, 2015). The effect is predicted to be more intense should the rate of greenhouse gas emission not be curbed. Though West Africa emits less compared to the western world, it is prone to the looming threat of climatic variations.

Adiku et al. (2015) observed that while the European climatic challenge is rested on high precipitation, West Africa experiences high temperatures. The high temperatures spread malaria(UNICEF, 2014), rising sea level causes flooding that render people homeless, and unfavourable weather reducing agriculture returns (Nubuor, 2017).

Sarr (2012) noted these specific examples in West Africa's extreme climate change effects; in the year 2005, the capital of Senegal, Dakar, flooded leading to the displacement of people from their homes and the city's N1 highway. This was as a result of heavy rain record of 376millimitres from 16th of August to 22nd of August, Burkina Faso has recorded the worst-case flood in the sub-region for more than four (4) decades. The nation's 2007 disaster killed 33 persons whilst rendering 26,000 homeless. Burkina Faso also suffered 55 dams run over with negative externality in the year 2008 - killing 23 with 14,000 displacements in Northern Togo. The high plateau region in the Central part of Togo swept away more than 30,000 houses, rendering over 10,000 homeless among other loss amounting to an estimate of FCFA 9.4billion. The 1st and 2nd September 2009 showers of rains in Ouagadougou was a catastrophic one. The total rainfall in the two days peaked 130% above the extreme rainfall measure. Aside from the many destructions, this unusual rainfall also killed eight persons and destroyed 9,300 hectares of crops. According to the paper, the National Emergency Management Agency in Nigeria recorded 7.7million victims, 2.1million homeless, and more than 350 dead between the 1st July and 31st October flood in 2012 in the West Africa country.

Considering urban planning & climate change in Ghana, Amoateng (2009) argued that the northern and southern parts of Ghana experience annual drought and flood respectively because of intense climate change. An expectation of 41^{o}C rise in temperature for the northern part of Ghana is

associated with a national temperature rise range of 1.7^{o}C to 2.04^{o}C by 2030. Ghana's Environmental Protection Agency (EPA) has reported that the expected 3cm rise in sea level and other climate challenges in Ghana is strongly attributed to GHG emissions (EPA, 2011).

N'Zué, (2018) used time-series data from 1960 to 2016 to conclude that the effects on agriculture from 1960 to 2016 is due to temperature rise. Again, the paper asserted that high temperature in Cote d'Ivoire at the time was responsible for the nation's poor economic performance.

2.3 Chapter Conclusion

The chapter has noted that there has been a positive trend of FDI in West Africa since 1970. This has contributed a lot to the sub region's development. However, the activities of multinationals in West Africa, especially the extractive industries harm the natural environment through GHGs emissions that bring forth climate change. This harms West Africa's natural environment and thus, such activities need to be monitored to curb emissions to the minimal level.

CHAPTER THREE

LITERATURE REVIEW

3.0 Introduction

With most developing countries partaking in the global value chain and production in recent times, multinational companies have expanded their activities by setting up production branches in low and middle-income countries. These developing countries have also taken a keen interest in the relationship between financial development in the form of capital flow and the environment to suit sustainable development.

Chapter three focuses on both the theoretical and empirical literature of FDI-environmental quality relationships. This comprises three of the basic hypotheses that link environmental quality with financial development, namely the Pollution Haven Hypothesis, the Pollution Halo Effects, and the Porter Hypothesis. Furthermore, the study also reviews various empirical works in the literature surrounding the FDI-environmental quality relationship and lastly reviews the effects of governance on environmental quality.

3.1 Theoretical Literature

There exist many hypotheses surrounding the FDI-environment nexus. The study reviews the pollution haven hypothesis and the other two, pollution halo effect, and the porter hypothesis.

3.1.1 Pollution Haven Hypothesis

The sway from stringent environmental regulations in the developed countries cut down the cost of implementing environmental rules and regulations. To maintain the level of productivity and minimize the associated cost in maintaining high environmental standards, foreign enterprises in developed countries cause shirk in their responsibilities by transferring pollution firms into the developing countries with less stern environmental rules and regulations. The industries in the developing countries operating under low environmental control standards, in absorbing the transnational corporations significantly put the host country in danger of environmental pollution. This underlines the proposed principle "The Classical Pollution Haven Hypothesis"(Chichilnisky, 1994; Copeland et al. 1994). In Copeland and Taylor (1994) research on national income, international trade and environmental quality linkages, they proposed a static model of North-South trade to conclude that income ascertained from trading internationally can affect environmental pollution in diverse ways from income generated through economic growth. The research revealed that free trade increases global pollution.

The PHH assumes that pollution is an imported good from developed countries to less developed countries. In part, this is attributed to the differences in environmental policies and regulations among countries. Gaps in the environmental standard and policies of developing countries lead to the influx of foreign multinational corporations from the highly industrialized nations into the less developed domestic economy.

Similar to earlier scholarly articles related to the FDI-environment argument, it is observed that the environmental impact of FDI-inflow is possible because of trade. Antweiler et al. (2001)

comprehensively wrote about the impact of trade on the environment. In their study, the environmental effects of trade inflow are segregated into three basic forms depending on the interactive role of other factors that come to play. The study by Moradi et al. (2014) and Brown (2014) argued that FDI inflow is possible with trade openness and thus, related the effect of FDI on environment on three propositions; the scale effects, the technique effects and the composition (Structural) effect.

The scale effect measures the economic activity within the confinement of one's country. This is mostly measured by per capita GDP(Brown, 2014; Moradi et al., 2014) or GDP per kilometer square (Appiah-Konadu, 2013). Secondly, the technique effect measures the rate at which emission reduces as income increases (regulatory standards). Again, the theory postulate that changes in the industrial structure of a country also affects its emission level. As manufacturing value-added in a country increases, emission increases. Likewise, when an industry is pollution-intensive (capital per labour ratio increases), emission increases. The composition effect refers to the changes in the pattern of the production activity as a result of the adoption of policies and procedures that change the industrial structure.

According to Cherniwchan et al. (2013) the theory of the Pollution Haven Hypothesis highly depend on environmental policies and regulations and thus, classified it into two main sections; first, the degree to which environmental regulation and policy affect host country's ability to compete both domestically and abroad and secondly the extent to which cross-country dissimilarities in environmental regulation and policy might result in industrial flight. The PHH posits that strict environmental policy in developed countries leads to the movement of whole or part of industries that find it difficult to cope with these standards to developing countries with less

stringent environmental standards. The environmental policies in the host country sensitize the MNCs initially as they invest in the host country. This makes them environmentally conscious in the early stages of their production existence in the host country. They adhere to environmental rules and regulations thereby operating with caution. As time goes on, these companies realize the loopholes in the host country's environmental regulations and capitalize to exploit the welfare of its citizens in polluting the environment. Seeking for large sales and supernormal profit to beat competition and also grow the business becomes the main motive at the expense of the environment.

The pollution haven hypothesis simply states that increased level of carbon dioxide emissions in developing countries with low environmental regulations is a function of extractive and industrial sector foreign direct investment share which constitute 70% of the total share in the case of West Africa (William, 2017).

Pollution Halo Effect

Multinational companies from developed countries that set branches in the host developing country are faced with stringent environmental policies. This induces the MNCs with sophisticated production equipment, advanced technology, and efficient management skills to adopt high standard environmental policies in the host country. Thus, the influx of MNCs in developing countries has a positive impact on its environment aside from the other basic contributions like the expansion of the developing country's industry, creation of jobs for its citizens, and diversification of the consumer products in the host country.

The MNCs after investing in the less developed country contribute immensely to curbing the host country's environmental challenges. This manifests through the diffusion of updated knowledge on economic activities, positive technological impacts from technology spillover and sponsorship through the transfer of funds. They inculcate into the production activities of the enterprises in the host country efficient use of resources and therefore improves the host country's environmental protection technology.

This theory was first postulated by Leonard and Duerkson (1980) when they researched on trade liberalization and financial development linkages. They argued that MNCs that pollute a lot choose to relocate to other industrial countries other than developing countries. They buttressed the point of asserting that for MNCs to relocate to other countries, the cost incurred on environmental pollution policies is not the focal point under consideration. They rather pinpointed crucial factors like the ease to have access to labour training, good governance through the stabilized political institution, and high infrastructural base.

Again, FDI is a key instrument in diffusing environmentally friendly technology into the host country. The host country enjoys this from transnational corporations (MNCs). Taking into consideration the direct effect, there is the incorporation of global most updated technologies from the transnationals into the developing countries where they invest. The latest environmentally-friendly technologies rich in improving environmental efficiency are innovations from the developed country's transnational corporations who also man it. The subsidiary local branch of MNCs adopts this environmental efficiency technology into its operations that help to reduce the environmental accidents and risks in the host country.

Transnational relationships also help policymakers in developing countries to strengthen their environmental regulations as they embrace policy innovations from foreign industries. This indirectly sensitizes the domestic community to undertake more environment-quality actions. Policies are taken by various Environmental Protection Agencies in host countries to nullify specific environmental challenges; emission standards for CO_2 to address anthropogenically-forced climate change problems or sulphur dioxide to deal with terrestrial acidification difficulties. Diversification in energy usage to reduce CO_2 emissions is also suggested.

The theory of the pollution halo effects has been considered as a positive side of the pollution haven hypothesis. Yu (2019) re-examined the pollution halo effect to conclude that the theory is dependent on the technological strength of the multinational companies to diffuse such modern technologies into the host country. Again, the theory considers the threshold effect of emissions to consider whether the host country's environment is polluted or not. However, this is subject to various environmental protection agency policies in various countries. The pollution halo hypothesis is also highly hinged to the stringent level of the environmental policies in the capital-intensive host countries. Liu and Wang (2016) also examined the theory to suggest that most literature surrounding the pollution halo effect employs the endogenous approach in their analysis but this suffers from the provision of an effective solution to the challenge of endogenous problem of environmental regulation.

Though there is short term dynamism of the host industries producing goods of low standard and brand it with modern technology when they realize they cannot compete, the long term positive spillover impacts of FDI to the host country exceeds the short term negative effects.

Porter Hypothesis

Porter in his hypothesis, (Porter, 1991) suggested that tight environmental regulations do not only increase the cost of production by firms in a developed country but also have positive impacts on them. Stern environmental regulations cause the firms to invest in environmental innovations that enhance efficiency and improvements resulting in increased productivity. Industries in developed countries in appreciating the positive impact of strict environmental policies in their economy can capitalize on that to internalize the cost incurred in complying with these stern environmental standards and ethics. Porter in 1991 states that sometimes the positive spillover effects of the stringent environmental regulations do not only offset the cost incurred by the firm but also goes further to ascertain extra profits for the firm.

Also, the porter hypothesis revealed that stringent but flexible environmental regulations breed environmental innovations which in turn also bring about environmental performance by default and yield business performance sometimes. Porter (1991) pointed out that this outcome is valid only when environmental regulations are properly crafted to suit the intended purpose.

However, looking at the effects of environmental policy stringency on FDI, Porter (1991) noted that some industries in the developed countries overlook these benefits and concentrate on the cost associated with the policies. This forms the basis for their movement to less developed countries with relaxed environmental policies that had to haven the pollution that will be caused by the MNCs.

Porter & Van Der Linde (1995) further elaborated on the porter hypothesis theory that there are five reasons why drafting proper environmental regulations will yield this positive outcome. “First, regulation signals companies about likely resource inefficiencies and potential technological improvements.” “Secondly, regulation focused on information gathering can achieve major benefits by raising corporate awareness.” “Third, regulation reduces the uncertainty that investments to address the environment will be valuable”. “Again, regulation creates pressure that motivates innovation and progress”. “Fifth, regulation levels the transitional playing field. During the transition period to innovation-based solutions, regulation ensures that one company cannot opportunistically gain position by avoiding environmental investments”.

Despite the aforementioned assertion, Porter & van der Linde (1995) admitted that innovation cannot always fully offset the cost of compliance, especially in the short run before learning can reduce the cost of innovation-based solutions”

Factor Endowment Hypothesis

The factor endowment hypothesis, also known as the Heckscher-Ohlin theory is classified as the current international trade theory. The factor endowment theory posits that countries operate using the comparative advantage production technique in the international market. Individual countries produce and trade the goods and resources of which they are mostly endowed. With trade openness, countries with enough extractive resources specialize in the production and trading of more natural resources while importing less endowed goods and resources.

Ragland et al. (2015) linked the factor endowment theory to the international market selection to indicate that the theory helps multinationals to determine which country to invest. This helps in

not only suggesting the target market but also to explore the business challenges in the economy. Specifically, multinational companies choose to relocate to countries with more natural resources for business profit by considering the environmental cost associated with their operations. The theory posits that cheap and abundant domestic factors attract multinationals. This means that less stringent environmental regulations lead to an influx of multinationals into such economies whilst stringent environmental policy in a particular economy restrict the influx of more multinationals.

3.2 Empirical Literature

The empirical literature review existing works on the pollution haven (PHH) hypothesis followed by the review of FDI-Environment relationship.

3.2.1 The Pollution Haven Hypothesis

The Pollution Haven Hypothesis has been explored in the existing literature. While some empirical studies confirmed the existence of the hypothesis, others rejected the hypothesis. Some researchers also found the result of the theory to be inconclusive.

In an attempt to explore the PHH, the following studies confirmed the existence of the Pollution Haven Hypothesis.

In the first place, Lee (2009) used autoregressive distributed lag (ARDL) co-integration and Granger Causality to explore the FDI-pollution nexus in Malaysia. Lee used 30-year data from 1970-2000 to suggest that though FDI-inflow is a major tool for economic growth in many

Southeast Asian nations, this is only achieved with no positive treats to the sub region's environment. This indicates that economic growth in most developing countries as a result of FDI-inflow giving no attention to environmental impact is only temporal. FDI affects environmental pollution positively in the long run. In asserting the validation of PHH, the paper also cited that there is a one-way causal relationship between FDI and environmental pollution.

Also, Jorgenson (2009) worked on existing multiple theoretical arguments to empirically analyze the effects of secondary FDI in manufacturing on industrial organic water pollution intensity with data span from 1980-2000. The result of the study indicated that FDI negatively affects the natural environment. Thus, there is a positive relationship between FDI-inflow and industrial water pollution. After finding strong evidence in support of PHH, he extended his research by looking into the effects of industrial organic water pollution on human health. The paper deduced that industrial water pollution causes child and infant mortality in developing countries in the ECOWAS region. Consequently, Dick (2010) in analyzing the environmental effect of FDI-inflow from 1963-1987 from Panel OLS models approach asserted Jorgen's (2009) findings giving a strong piece of evidence in support of the validity of PHH.

Again, Wang (2012) posited that FDI inflow pollutes the environment. Hence adding to knowledge on the empirical evidence of PHH. Wang did country-based panel work on the cities in China on economic growth, financial improvement, and emission. The paper employed generalized least squares (GLS) over the period 1990-2005 in its judgment. Johansen-Juselius cointegration model was used to spell out the causal liaison between FDI and environmental performance in Malaysia

in the period 1965-2010; the result unfolded that FDI inflow deepens land degradation adding up to the other evidence aforementioned supporting PHH.

Furthermore, Hitam & Borhan (2012) conducted a benefit analysis of FDI in Malaysia. Their paper stemmed from the idea that the benefit of FDI is the improvement in the host country's financial sector thus aiding in economic growth. The cost of FDI is attributed to the increase in environmental pollution in the host country. The study justified the effect of FDI on environmental pollution using the non-linear model from the period 1965 to 2010. The paper confirmed the validity of the EKC hypothesis in the long run and also asserted that a 1% increase in FDI-inflow results in a 2.03% rise in CO_2 emission. Thus an increase in FDI will lead to more than a proportionate increase in CO_2 emission. This would not have happened should Malaysia exercise a high standard of environmental control policies. This made the PHH applicable in Malaysia.

Besides, Ayu (2014) adopted the generalized method of moment (GMM) instead of panel ordinary least squares (OLS) estimator to highlight potential factors deemed to be major determinants of CO_2 emissions in the Middle East and North Africa (MENA) region. The study confirmed the existence of PHH. The research used data available over the period from 1971 to 2009 to suggest to policymakers that the key determinants of CO_2 emission in the MENA region are per capita gross domestic product (GDP), energy consumption based on fossil fuel, foreign direct investment (FDI) and agriculture production. There is no argument that growth in income alleviates poverty, and an increase in energy use boost economic growth but FDI-inflow aid in the financial development of the country. Nonetheless, these major indicators in the quest of enhancing

economic growth also increase CO_2 emissions in these developing countries. Less environmental rules and regulations pave the way for an increase in growth at the expense of the environment.

Further, Shahbaz et al. (2015) are one of the current researchers who have presented evidence on PHH. In their work, Shahbaz and others used the Fully Modified Ordinary Least Squares (FMOLS) method in their analysis to justify the nonlinear relation between FDI and carbon emissions in countries with different income levels. They elucidated that industries in polluting sectors of the developed countries will relocate to less developed countries because of the high standard of environmental control conditions in the developed country. This exposes the host country to pollution-prone activities, supporting the evidence of the PHH.

Moreover, Cole et al. (2017) examined FDI-environment and emphasized two basic policy issues; the effects of environmental policies on the location of industrial plants from MNCs and secondly the impacts of FDI on the emission of various pollutants especially CO_2. The paper went on to deduce whether people from domestic countries experience positive spillover from the MNCs to the host country. By extension, the review postulated that industries in developed countries take advantage of less stringent environmental regulations in developing countries and outsource the dirty part(s) of their production activities into the developing countries through investment, hence the existence of the PHH.

Lastly, Hanif et al. (2019) deepened the existence of PHH, deducing that a 1% increase in FDI shockingly increases emission by 0.12% holding all other variables constant. It is understood by

developing countries currently that FDI-inflow aids in environmental-efficiency improvement. It is known that developing countries in Asia have not embraced many stringent environmental regulations enough to protect the environment. It is therefore imperative to note that the enjoyment of the benefit of FDI-inflow by developing countries comes with a cost. Hence negative externalities on the host country's population through health risks and other environmental hazards.

In contrast to the empirical studies confirming the pollution haven hypothesis, the following empirical studies rejected the existence of the PHH. Temurshoev (2006) empirically examined the validity of PHH and Factor Endowment Hypothesis in the US and China employing the input-output technique with panel data from 1992 to 1997. The result of the study indicated that China's trade-induced FDI reduces carbon dioxide emission whilst the US suffers the opposite scenario. The study rejected PHH in China.

The work of Perkins and Neumayer (2009) argue that FDI is a key instrument in diffusing environmentally friendly technology into the host country. The host country enjoys this from TNCs both from direct or indirect positive impact. Taking into consideration the direct effect, there is the incorporation of global most updated technologies from the transnationals into the developing countries where they invest. The latest environment-friendly technologies rich in improving environmental efficiency are innovations from the developed country's transnational corporations who also man it. The subsidiary local branch of TNCs adopts this environmental

efficiency technology into its operations that help to reduce the environmental accidents and risks in the host country. The paper rejected the PHH.

Zhou et al. (2013) adopted dynamic panel data to reject the validity of the pollution haven hypothesis. The studies used panel data of China's five megacities from the year 2000 to 2012 to explore the implications of foreign investments on the productivity of domestic firms in the host country- FDI spillover. They dwelled on the energy sector to document that increase in FDI-inflow are favourable to enhance energy efficiency improvement and consequently recede carbon dioxide emission. The FDI has numerous positive spillover effects on the host country from employment expansion, improved management, and highly technological advancement.

It is equally important that Twerefou et al. (2015) examined the impact of international trade on the quality of the natural environment in Ghana. Twerefou et al. (2015) followed Pesaran and others (2001), Pesaran and Pesaran (2009) using the optimal ARDL as the best method for estimating co-integrating function. Considering the data span from 1970 to 2010, the paper accentuated the performance of the environment taking into consideration the disaggregation of the various effects. The study went further to compare the magnitude of the various effects to deduce the overall effects. The technique effect according to the research revealed a positive impact on the environment in that the rise in per capita income from international trade is used to develop the host country making its indigenes undertake environmentally friendly activities. The huge CO_2 emission as a result of the increment in urbanization overrode the positive technique effects. This was the fundamental reason for Twerefou's suggestion that cleaner technology and energy-efficient automobiles should be employed in production activities to reduce energy

consumption that triggers the emission of CO_2. The research, in the end, could not support the PHH.

Furthermore, Shao (2018) used World Development Indicators dataset from 1990 to 2015 and the dynamic panel model (GMM) to explore the PHH in 63 high-income countries and 125 low-income countries. The study indicated that high-income countries select strong protective environmental regulations and also specializes in the production and usage of clean goods. Technical efficiency in production and regulatory standards is the hallmark for most of its industries compared to middle and less developed countries. They possess a high standard of transparency in their environmental regulations and this attracts foreign investors in choosing to invest in high-income countries. Again there is a notion that FDI is attracted in firms and industries that are pollution-free in high-income countries and thus summarizes that FDI inflow mitigates carbon intensity. The paper suggests that the result of these undoubted characteristics of FDI in high-income countries is a positive spillover effect that ripples in such countries rejecting the pollution haven hypothesis.

Despite the two opposing conclusions on the empirical investigations of the pollution haven hypothesis discussed above, few studies have also found mixed results. Ambec et al. (2013) added to the literature by reviewing the porter hypothesis. The study postulated that stringent but flexible environmental regulations bring about environmental innovations. This improves the quality of the environment. Again most firms and industries engaged in research to overcome environmental pollution end up internalizing it. In reviewing the original documents, the paper cited clearly that

this outcome is valid only when environmental regulations are properly crafted to suit the intended purpose but fails in the absence of stringent environmental regulations. The study found a mixed result for the FDI-environmental quality nexus.

Also, Sulemana et al. (2016) in analyzing the EKC for air pollution in Africa and high-income OECD countries considered the impact of financial development and democracy. The research employed data from World Bank's WDI and POLITY IV from the year 1990 to 2010 to empirically examine the validity of the EKC in the two regions. The paper's findings after indicating that CO_2 emissions in Africa support the EKC hypothesis, also revealed that pollution in the early stages of Africa's development is attributed to the influx of many multinational companies in the continents as a result of its lax environmental regulations. This validates PHH in the short run but rejects PHH in the long run where the economy is booming, giving rise to the usage of environmentally friendly machines and techniques in production. Besides, the industries and individuals also have in-depth knowledge about the need to protect the environment and thus adhere to environmental rules and regulations.

Lundh (2017) discussed the effects of environmental policy stringency on FDI. The paper highlighted that some industries in the developed countries overlook the benefits of stern environmental policies and concentrate on the cost associated with the policies. This forms the basis for the movement of some industries to less developed countries with relaxed environmental policies that had to haven the pollution that will be caused by the MNCs. Industries that innovate to internalize their cost of production do not move to less stringent environmental economies. The result of the study covering the OECD and BRICS countries revealed inconclusive results for the PHH in the entire model.

3.2.2 Foreign Direct Investment (FDI) and Environment Relationship

The trade-off between environmental performance and the 21st Century economic development is still a bothering challenge for both scholars and environmental policymakers. Whilst some studies have found a unidirectional relationship between FDI and the environment, others have revealed a unidirectional linkage from FDI to the environment and vice-versa. Aside from these, the result of some papers showed no relationship between FDI and the environment.

The following studies showed a bidirectional relationship between FDI and environmental quality.

To commence, Hoffmann et al. (2005) worked on the granger causality test of FDI and pollution. The study sampled 112 countries globally over 15 to 28 based on the data available. Employing the bi-variate framework, the paper uncovered a bidirectional relationship moving from FDI to environmental pollution and also moving from the environmental pollution to FDI. This was influenced by the level of economic development in the host country.

Secondly, Thi and Vinh (2015) explored the linkages between foreign direct investment and the environment in Vietnam. The study used time series data from climate data explorer of the World Resource Institute, the World Bank and Environmental Protection Agency (EPA, USA) from 1993 to 2012. Employing the EKC hypothesis and the generalized method of moment model, the research uncovered an alternate directional relationship between environmental quality and FDI.

Furthermore, Amri (2016) chose foreign direct investment (FDI) as one of the independent variables in addition to real GDP per capita, labour, and capital to analyze their impact on

renewable energy consumption. The study used 75 developed and developing countries for the investigations with data span from 1990 to 2010. Employing the dynamic panel estimation technique, the researchers deduced that FDI granger causes renewable energy consumption and vice versa. Thus there is a bidirectional relationship between the two.

In the recent work on FDI-Carbon dioxide emission relationship, Kaya et al. (2017) employed the World Bank and Central Bank of the Republic of Turkey annual data from 1974-2010. After concluding that the EKC hypothesis is valid for the Turkish economy, the granger causality tests of the study unleashed a bidirectional relationship between foreign direct investment and carbon dioxide emission.

Other studies of the FDI-environment nexus revealed a unidirectional relationship from FDI to the environment and from the environment to FDI.

Firstly, Appiah-Konadu (2013) used a time-series analysis to investigate the effects of trade liberalization on the environment over 40 years from 1970 to 2010 in Ghana. Following (Antweiler et al., 2001), the study took into consideration scale, technique, and composition effect to verify the direction and the magnitude of the effect of trade openness on the environment. The composition and the scale effects of FDI increased carbon dioxide emissions. The two postulate an adverse effect on carbon dioxide emission. However, the technique effect of FDI decreases carbon dioxide emissions. Relying on the magnitude of the favourable technique effect and the adverse effects of the combination of composition and scale effects, Appiah revealed that the

negative effects outweigh the positive technique effect. Thus overall, trade-induced FDI negatively affects the quality of the environment.

Olufemi & Peter (2016) employed a cointegration analysis to investigate the growth effects of foreign direct investment and environmental quality in Nigeria from 1970-2013. The study assessed the relationship between FDI and the rest of the variables; human capital, trade openness, inflation, interest rate, and per capita income to ascertain a long-run association. After realizing that FDI impedes economic growth, a further conclusion supported that the quality of the environment is indifferent to growth in Nigeria. Nonetheless, tracking the interaction between FDI and CO_2 emission concluded that CO_2 should be controlled in order not to exceed a threshold of 67.4%. The study revealed a unidirectional relationship from FDI to environmental pollution.

Some works have also considered the long-run equilibrium relationships between macroeconomic variables and environmental degradation indicators. Behera & Dash (2017) investigated the relationship between FDI, GDP, energy consumption, urbanization, CO_2 emission in 17 Asian countries with data span from 1980-2012 employing panel cointegration analysis. Using Westerlund tests, evidence shows a long-run relationship between FDI and CO_2 in both low-income and middle-income South and Southeast Asian countries but not high-income South and Southeast Asian countries. Westerlund and Pedroni test on the entire panel nations revealed a long-run equilibrium relationship among the variables. The study concluded that FDI granger causes environmental pollution.

Shao (2018) coined his evidence from dynamic panel analysis in a nice question form; does FDI affect carbon intensity? The inconclusive result from existing literature triggered the examination of FDI-carbon emission nexus to clarify the relationship between the two. The study applied system GMM to analyse this relationship after employing panel data analysis to cater to the endogeneity problem. Shao used panel data of 188 countries globally during the period 1990-2018 to unveil a unidirectional causality from FDI to environmental quality. The outcome of the research first postulates that FDI spillovers increase the rise of carbon intensity. The result was repeated after introducing urbanization level, industrial intensity, trade openness, and share of fossil fuel into the analysis as control variables. This means host countries of FDI-inflow should be environmental friendly policy-minded before allowing an influx of FDI. A high standard of environmental control regulations should be maintained in the course of attracting FDI. In as much as updated technology is needed to reduce pollution during production, stringent environmental rules and regulations should also be set and implemented with close supervision. Quality government institutional policies will be needed to discourage FDI from pollution prone industries.

In addition, Assi (2018) employed time-series data and ARDL methodology to research on the impact of FDI on carbon dioxide over the year 1975-2014. Extending the paper of Kizilkaya on FDI-environment nexus in Turkey, the study revealed that in the short run, the coefficient of CO_2 is positive and nonzero. Thus carbon dioxide emission increases less than a proportionate increase in FDI; a 1 point (100%) increase in FDI gives rise in CO_2 emission by 0.03%. In the long run, the result reiterated the short-run period result that an increase in FDI will increase carbon emission. Carbon dioxide emission increased by 0.14% as a result of a 1 point (100%) rise in FDI. This summarizes a way direction contribution of FDI to CO_2 emission.

Adding to the existing empirical literature, Mukhtarov et al. (2019) explored ways in achieving global environmental sustainability despite numerous emissions in the 21st century. Azerbaijan, considered as one of the fastest-growing economies in the present day, is also rich in oil and gas resources. The paper analysed the impact of FDI on environmental degradation in Azerbaijan postulating that the alarming rate of CO_2 emission from consumption, in part stems from FDI-inflow. Using the cointegration technique on time series data covering 17 year period from 1996-2013, the paper deduced that the massive oil discovery in Azerbaijan attracted foreign investors in the form of FDI. With a whooping FDI increment in Azerbaijan from $627 million in 1996 to $5.29billion in 2012 (World Bank data 2018), Mukhtarov et al concluded that the rise in FDI-inflow in Azerbaijan though aided in financial development, it also on the other side harms the environment.

Satrovic and Muslija (2018) used 113 country datasets from 1995-2015 to determine the causal relationship between the environment and FDI. Employing the generalized method of moment (GMM) panel regression model, the study found a one-way unidirectional relationship flowing from the environment through tourism to foreign direct investment. In the dynamic panel data analysis of financial development-environmental performance nexus, Majeed and Mazhar (2019) employed a comprehensive form of the measurement of environmental quality (ecological footprint). This global study used a comprehensive indicator of the ecological footprint of 131 economies' panel data in 46 years spanning from 1971 to 2017. Empirically, the study employed five (5) different methodologies in its analysis; pooled ordinary least squares (OLS), Driscoll-

Kraay (DK) standard errors, fixed-effects model, random-effects model, and system generalized method of moments (GMM). Disaggregating financial development into domestic credit to the private sector, domestic credit to the financial sector by banks, and domestic credit provided by the financial sector, Majeed and Mahza (2019) revealed that all three indicators of the financial sector have a positive effect on the environment. That is the higher the financial development the lesser the environmental degradation-enhancing good environmental quality. This finding contrast with FDI-inflow as it increases ecological footprint, worsening the quality of the environment. The extension of the result added that FDI-inflow infiltrates developing countries with less stringent environmental policies and regulation with pollution.

Contrary to the aforementioned relationships between FDI and environmental quality, some studies found no linkages between them.

Kizilkaya (2017) jointly investigated the effect of FDI and economic growth on the carbon dioxide emission in Turkey. The study applied the ARDL bound testing approach over 34 years annual time series data from 1970 to 2014. Kizilkaya found that there is little information on FDI to predict its effect on carbon dioxide emission in the long run. Unlike the short term result matching the expected result, estimation for long term analysis revealed that the coefficient of FDI is not statistically significant. The paper revealed no empirical relationship between foreign direct investment and environmental quality in the long run.

Maku et al. (2018) who examined the effect of FDI on carbon dioxide emission in Nigeria from 1980 to 2014. The paper concentrated on the direction and the magnitude of the impact of FDI on

carbon dioxide emission. The study concluded that considering the full model, FDI has no relationship with environmental quality. At one year lag (-1), FDI insignificantly had a negative impact on carbon dioxide emission; two-year lag (-2) revealed that FDI had a significant negative effect on carbon dioxide emission at 10% and three year lag(-3) produced positive insignificant impact of FDI on carbon emission at 10% in Nigeria. In other words, the paper concluded that FDI has no significant impact on carbon dioxide emissions.

With regards to the impact of degree of democracy on environmental quality the study reviewed the following existing literature.

Gani (2012) investigated the relationship between carbon emission and the five major dimensions of good governance. The paper revealed that good governance could be measured by corruption, government effectiveness, political stability, regulatory quality, and rule of law. The paper after strongly supporting the Environmental Kuznets Curve (EKC) hypothesis, confirmed that the coefficient of corruption control, rule of law and political stability are statistically significant but negative. Data on 99 developing countries from 1998 to 2007 excluding 1999 and 2001 were used. Using panel data analysis for this investigation, only government effectiveness showed negative but statistically insignificant at 1% unlike the rule of law, political stability, and corruption control which revealed statistically significant at 1%. It is thus needful according to the empirical result from this study that good governance in the form of corruption control, political stability, and rule of law be given maximum attention at all levels of development because it positively affects carbon dioxide reduction.

In addition, the interest of Lv (2017) to examine the impacts of income and governance (democracy) on the environment quality (carbon dioxide emission) on various quantiles yielded positive results for low emitting countries. Using panel data covering the period of 1997-2010 for 19 emerging economies, the paper showed a strong significant interaction effect on carbon emission at the economies that are low emitters. There was a strong result of democracy decreasing carbon dioxide emission; nonetheless, this only happens when income level rises to some specific point; otherwise, its effect turns out to be adverse. It was then deduced that democracy increase carbon dioxide emissions in high emitting emerging countries. The research added to the empirical evidence new determinants of carbon emission considering the conditional distribution.

Iwinska et al. (2019) verified whether democratic governance has a positive impact on the environment. The paper reviewed existing literature on both theoretical and empirical debates on democratic regimes against environmental quality employing non-parametric correlation. Revisiting the existing debates, the paper was extended to check the interactional nexus among democracy, government effectiveness, economic prosperity, and perceptions of corruption. Two conclusions of opposing sides were achieved; democratic governance and environmental quality interactions yielded positive and statistical significance taking into consideration the entire database. On the other hand, bringing to light the interaction of government effectiveness, economic prosperity, and corruption perception nullifies the earlier conclusion. Only countries that can strategize in designing and enforcing governmental policies (lie within the strong government effectiveness (GE) indicator range (GE score 0.51-0.75)) tend to portray positive good governance. Corruption control did not unleash any strong evidence to affect democracy which in turn will influence the quality of the environment. Consequently, this evidence covers only countries with

a CPI score of 51-75 relatively portraying corruption-free states. In contrast to the two assertions aforementioned, is the level of a country's financial wealth (income). This positively influences the interaction between the democratic regime and environmental quality.

3.3 Concluding Remarks

This chapter reveals that evidence from empirical studies on PHH specifically FDI-environment nexus is inconclusive. While some scholars proved empirically the existence of the PHH hypothesis, others argued that the PHH does not hold. Even in the developed countries that most of the empirical studies are done, some reports are positive while others are negative. West Africa has received less attention in bridging the gap in empirical works on FDI-environmental quality relationships. Most attention given to curb emissions globally has been centered on carbon pricing leaving the macroeconomic variable like FDI. The reasons aforementioned gives room to undertake this study to fill these gap by proving empirically the effects of FDI on carbon dioxide emission in West Africa.

CHAPTER FOUR

METHODOLOGY

4.0 Introduction.

Chapter four discusses the theoretical framework and the various systematic approaches in addressing the objectives of the research. As noted in the literature review, different methodologies and data sources have been adopted to assess the effects of FDI on environmental quality. Again, various panel data estimation and diagnosing techniques have been employed to investigate the FDI-environment argument. This chapter consists of 5 sections; introduction, conceptual framework, empirical estimation, definition and measurement of variables and techniques for econometric estimation.

4.1 Theoretical Framework

Research on the relationship between environmental effects and economic activities has taken two forms in the literature (Danso-Mensah, 2015). Namely, the reduced equation model by Stern (2004) which measures the relationship between the state of the environment and the economy's income level and the structural equation model that matches the quality of the environment against environmental regulations, the composition of industries, and technological know-how. The structural form is superior to the reduced form because the former fails to stipulate the main causes of the environmental hypothesis under study, the PHH (Dinda, 2004).

The pollution haven hypothesis (PHH) hold some basic assertions in theory. Moradi et al. (2014), discussed three things that weaken the strength of the environmental regulatory stringency and deepens the pollution intensity in developing countries. However, two of them plays a major role in West Africa. Firstly, environmental quality is viewed as a normal good in developing countries. People care for the environment after meeting the basic needs of life. Majority of people in West Africa do not have the financial strength to meet their basic needs and also care for the environment. They mostly depend on the environment directly without the means to do so in an environmentally friendly way. Secondly, most developing nations aims to achieve economic growth and development. However this growth is highly dependent on trade openness that leads to an influx of multinationals to invest in the developing countries and this, in turn, makes the developing countries the haven of pollution-intensive companies (Kamara, 2013)

The theory underlining the pollution haven hypothesis indicates that multinationals are faced with high environmental standards and regulations in their parent countries. This cost such companies more to internalize the negative externalities they pose to the natural environment of their parent economies. However, some of these pollution-intensive industries in locales of high standard environmental economies in an attempt to sway this high environmental cost, relocate part of their production and distribution to the jurisdiction where the environmental regulation is less stringent to invest. This increases the carbon dioxide emissions level in the jurisdiction of lax environmental regulations.

The discussion above motivates the study to follow Maku et al. (2018) who hypothesized that increased level of carbon dioxide emissions in developing economy is expressed as a function extractive and industrial foreign direct investment in developing countries. The study after

considering the unavailability of sectorial FDI-inflow to all 16 West African countries, follows Williams et al (2017) which indicated that 70% of FDI inflow to West Africa goes to the extractive and the manufacturing industries to use annual total FDI-inflow.

$$CO_2 = f(FDI) \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (1)$$

However, Yanchun (2008) stated that assessing the effect of FDI on CO_2 emission in a simple regression like this could lead to the omission of some key independent variables and raise suspicious conclusions. The model follows the works of Maku et al. (2018) and Twerefou et al. (2017) to add per capita GDP(GDPPC). Again the extension of Make et al. (2014) also provided that carbon dioxide emissions could be expressed as a function of per capita GDP. The study follows Antweiller (2001), Twerefou et al. (2015) and Appiah-Konadu (2013) to include capital per labour ratio (K/L) to assess how the structural changes in the industrial activities of the host country affect carbon dioxide emissions. The study again adopt the HAVEN variable (product of trade openness and per capita GDP) to prove the PHH. This interaction term measures whether the level of emissions in West Africa increases when the domestic economic activities within the confinement of the sub-region are open to multinationals to invest through trade openness(Fetahi-Vehapi, 2016). Carlsson & Lundström (2003) indicated that political freedom highly affects environmental quality in developing countries as autocracy weakens the power of citizens to voice out their stands on environmental challenges, specifically carbon dioxide emissions whilst democratic governance do the opposite. Again the study followed Buitenzorgy & Mol (2011) and Sulemana et al. (2016) to select the degree of democracy (DD) as governance institutional variable for the analysis. The study follows the measurement of Integrated Network for Societal Conflict Research(INSCR) polity four datasets where the polity score of degree of democracy is derived

from the institutionalized democracy minus institutional autocracy (scale of negative 10(highly autocratic) to positive ten(highly democratic)).

Thus, the functional form of the equation is as follows

$$CO2_{it} = f\left(FDI, GDPPC, {}^{K}/_{L}, HAVEN, DD\right) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots . (2)$$

4.2 Empirical Estimation

Considering Equation (2), we estimate the empirical model in panel form as

$$CO_{2it} = \alpha + \beta_1 FDI_{it} + \beta_2 GDPPC_{it} + \beta_3 {}^{K}/_{Lit} + \beta_4 HAVEN_{it} + \beta_5 DD_{it} + \mu_{it} \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

where

CO_{2it} = proxy for the environmental quality variable, measured by CO_2 emission per capita (CO_2) in metric tons.

FDI_{it} = foreign direct investment per GDP

$GDPPC_{it}$ = gross domestic product per capita

DD_{it} = the degree of democracy

${}^{K}/_{L_{it}}$ = the gross capital formation per labour ratio

$HAVEN_{it}$ = the interaction term between trade openness and per capita GDP.

μ_{it} = stochastic error term assumed to be normally distributed with zero mean

The study normalizes the addictive form of equation (3) by taking the natural log on both the dependent and the independent variables. This also allows for interpreting the coefficients as elasticities.

$$lnCO_{2it} = \alpha + \beta_1 lnFDI_{it} + \beta_2 lnGDPPC_{it} + \beta_3 ln^{K}/_{Lit} + \beta_4 lnHAVEN_{it} + \beta_5 lnDD_{it} + \mu_{it} .. (4)$$

To proof the PHH empirically, the HAVEN variable should be positive and statistically significant. That is the coefficient of the HAVEN variable should be greater than zero and statistically significant ($\beta_4 > 0$) (Doytch & Uctum, 2016; Riti, 2016).

4.3 Definition and Measurement of Variables

The independent variable is carbon dioxide emissions used as a proxy to measure environmental quality. Explanatory variables are the foreign direct investment (FDI) as a percentage of GDP and HAVEN(Interaction of trade openness and per capita GDP). The study control for gross domestic product per capita (GDPPC) and capital-labour ratio($^{K}/_{L}$). The study also adopts governance proxy, degree of democracy (DD) as a control variable which affects environmental quality (Buitenzorgy & Mol, 2011; Sulemana et al., 2016)

4.3.1 Dependent variable (Carbon dioxide(CO_2))

Carbon dioxide, the dependent variable is a global indicator for the measurement of environmental quality since it is the major GHG emitter contributing almost 72% (Sanglimsuwan, 2011). It is

mostly produced from the burning of fossil fuel during economic activities in the various commercial and industrial sectors.

4.3.2 Independent variables

4.3.2.1 Foreign Direct Investment

Foreign firms invest in domestic firms that mostly operate in the same line of production mostly in the extractive sectors in West Africa. The global benefits of FDI inflow cannot be overlooked in the 21st Century. Given this, developing countries adopted a strategy of leveraging the numerous trade restrictions in their financial sectors to aid in the free flow of foreign investment. This has resulted in a substantial increase in investment in West Africa though Africa as a continent still receives minimum FDI-inflow.

Though privatization and capital mobility in the 1990s has yielded positive result in FDI inflow to West Africa, it has also led to numerous rise in the GHG emission in the sub-region. In contrast to this, other scholars like Shahbaz and Lean (2012) argue that improvement in financial development enhances quality environment. The inconclusive result in literature has motivated further insight into the FDI-environment nexus. For this study, financial development, measured by total annual FDI-inflow as a percentage of GDPPC is used as the main independent variable. This is because 70% of FDI-inflow to the West African sub-region goes to the extractive and the industrial sub-sectors. It is expected to give a plus (+) or minus (-) sign.

4.3.2.2 Gross Domestic Product

The theory is guided by Kuznets' (1955) assertion that as an economy expands through an increase in gross domestic product, emissions level of such an economy will increase. This is buttressed by scholars in the field like Grossman and Kruger (1991) and Copeland and Tailor (1994). Following Twerefou et al. (2017) to measure the level of income in West Africa, GDPPC is used as a proxy for the income level of residents in West Africa. Shabaz et al. (2012) among other authors found out in their empirical research that per capita GDP deteriorates the quality of the environment. The study expects a plus sign of GDPPC with the intension that as the economy expands, pollution level increases.

4.3.2.3 Degree of Democracy

With heightened interest in institutional and political influence on environmental quality, the degree of democracy (DD), is used to measure the performance of governance in a particular country. This takes the form of the autocratic and democratic way of governance in West Africa. In theory, people take advantage of leniency and weaknesses in democratic institutional governance to pollute the environment (Kinda, 2011). The other side is the fact that individuals and firms have little power to respond to their reasons to pollute and thus, engages in the best environmental practices possible enough. Sulemana et al. (2016) in analysing the role of democracy in the EKC, concluded that the degree of democracy is indifferent to carbon dioxide emission. The belief in the literature that democratic nations have a poor environmental quality whilst autocratic countries have clean environment reveals an expectation of positive or negative sign.

4.3.2.4 Capital-Labour Ratio

The study used the gross capital formation per labour to measure the changes in industrial activities in West Africa. Antweiller et al. (2001) proposed that when a country is resource-based or operate more using capital resources against labour, its emissions level increases. Specifically, an increase in capital-to-labour ratio will increase pollution concentration in West Africa all other things being equal. According to the factor endowment theory, West Africa has a comparative advantage in extractive resources and thus, expected to specialize in industries that are resource-based (Appiah-Konadu, 2013). Thus the study expects plus or minus sign.

4.3.2.5 HAVEN

The haven variable is computed by the researcher from the World Development Indicators (WDI) dataset. It is the interaction term between trade openness (Import as a percentage of GDP plus export as a percentage of GDP) and the gross domestic product per capita. The theory posits that as an economy is open to trade, its emissions level is affected. The study of Fetahi-Vehapi (2016) indicated that this interaction term assists in comparing the effects of domestic economic activity(GDPPC) on emissions independently and the effects of this same domestic economic activity on emissions when open to external trade. The interaction term captures the existence of PHH or otherwise. While the study of Twerefou et al. (2015) rejected PHH, Hanif et al. (2019) confirmed the PHH. Thus, the study expects either a plus sign or minus sign.

Table 4.1 Variable specification

No.	Variable	Description	Source
1	CO2	Carbon dioxide emissions (metric tons per capita)	WDI data
2	FDI	Foreign direct investment, net inflows (% of GDP)	WDI data
3	GDPPC	GDP per capita growth (annual %)	WDI data
4	K/L	The ratio of gross capital formation and the total labour force	Authors computation on WDI data
5	DD	Ranges from -10 to 10 with higher values indicating increasing democracy	INSCR data
6	HAVEN	Interaction between trade and GDPPC	Authors computation from WDI data

Source: Author's own computation

4.4 Justification of the Estimation Technique

The nature of the data employed for the study determines its estimation technique. The research adopts panel estimation technique per the data in use and also some useful justifications in favour of panel estimation technique. The panel estimation technique is preferred over the time series and cross-sectional models to fish out the dynamism in the relationship of economic activities and the environment. The study combines both time and cross-sectional effects (panel data analysis) to pick-up unbiased and impartial results that might have occurred in only time series analysis or strict cross-sectional analysis. Since time-series data is affected with non-stationarity and

multicollinearity while cross-section is prone to heterogeneity challenges, panel data analysis cater for these problems and also nullifies the issue of omitted and unobservable bias (Gujarati, 2003). Consequently, panel data analysis according to Sequeira and Nunes (2008) heals the problems of endogeneity by checking errors that might occur in measurement, specific country effects, and reverse causality whilst allowing analysis complex behavioural models. The study based on the reasons stated above chooses static panel data analysis technique to curb the research challenges that cannot be easily solved by time-series technique or cross-section effect (Hsiao et al., 2003).

4.4.1 Panel Regression Estimation Technique

The model specified above is perceived to fail the five assumptions that hold for ordinary least square (Linearity, exogeneity, homoscedasticity, non-autocorrelation, full rank, or non-multicollinearity and non-stochastic independent variable) analysis where individual effects do not matter. That is the time-specific and cross-section effects do not exist $y_{it} = \alpha + X_{it}' \beta + \varepsilon_{it}$ ($u_i = 0$).

Following Wooldridge (2010), panel data is ideal for the measurement of relationships that cannot be explored by specific time series analysis or cross-section model analysis. Below is the general form of the panel regression model:

$$y_{it} = \alpha_i + x_{it}\beta + w_{it} \quad \ldots\ldots (6)$$

Here, Yit is the explained variable for the cross-section unit i and time units t where i =1…n and t=1,…,T with α_i being the individual effect of heterogeneity. The w_{it} is a combined error term. This comprises of the combination of the cross-section error component (ε_{it}) and the summed unit

of both time series error term and cross-section error term component (μ_{it}). Thus, the combined error term could be stated mathematically as

$W_{it} = \varepsilon_{it} + \mu_{it}$ .... (7)

The OLS is the best model to be used if ($\mathcal{E}_{it}$) is observed for all individuals. This is because the panel will become an ordinary linear panel. It is therefore inappropriate to use OLS as a model should ($\mathcal{E}_{it}$) be unobserved and thus, fixed and random effects are better to measure the relationship between the explained and the explanatory variables.

To overcome the problems of biased estimation in employing OLS (heteroskedasticity, and autocorrelation), fixed effect (FE) and random effect (RE) panel estimation model is chosen over OLS to suite the study.

4.4.1.1 Pooled Regression Model

The existence of identical groups to be selected (pooled out) demands a pooled regression model of which researchers can apply ordinary least squares on groups as we give them symbols. In an attempt to use a pooled regression model, the existence of small T-statistics shows that the model is suffering from a huge standard error. This depicts that the symbolized groups are not identical. It also overlooks the individual time effects and hence the likelihood of overestimation of coefficient significance (Danbolt, 2004). Again OLS formula fails to capture variance of OLS estimators. This is the reason why researchers question the usual F and T-test statistics values of OLS estimation when the data shows heteroscedasticity. The equation below represents the general pooled OLS model

$y_{it} = \alpha_i + x_{it}\beta + \mu_{it}$ ……. …… (8)

Here,

y_{it} is the dependent variable where i = entity and t = time.

α_i (i =1….n) is the common y-intercept.

x_{it} Represents explanatory variables

β is the coefficient of the explanatory variables and u_{it} is the error term

4.4.1.2 Fixed Effect Model

The fixed effect panel data analysis best describes the discrepancies in the intercept with an assumption that the variance across various subjects is constant. It also assumes that there is an equal slope. Here there is a correlation between country-specific time-invariant effects and the independent variables. The functional form of fixed effect is stated below

$y_{it} = (\alpha + \mu_i) + X'_{it}\beta + \nu_{it}$ …….. (9)

The fixed-effect model has the power to control the country-specific time-invariant effects, μ_i represent the specific effect peculiar to individual time period omitted in the regression of which errors are independent identically distributed,

$$\nu_{it} \sim IID(O, \sigma^2\nu)$$

The fixed effect removes the country-specific characteristics which single them out from the rest and are time-invariant. This is achieved by dwelling on the within transformation in the model to lower the variables. Thus, the explained variable Y and the explanatory variables Xs are both

deducted from the observed values of the variables. This means that the demeaned variables within each subject have a zero (0) mean. The within transformation equation is stated as

$$y_i - \overline{y}_i = (\chi_{it} - \overline{\chi}_i)\beta + (\mu_i - \overline{\mu}_i) + (\nu_{it} - \overline{\nu}_i) \text{ .... (10)}$$

Where $\overline{y}_i = \frac{1}{T}\sum_{i=1}^{T} y_{it}$,, $\overline{\chi}_i = \frac{1}{T}\sum_{i=1}^{T} \chi_{it}$, $\overline{\nu} = \frac{1}{T}\sum_{i=1}^{T} \nu_{it}$, $\overline{\mu} = \mu_i$

Considering the within transformation stated above, the real or actual values are taken. Again the mean values of the variables are calculated from the actual values and deducted from the actual values. The fixed effect assumes that the country-specific error term μi do not change over time and thus, the real value equal the mean value of the variables. The country or industry-specific effects in the equation is cancelled out using the within transformation.

4.4.1.3 The Random Effect Model

The realization of the researcher that there is no fixed effect in a specific model demand that random effect is safe to be used. Random effect best fit when there is no mutual correlation between the observed and the unobserved variables. Again, coefficients variations in the random effect model draw its source from average variations between 'within and specific' effects. It is believed that the random effect is strongly demanded at the time when variation across countries is presumed not to be correlated with the independent variables in the model. That is

$C(\mu_i, \nu_{it})=0$ .... (11)

For random model, special qualities about two specific countries such as differences in climatic conditions, different environmental protection treatment given to firms, environmental rules and regulations on natural resource extraction, geographical differences, and domestic traditional

industrial operations among others are included as explanatory variables during the estimation of the model. The model holds an assumption that the explanatory variables or the regressors do not correlate with the country-specific-time-invariant error term. Thus, it allows for time-invariant variables to be captured as an independent variable in the model. However, considering the static panel model employed for the study, it is observed that the independent variables are visibly specified in the model and can be easily observed but not the country-specific time-invariant effect. In line with the discussion above, the study adopts the panel random effect econometric estimations over pooled OLS for the study because of the following reasons

1. It caters for individual and time effect (Danbolt, 2004)
2. It also corrects for heteroscedasticity problem (Gujarati & Sangeetha, 2007)
3. It corrects for models with huge standard errors and small test statistics.

4.4.2 Panel Diagnostic Test

4.4.2.1 Autocorrelation

Autocorrelation (serial or cross autocorrelation) is the arithmetical or mathematical demonstration of the level of equality that exists between a specified time series and its lag over ensuing or successive time intervals. Autocorrelation is mostly a time series problem. This mostly arises when the time (T) is large. Nonetheless, it is also a cross-sectional challenge. Panel data combines both time series and cross-sectional data. Hence the loud presence of serial correlation in panel data that need to be attended to. With serial correlation problem in cross-section, data in one group may mull over data in a nearby group. Autocorrelation blisters a panel analysis model for anticipation though it does not lead to bias estimation.

Wooldridge (LM) test of panel serial correlation would be used to test for autocorrelation. Should P>t gives a value less than the specified significant level (5%) then there is the presence of autocorrelation. Otherwise, the model is free from serial correlation. Newey-West Standard Error correction test would be employed to deal with the challenge if it is realized that serial correlation is a problem.

4.4.2.2 Heteroscedasticity.

Heteroscedasticity, also known as heteroskedasticity is a problem in econometrics when the assumption that the variance of errors in a model is non-constant across the entire observations. Homoscedasticity is when there is constant variance across all the observations under consideration.

Standard estimation methods fail to give standard results in the presence of heteroscedasticity as it triggers the model to bow to biased parameter estimation and standard errors. Hence, an inefficient test of statistics. To correct the heterogeneity challenges, the study will explore the Huber/White test, Wald test, and Breusch Pagan test to see which one best fits the work. In addition to this is the availability of unique social, economic, and geographical qualities that do exist among the West African countries. An attempt to overlook these specific characteristics estimate of OLS to be biased and inconsistent should there even be an absence of serial correlation.

4.4.2.3 Stationarity (Unit Root) Test

In time series analysis, some statistical properties like variance, serial correlation, and mean among others are constant over time. In such a situation, we say there is the presence of unit root or

stationarity. Though unit root is mostly a time series analysis phenomenon, it is also appropriate to verify the stationarity level of variables in the panel study to avoid working with spurious regressions. Gujarati (2003), revealed that "a stochastic process is said to be stationary if its Mean, and Variance are constant over time and the value of Covariance between two time periods depends only on the distance between the two time periods and not on the actual time at which the Covariance is computed". To suit this study, the Hadri-LM panel stationarity test would be employed to conduct the unit root tests of the variables.

4.4.2.4 Other Diagnostic Test

The study will also test for the "time-fixed effect" to know whether there is a difference between the time to be able to tell if they are jointly significant and thus needful for the analysis or not. Again, the study will conduct the Pesaran CD test to verify whether there is cross-section dependence in the West Africa data.

CHAPTER FIVE

RESULT AND DISCUSSIONS

5.0 Introduction

This chapter analyses the data, present the result from the empirical estimation and discusses the major findings of the study. This includes the descriptive statistics, unit root test, The pooled OLS(see appendix I) the random effect not corrected for time effect, serial correlation and heteroscedasticity (see appendix II), the Breusch Pagan test, the Hausman test and the panel random effect generalized least squares (GLS) model(corrected for time effect, serial correlation and heteroscedasticity) after exploring some diagnostic tests.

5.1 Descriptive Analysis

The study takes into consideration sixteen West African countries for the 10 years 2005-2014 inclusive. Though there is current trend analysis of FDI in literature, the choice of the study period is influenced by the unavailability of recent data for CO_2 in West Africa. The research provides some basic descriptive statistics on the variables under study; namely, the mean, the standard deviation, the minimum, and maximum values as well as the skewness of the variables under study. Table 5.1 reports the result of the descriptive statistics.

Table 5.1: Descriptive Statistics

Statistics	Study Variables					
	CO_2	FDI	GDPPC	K/L	HAVEN	DD
Mean	0.354565	8.06472	2.150856	0.00291	69.2513	3.4875
Maximum	1.234938	104.3374	18.05314	0.18785	1380.34	10
Minimum	0.049001	0.159779	-10.862	2.82e-07	0.00013	-5

Std. Dev.	0.260095	13.89839	3.561782	0.18705	164.789	4.411231
Skewness	1.113717	4.972356	0.7602711	7.850698	5.66602	-0.550473
Observations	160	160	160	160	160	160

Source: *Author's Computation using Stata 14. Data obtained from WDI and POLITY 2 data*

From Table 5.1, carbon dioxide emissions level in West Africa from 2005 to 2014 averagely stood at 0.354565 Kilotons (Kt). This is far below the global average of 0.6Kt. West Africa also recorded maximum, minimum and skewness value of 1.234938Kt, 0.049001Kt and 1.113717 respectively. The rate of dispersion of carbon dioxide is 0.260095Kt. The average FDI as a percentage of GDP value is 8.06472 compared to the global average of 14.03. It also recorded a maximum value of 104.3374 and a minimum value of 0.159779 while the standard deviation and skewness values are 13.89839 and 4.972356 respectively. Gross domestic product per capita recorded a mean value of 2.150856, maximum value of 18.05314, minimum value of -10, standard deviation of 0.260095 and skewness of 1.113717.

The gross capital formation per labour ratio recorded an average value of 0.00291 over the ten years from 2005 to 2014. It also recorded maximum and minimum values of 0.18785 and 2.82e-07 followed by standard deviation and skewness with 0.18707 and 7.850698 respectively. While the mean value of HAVEN stood at 69.2513 that of the degree of democracy stood at 3.4875. The maximum value of HAVEN is 1380 as that of the degree of democracy is 10. Haven and degree of democracy recorded minimum value of 0.00013 and -5 respectively. The dispersion rate of Haven is 164.789 while the dispersion rate of the degree of democracy is 4.411231. The HAVEN variable and the degree of democracy recorded a skewness value of 5.66602 and –0.550473 respectively.

5.2 Stationarity Test (Unit Root Test)

Panel stationarity test is important as non-stationary variables leads to spurious regression. Thus, conducting this test allows the researcher to control for non-stationary variables. For this study, the Levin-Lin-Chu panel stationarity test (Levin et al., 2002) and the Hadri (LM) stationarity test is conducted (Hadri, 2000). In both cases, the null hypothesis (H_o) stipulates that there is a unit root. This means the variable is non stationary against the alternative hypothesis (H_1) that there is no unit root implying the presence of stationarity.

Table 5.2: Levin-Lin-Chu and Hadri LM Panel Unit Root Test

Variables	Levin-Lin-Chu	(Hadri LM)
lnCO2	0.0000***	0.0000***
lnFDI	0.0001***	0.0000***
lnGDPPC	0.0000***	0.0221**
lnK/L	0.0023***	0.0001***
lnHAVEN	0.0000***	0.0002***
lnDD	0.0094***	0.0026***

Source: Author's computation with WDI/Polity 2 dataset

****, ** & * denote 1%, 5% and 10% level of significance respectively.*

Table 5.2 depicted that all variables are stationary at levels and thus, good for panel estimation.

5. 3 Presentation of Results

This section estimates the various models conducted to obtain the final result presented. The section first shows the result of pooled OLS estimation (see appendix I) and secondly undiagnosed Random Effects model (Appendix II). This is followed by the Breusch Pagan test and finally

Hausman test to choose between fixed and random effects. Hausman test results (Table 5.4) revealed that RE is preferred to FE. Thus the random effect is selected. The RE model is diagnosed for cross-section dependence, time effects, serial correlation, and heteroscedasticity before presenting the final random effects results.

The Breusch Pagan Test determines the heterogeneity effects. That is to test which of pooled OLS and 'Fixed and Random Effects Models' is good for the study. The null and alternative hypothesis are as follows:

H_o: Variances across units is zero (no heterogeneity or panel effects and thus OLS is appropriate)

H_1: Variances across units is not zero (panel effect is present; random effects is appropriate)

Table 5.3: Breusch-Pagan LM Test. Random/Fixed Effects or pooled OLS?

Estimated Result:

	Var	**sd=sqrt(Var)**
lnCO2	0.1193681	0.345497
E	0.0056592	0.0752276
U	0.1598746	0.3998432

Test: Var (u) = 0

Chibar2(01) = 607.61
Prob > chibar2 = 0.0000

Source: Author's computation from Stata 14

From Table 5.3, the p-value = 0.000 is less than 0.05. This rejects the null hypothesis in favour of the random estimation model (REM)/fixed estimation model (FEM) over the pooled model.

Table 5.4: Hausman Test for fixed versus Random Effects

Test: Ho: difference in coefficients not systematic

chi2(5) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 0.21
Prob>chi2 = 0.9991

Source: Author's computation using data from World Bank's WDI

We further undertake the Hausman test that test for the correlation between regressors and individual effects to choose between fixed and random effects models.

The p-value of 0.9991(Table 5.4) means we **fail to reject** the null hypothesis that there is no correlation between the regressors and the individual effects. Thus, the random effect model (REM) is chosen over the fixed effect model (FE).

5.4 Other Diagnostic tests

Random effect result is diagnosed with contemporaneous correlation (cross-sectional dependence), the significance of time effect, serial correlation, and heteroscedasticity.

Table 5.5 Diagnostic Tests Result

Variables	Pr	Prob>F	Prob>Chi2	Prob>chi2
Cross-section Dependence	0.0000			
Serial Correlation		0.000		
Heteroscedasticity			0.0000	
Time Effect				0.0012

The Cross-section Dependence test sought to verify whether the residuals across entities are correlated or not. From Table 5.5, The Pesaran CD test showed that Pr = 0.0000. This shows the presence of a cross-sectional dependence problem. This is corrected using Driscoll-Kraay standard errors (Driscoll & Kraay, 1998).

Wooldridge test for autocorrelation in panel data determines whether the standard errors of the coefficients are the actual values or underestimated. Wooldridge test for autocorrelation has the null hypothesis of no first-order autocorrelation. From Table 5.5, Prob>F=0.0000. This is less than 0.05. Thus we reject the null hypothesis, concluding that there is autocorrelation

The heteroscedasticity test determines whether there is constant variance (homoscedasticity) across all the variables or not (heteroscedasticity). Table 5.5 further revealed that there is heteroscedasticity. The modified Wald Test indicated that Prob>chi2 is less than 0.05.

Again, the test for the significance of time determines whether the coefficients for all years are jointly equal to zero or the coefficient for all years is jointly not equal to zero. Table 5.5 revealed that Prob>chi2 = 0.000. Thus we reject the null hypothesis that the coefficients for all years are jointly equal to zero and thus, time random-effects are needed.

The RE model finally proceeded to correct for time effects, serial correlation and heteroscedasticity before presenting the final output (result) for analysis as shown in table 5.6

Table 5.6: Random Effects GLS Regression Model Results

Variables	Coefficient	Standard Error	z-Statistic	*p-values*
lnCO2				
lnFDI	**0.0462****	(0.0218)	[2.12]	**0.034**
InGDPPC	0.0260	(0.0239)	[1.09]	0.276
InK/L	0.0113	(0.0123)	[0.92]	0.356
InHAVEN	**0.0031****	(0.0015)	[2.05]	**0.041**
InDD	**0.0728***	(0.0441)	[1.65]	**0.099**
Constant	**-0.7047*****	(0.1156)	[-6.10]	**0.000**

Number of Obs = 160	**Wald Chi2(14) = 877.60**	
Number of groups = 16	**Prob > chi2 = 0.0000**	
Obs per group:	sigma_u	= 0.40001986
Minimum = 10	sigma_e	= 0.06516332
Average = 10	rho	= 0.9741495
Maximum = 10	Corr(u_i , X) = 0(assumed)	

Source: *Author's Estimation with data from World Bank's WDI and INSCR data*

****, ** & * denote 1% and 5% and 10% level of significance respectively.*

5.4 Discussion of Results

The discussion of the core findings of this study is presented in this section. The study discusses the effect of FDI on environmental quality using carbon dioxide as a proxy, assessing the validity of the pollution haven hypothesis (PHH), and also discuss in brief the effects of the control variables (economic growth, degree of democracy and capital per labour ratio).

From table 5.6, there is a positive relationship between FDI and per capita carbon dioxide emissions. This can be interpreted as all other things being equal, per capita CO_2 emissions increases as foreign direct investment increases. Thus, an increase in foreign direct investment decreases the quality of the environment and increases environmental deterioration. The results reveal that FDI is positive and significant at 5%. Specifically, an increase in West Africa's FDI

inflow by 1% increases per capita carbon dioxide emission by 0.0462% representing a weak significant value. The positive coefficients might be as a result of numerous emissions from multinational companies in West Africa (Eluka et al., 2016; Ouoba, 2017). This stems from the quest of West Africa to improve its economy through trade openness that brings in foreign direct investment (Antweiller 2001). Thus, allowing many multinational companies into the sub-region which come to contribute to the deterioration of its environment. This result posits that the activities of multinationals through FDI increases the emissions level in developing countries as a results of less stringent environmental standards (Ferdausy & Rahman, 2009). Thus, West Africa accepts FDI to develop the sub-region while doing little to control the negative impact this might have on the natural environment. In line with this, Ouoba (2017) indicated that the government of Mali has not done so much to control environmental challenges of FDI in the country, Anekwe (2018) and Osuagwu & Obumneke (2013) also noted that this case is not different in Nigeria. This weakens the ability of the sub-region to protect its environment.

Again, increased emission in West Africa as a result of FDI-inflows may be caused by the failure of some environmental authorities and protection agencies in the sub-region to perform their duties effectively. It could also be attributed to the lax environmental regulations found in West African countries. This may suggest that governments in the sub-region are focused on FDI to improve growth but doing less in protecting the negative effect on the environment. The result is in line with the findings of Maku et al. (2018) which established that FDI-inflow increases carbon dioxide emission in Nigeria. Again, Abdouli and Hammami (2017) also examined the environmental performance of foreign direct investment in the Middle East and North African (MENA). Their study concluded that FDI-inflow harms the natural environment. On the other hand, the result is

in contrast to the findings of Mabey & Mcnally (1999) who argued that updated technology in recent production is moving the economy from pollution haven to pollution halo and sustainable development. Also, Pazienza (2015) revealed that FDI is beneficial to the natural environment of the OECD countries. The result of this study opposes the finding of Demena & Afesorgbor (2020) who found that FDI is beneficial to environmental quality in West Africa.

To address the second objective under discussion, the positive coefficient of HAVEN 0.0031 implies that the pollution haven hypothesis exists in West Africa. This could be attributed to high emissions from industrial operations from multinational plants and machinery. From Table 5.6, the HAVEN variable is positive and significant at 5%. To be more specific, this means *ceteris paribus*, a percentage increase in multinational industries in West Africa increases carbon dioxide emission by 0.0031 percent. This confirms the PHH that multinational companies relocate from the developed world of stern environmental regulations to pollute in developing countries with lax environmental regulations (Baghebo & Apere, 2014; Grether et al., 2012). This finding corroborates that of Solarin et al. (2017), Yu (2019), To et al. (2019) and Gharnit et al. (2020) who also validated the PHH that multinational companies from the developed companies with stringent environmental standards relocate part of their activities into developing countries with lax environmental regulations and this increases the emission level of the developing countries. In contrast to the result of the study is the finding of Mert and Caglar (2020) and Salehnia et al. (2020) who rejected the pollution haven hypothesis.

The study controlled for other factors that might also affect carbon dioxide emission. Namely, degree of democracy, per capita GDP and gross capital formation per labour ratio. However, only the governance institutional variable was significant.

The study revealed that governance, proxied by the degree of democracy is positive at 10% significance level. This means that holding all constant, as West African economies are more open to democratic governance where the voice and the right of the people are respected, they take advantage to pollute (Kinda, 2011). Again, pollution in democratic sub-sector could also be as a result of the institutional weakness in democratic governance to check environmental polluters and apply the appropriate sanctions (Gani, 2012). Specifically, a percentage increase in democratic governance increases carbon dioxide emission by 0.0728 percent. Unlike Twerefou et al. (2015) who found that democratic governance does not affect carbon dioxide emission and thus, no impact on the quality of the natural environment in West Africa, this study agrees with Sulemana et al. (2016).

5.5 Chapter Conclusion

This chapter has highlighted the various empirical stages that answer the research questions raised in chapter one. The study revealed that foreign direct investment impedes environmental quality in West Africa. It further validates the pollution haven hypothesis in West Africa.

CHAPTER SIX

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

6.0 Introduction

This chapter presents the conclusion to the study outlining the effects of foreign direct investment (FDI) on environmental quality in West Africa. The chapter is divided into four sections. Section 6.1 presents a summary of the findings. Section 6.2 presents the conclusion of the study. Also, the chapter makes policy recommendations in Section 6.3 and finally, section 6.4 provides the limitations of the study and areas for further research.

6.1 Summary of Findings

This study sought to examine the effects of foreign direct investment (FDI) on environmental quality in West Africa using carbon dioxide emissions as a proxy for environmental quality. It also investigated the existence of the pollution haven hypothesis in West Africa. That is to determine whether West Africa serves as a haven for foreign industries that pollute the natural environment through CO2 emission. To achieve the objectives of the study, the research employed panel data from 2005 to 2014 and the random effects econometric estimation model for the empirical estimations. The findings of the research are summarized below:

The probability of F-statistic value for the generalized least square random-effects model for the discussion is 0.0000. This means the random effect model is also good for the panel analysis.

Our findings show that FDI-inflow is detrimental to environmental quality proxied by carbon dioxide emissions in West Africa. The standardized coefficient of the independent variable revealed a significant positive relationship between FDI and carbon dioxide emissions. This means that foreign direct investment contributes to environmental degradation by way of increasing the amount of CO_2 in the atmosphere. Specifically, investment in West Africa by the multinational companies in the extractive sector emit carbon dioxide that harms the natural environment.

The PHH posits that high emission in developing countries is characterized by an influx of dirty firms from developed countries. As the firms in developed countries face strict environmental regulations, they relocate part of their activities (mostly the production areas that pollute) to developing countries with lax environmental rules and regulations. This is believed to increase the pollution level in developing countries. The study confirmed the existence of the pollution haven hypothesis (PHH) in West Africa.

6.2 Conclusion

The FDI-environment relationship in both the theoretical and empirical literature remains inconclusive. Again, many studies done in the area center on the EKC other than PHH. Thus, the attention in literature is that it is the growth of an economy that degrade the natural environment, without addressing the negative effects of some multinationals in the sub-region. This particular study considers all the sixteen countries in West Africa to examine FDI-environmental quality nexus and also extent the debate to prove the PHH.

The results of this study indicate that foreign direct investment harms the environment through an increase in carbon dioxide emission. Thus, despite numerous positive effects of FDI, it also affects the sub region's natural environment negatively.

The study validated the PHH, acknowledging that pollution-induced multinational companies relocate from strict environmental regulations in their countries to establish their high emission firms in the sub-region where there are lax environmental regulations. The significant negative impact of FDI on the environment means policies to attract MNCs should be reviewed to assess the impacts of their operations on the natural environment before granting them any permit to operate. Again, environmental rules and regulations in West Africa must be strengthened with effective supervision to ensure that these companies adhere to the environmental standards of the sub-region. The activities of multinational companies should be checked to reduce emission in the sub-region.

6.3 Recommendations

The findings aforementioned give rise to the following recommendations

This research suggests that as West Africa aims to boost growth through FDI inflow it is prudent that regional policymakers, government, and environmental protection agencies, non-governmental organizations (NGOs) among other stakeholders ensure that environmental quality rules and regulations are intensified and strictly adhered to so that the sub-region will not suffer increased environmental degradation. Sustainable development is not possible if the quality of the environment is overlooked. The Economic Community of West Africa States, West Africa Science

Service Centre on Climate Change and Adapted Land Use (WASCAL), Partnership for Environmental Governance in West Africa (PEGWA), and others should treat environmental issues with high level of interest and sense of urgency. Again, global environmental regulators like the United Nations Environmental Programme (UNEP) should assist West African countries to ensure effective environmental policies.

The study recommends that environmental regulators in individual West African countries like Environmental Protection Agency (EPA) in Ghana, the Federal Environmental Protection Agency (FEPA) in Nigeria, Environmental Protection Agency of Sierra Leone etc, should enforce the environmental regulations (carbon pricing, emission limit) implemented in their domestic countries. This should be done with effective supervision, monitoring, and evaluation to yield the intended purpose.

The study also suggests that the importation and use of plant and machinery that are obsolete by multinational companies be reduced to the minimum level. This will reduce emission levels in West Africa.

Modern and pollution-free technology should be used by firms in West Africa during production. It is advised that regular checks are done on harmful industrial machines like oil refinery plants, chemical plants etc. before use to avoid high emissions. This will ensure that MNCs curb the emission level in West Africa.

6.4 Limitations of the Study and Areas for Further Research

A major challenge for the study is the measurement of environmental quality. To measure the serenity of the environment, the best way is to measure environmental performance which comprises environmental health and ecosystem vitality. This will bring to play several environmental indicators like water quality, unsafe sanitation, and other air pollutants like Nitrogen Oxide, particulate matter, chlorofluorocarbons (CFCs). Thus, it is suggested that potential researchers on FDI-environment nexus open up the scope of environmental quality measurement to cover several environmental indicators as possible.

It will also be of a great impact if further studies in this area will take into account sector-specific research to reveal the key sectors that pollute as FDI-inflow is channeled there. It will be an added advantage should further research in the area be extended to comparative analysis among the regional blocks in Africa

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APPENDICES

APPENDIX I: Pooled Ordinary Least Square Model (CO_2 as Dependent Variable)

Variables	**Coefficient**	**Standard Error**	**t-Statistic**	***p-values***
InCO2				
InFDI	-0.0123805	(0.0709644)	[-0.17]	0.862
InGDPPC	0.1260404	(0.1522937)	[0.83]	0.409
InK/L	0.0814848	(0.030822)	[2.64]	0.009
InHAVEN	0.0078025	(0.0113014)	[0.69]	0.491
InDD	**0.0659228*** **	(0.0884642)	[0.75]	**0.457**
Constant	**-0.3757461*** **	(0.2090063)	[-1.80]	**0.074**

Number of Obs = 160
F(5,154) = 1.59
Prob > F = 0.1656

R-squared = 0.0491
Adj R-square = 0.0183
Root MSE = 0.34233

Source: *Author's Estimation from Stata 14.*
****, ** & * denote 1% and 5% and 10% level of significance respectively.*

APPENDIX II: Random Effects Model Results (CO_2 as Dependent Variable)

Variables	Coefficient	Standard Error	z-Statistic	*p-values*
InCO2				
InFDI	0.0746857	(0.0221198)	[3.38]	0.001
InGDPPC	0.0135943	(0.0348749)	[0.39]	0.697
InK/L	0.00399	(0.0092289)	[0.43]	0.665
InHAVEN	0.0046182	(0.0025697)	[1.80]	0.072
InDD	0.1375289	(0.0560685)	[2.45]	0.014
Constant	-0.7542371	(0.1188818)	[-6.34]	0.000

Number of Obs = 160
Number of groups = 16
Obs per group:
Minimum = 10
Average = 10
Maximum = 10

Wald Chi2(5) = 20.98
Prob > chi2 = 0.0008
sigma_u = 0.39984321
sigma_e = 0.07522761
rho = 0.96581246
Corr(u_i, X) = 0

Source: *Author's Estimation from Stata 14.*
, ** & * denote 1% and 5% and 10% level of significance respectively.*

APPENDIX III: LIST OF 16 WEST AFRICAN COUNTRIES UNDER STUDY

BENIN
BURKINA FASO
CAPE VERDE
COTE D'IVOIRE
GAMBIA, THE
GHANA
GUINEA
GUINEA BISSAU
LIBERIA
MALI

MAURITANIA
NIGER
NIGERIA
SENEGAL
SIERRA LEONE
TOGO