

**UNIVERSITY OF GHANA**

**CLIMATE CHANGE AND INCLUSIVE GROWTH IN AFRICA: THE ROLE OF  
ADAPTIVE CAPACITY**

**BY**

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**DECLARATION**

I declare that, except for references made to other research works for which I have duly acknowledge, this thesis is my own work produced under supervision. This thesis has not been presented to any other academic institution for any academic reward. I therefore take full responsibility for any lapses in this document.

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**CERTIFICATION**

I hereby certify that this work was duly done and supervised in accordance with laid down regulation of the University of Ghana.

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**DEDICATION**

I dedicate this thesis to my Family.

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## LIST OF ABBREVIATIONS

ADF	Augmented Dickey-Fuller
AfDB	African Development Bank
AIC	Akaike Information Criterion
ARDL	Autoregressive Distributed Lag
CO <sub>2</sub>	Carbon dioxide Emission
EPIC	Erosion Productivity Impact Calculator
FAO	Food and Agriculture Organization
FDI	Foreign Direct Investment
GCM	General Circulation Model
GHG	Green House Gases
HQC	Hannan-Quinn Criterion
IPCC	Intergovernmental Panel on Climate Change
IPS	Im, Pesaran, and Shin
ND-GAIN	Notre-Dame Global development Index
NSSA	Non-Sub-Sahara Africa
OECD	Organization for Economic Cooperation and Development
OLS	Ordinary Least Square
PCA	Principal Component Analysis
SC	Schwarz Criterion
SDGs	Sustainable Development Goals
SSA	Sub-Saharan Africa
UNDP	United Nations Development Fund
UNFCCC	United Nations Framework Convention on Climate Change
WDI	World Development Indicators
WGI	World Governance Indicators
WGBT	Wetbulb Globe Temperature

## ABSTRACT

This paper examines the climate change effect on inclusive growth and the possible moderating role of adaptive capacity in climate change/inclusive growth in the long and short-run. The study employs temperature change anomalies (with 1951-1980 as the baseline climatological year) and CO<sub>2</sub> emissions (metric ton per capita) as variables for climate change and a set of variables as indicators to measure inclusive growth. These set of indicators are adopted from the Asian Development Bank (2014) key indicators for inclusive growth which falls under five broad categories namely: Poverty and inequality; Growth and Expansion of Economic Opportunity; Social Inclusion to Ensure Equal Access to Economic Opportunity; Social Safety Nets; Good Governance and Institutions. Out of this, the study obtains a single variable using Principal Component Analysis (PCA) and fitting the dataset to an Autoregressive Distributed Lag (ARDL) model we determine the long and short-run effects of climate change and adaptive capacity on inclusive growth and the moderating role of adaptive capacity.

The studies establish that temperature change anomalies and increases in CO<sub>2</sub> emissions lead to a fall in inclusive growth significantly. Thus, climate change has a negative impact on inclusive growth. The study also demonstrates that adaptive capacity contributes to inclusive growth significantly but only in the short-run. However, when the individual component of climate change is considered we observe a significant effect of climate change on mortality rate under 5 (per thousand live births) and contributing family workers (as a percentage of total employment) with adaptive capacity mitigating the negative impact of temperature change anomalies and carbon dioxide in relation to mortality rate. The study, therefore, indicates that climate change negatively affects climate sensitive indicators of inclusive growth and also these sensitive indicators responds appropriately to climate adaptation efforts and strategies.

## CHAPTER ONE

### BACKGROUND OF THE STUDY

#### 1.1 INTRODUCTION

The debate as to whether economic growth is in and of itself sufficient for sustainable development still remain among policymakers and researchers (Ncube, 2015). This debate is driven by the fact that economic growth across the continent is not accompanied by improvement in the living conditions of its people despite records of economic growth. The call by civil societies for the inclusion of the poor in the growing process as well as benefits from its outcome is ever increasing. Economic growth is described as a disguise for the gap that exists between the poor and rich. Thus, positive economic outcomes are good on many fronts, nevertheless, such outcomes have rather served to create insecurities through widening disparities between the poor and rich. Such disparities have led to the distrust of government by citizens and civil societies who are calling for the need for growth that is broader and ensures societal progress (Stiglitz, Sen, & Fitoussi, 2009)

Largely, the economic growth of countries on the African continent is understood to be characterized by disparities and inequalities which are attributable to the lack of structural transformation and sectoral diversification. Faced with the task of ensuring inclusiveness in the growth process, governments and policymakers have responded by ensuring that growth is inclusive, spelling broader economic growth that benefits all. Inclusive growth refers to how fast growth is occurring as well as the form of such growth. It is a concept that embraces equity and equality. Inclusive growth highlight social welfare needs that cover non-income dimensions. It therefore, focuses on gender, ethnic and the geographical rather than economic outcomes alone (Ranieri & Almeida Ramos, 2013).

On another front, documentation indicates that climate change affects the economic growth of Africa (Abidoyea and Odusola, 2015; Odusola and Abidoye, 2015; Lanzafame, 2014; Dell et al., 2010; Fankhauser & Tol, 2005; Ouattara & Strob, 2008). This is because Africa's economy is largely driven by primary manufacturing sectors which are linked to the climate.

As a result, economic losses created by climate change risk poses challenges to socio-economic development in developing and emerging economies, resulting from the high level of dependency of the poor on agriculture and forestry which are climate sensitive. It increases poverty and has the potential to repress inclusive growth, which is fundamental to sustainable development and growth across developing regions. The World Bank (2016) documents that 26 million people are forced into poverty each year resulting from climate change risk and this could reach 100 million people by 2030 with South Asian and Africa being hit the hardest. Africa emits less greenhouse gas emissions (GHG) (UNDP, 2006), yet it suffers more from the effects of climate change. Insufficient adaptation and a low adaptive capacity multiplies this effect. This could spell trouble for Africa's efforts towards inclusive growth making it a daunting task since such efforts channeled towards inclusive development and growth could be reversed by such threat.

This makes the climate change situation in Africa serious and costly, affecting developmental efforts and strategies, particularly the wellbeing of its poor. Africa accounts for an insignificant amount of greenhouse gas (GHG) emissions and yet suffers extreme damaging effects than any other region (World Bank, 2015; Coumou et al., 2016; AfDB, 2011; Barr et al., 2010; IPCC, 2007), due to its high level vulnerability (Hallegatte, 2015; Gupta, 2014). The need to tackle this challenge for Africa becomes more pressing for the international community as climate change stands in the way of sustainable growth and its related issues like poverty and environmental sustainability (UN, 2015; Brown et al., 2010). This has garnered commitments and response from countries across the globe culminating in adaptation and mitigation efforts

to contain this fallout. For developing countries, particularly Africa, adaptation efforts have taken centre stage in policy strategies suggesting its importance compared to mitigation efforts because of its vulnerability (Barr, Fanhauser & Hamilton, 2010).

The negative effect of climate change on the continent is not far out in the future and is already taking place. As such, the continent's response is not the immediate reduction of greenhouse gas emission (CIGI, 2009) but building resilience and adaptive capacity. Therefore, whereas the response in other regions would be to consider mitigation strategies, for Africa, the way forward would be to emphasize adaptation strategies and build adaptive capacity (Collier, Conway & Venables, 2008) that sustains growth. Adaptation strategies to confront these fallout is, without doubt, the way forward if it is to experience shared economic growth. How effective these strategies are depend on the level of adaptive capacity (Smit & Olga, 2009), therefore, if the ability to adapt is low or non-existent vulnerability levels will increase.

In Africa's quest to pursue inclusive growth, it becomes paramount that any progress chalked is not eroded. Consequently, it becomes important to enhance adaptive capacity (Ensor, Hoddy & Ratner, 2015). Smit and Pilisofova (2003) remark that activities that augment adaptive capacity can be pursued together with sustainable development goals that promote the living condition of the poor. In fact, Robinson and Herbert (2001) by analysing climate change and sustainable development together, have argued that an analysis of both come with essential benefits.

Adaptive Capacity has been established to be closely associated with sustainable development making adaptive capacity fundamental to sustainable development and equity (IPCC, 2007). It has an influential role that is critical to the sustenance of developmental goals (Engle, 2011; Folke, 2006). Adaptation strategies carried out deliberately tend to bring about equity in sustainable development (IPCC, 2007). Even though sustainable development goals have the

potential of increasing adaptive capacity, certain types of development must be designed and pursued to contain climate change. Consequently, an adaptive capacity that is designed to tackle climate change will help reduce vulnerability and help promote sustainable development. Countries on low resources such as technology, infrastructure and information and the access to resources lack the capacity to adapt (Smit & Pilisofova, 2003).

Accordingly, development particularly inclusive growth that captures climate change, emission reduction efforts, adaptive capacity and resilience are needed to safeguard developmental efforts and assistance against climate change threats thus ensuring sustainability. This reduces vulnerability and increases resilience against climate stressors while also maintaining and advancing economic, environmental and social well-being that cuts across the poor. This suggests that the response of the continent to climate change challenges should not mainly be to manage and cope with the unavoidable but increase the continent's adaptive capacity against future climate change impact.

The link between sustainable development, climate change and economic growth have garnered quite some studies but considering a holistic approach, the examination of the influence of climate change on inclusive growth is extinct and this paper examines exactly that relationship as well as the moderating role adaptive capacity plays in this relationship. In this vein, the study examines climate change impact on inclusive growth and the possible moderating role of adaptive capacity, thus providing empirical evidence to support adaptation efforts contribution towards Africa's inclusive growth

## **1.2 RESEARCH PROBLEM**

Climate change has been established to influence economic growth (Abidoyea & Odusolab, 2015; Alagidede & Adu, 2014; Fankhauser & Tol; 2004) and also established to be linked to sustainable development (Munasinghe & Swart, 2007; Beg et al., 2002; Robinson & Herbert;

2001). All these studies have demonstrated the negative effect of climate change on economic growth which ultimately impacts the poor. It has implication for those affected but there is no empirical research relating to how the negative impact of climate change on the poor could be moderated. Therefore, in the context of individual wellbeing and standard of living the study examines the negative influence of climate change and how it can be moderated.

Distinct from others, this study examines climate change impact on inclusive growth while at the same time looking at how adaptive capacity moderates the negative impact of adaptive capacity on inclusive growth. This provides empirical evidence to support adaptation strategies and build adaptive capacity to confronting the negative impact of climate change in a way that increases resilience and ensures that progress in inclusive growth is not inhibited.

Consequently, the study employs carbon dioxide emission (COE) and temperature change anomalies ( $\Delta$ TEMP) as measures for climate change as well as key indicators for inclusive growth and adaptive capacity. The study employs data from 1995 to 2016 under the Autoregressive Distributed Lag (ARDL) estimator for panel data that allows the study to determine the short-run and the long-run effects of climate change and adaptive capacity on inclusive growth as well as the moderating effect adaptive capacity on the negative impact of climate change.

### **1.3 RESEARCH OBJECTIVES**

- To examine the long and short-run effects of climate change on inclusive growth
- To examine the long and short-run effects of adaptive capacity on inclusive growth
- To examine the moderating role of adaptive capacity on climate change negative effect on inclusive growth

### **1.4 RESEARCH QUESTIONS**

- What are the long and short-run effects of climate change on inclusive growth?
- What are the long and short-run effects of adaptive capacity on inclusive growth?
- Does adaptive capacity moderate the climate change negative impact on inclusive growth?

### **1.5 SIGNIFICANCE OF THE STUDY**

Climate change impact on economic outcomes has largely been negative (Abidoeye & Odusolab, 2015; Alagidede & Adu, 2014; Fankhauser & Tol, 2004) and is expected to have far-reaching consequences on shared growth, especially in the case of individual well-being. That is, if climate change has implication for economic growth, then it might impact the poor. Finding of the study will provide useful insights for policymakers and academics into climate change risk. For policymakers in Africa, this work becomes important because it provides empirical evidence to support the provision of adaptation efforts to moderate the impact of climate change which could affect shared growth. Therefore, the empirical verification of the moderating role of adaptive capacity to climate change impact on inclusive growth is critical. The Outcome of the study will lend support to the pursuit of adaptation strategies to be based more on evidence than guesswork. For academia, this research adds to literature by granting the academic community a better insight into the nexus between climate change, inclusive growth and adaptive capacity as well as open up discussion in this light that provokes thoughts and ideas to support Africa's inclusive growth agenda.

### **1.6 SCOPE AND LIMITATION OF THE STUDY**

The study investigates the impact of climate change on inclusive growth and the moderating role of adaptive capacity in the climate change and inclusive growth relationship. There were

no sampling techniques used here. Countries were selected based on availability of data. The study's limitation is in the fact that the period of study is too short, considering that climate change is better assessed when it is taken over a longer period of time.

### **1.7 ORGANIZATION OF THE STUDY**

The study begins with an introduction, research problem, the significance of the study and the organization of the study which is captioned as chapter one. Chapter two provides an examination of the literature, while chapter three provides the methodology, showing the method for analysis of the data and estimation procedures. Chapter four presents the results, the analysis and discussion with chapter five focusing on the conclusion, policy implication and recommendations.

## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.1 INTRODUCTION**

Scientific evidence suggesting the warming of climate systems is undisputable. Global warming affecting climate systems has led to changes in the climate that negatively affects food security and agriculture, health, economic growth, conflict and energy. A careful examination of these negative effect helps design economic policies and institutions that mitigate these threats (Dell, Jones and Olken, 2013). Examining climate change negative effects is important because it enables us to estimate the potential economic implication of future climate change (Dell et al., 2013). As a result, it becomes paramount that developing countries ensure that climate change risk is documented and integrated into the developmental agenda of Africa.

#### **2.2 CLIMATE CHANGE IMPACT CHANNELS**

Africa faces a direct impact of climate change since the continent directly depends on agriculture whiles exhibiting low capacity to adapt (Collier, Conway & Venables, 2008). According to the UNFCCC (2007) factors like poverty, lack of technology, illiteracy and lack of skills, weak institutions, limited infrastructure and information, low levels of primary education and health care, low management capabilities, poor access to resources and armed conflicts contribute to low adaptive capacity. The World Bank (2010) also confirms this by saying that the presence of certain factors in developing countries account for its vulnerability. These are weak institution, limited financial and human resource, natural fragility and high exposure to drought and floods and the reliance on climate-sensitive resources. The poor

mostly bare the brunt of climate change fallout and yet its greenhouse gas emissions are low (IPCC, 2014). Africa is recognized as the continent that suffers most from climate change. Decades gone by has seen climate change affect the continent through climate stressors like high-temperature anomalies, weather shocks, floods, sea level rise, increasing aridity, drought and rainfall variability, affecting productivity, health, education and food security.

### **2.2.1 Climate Change and Health**

WHO (2018) has linked increased mortality rate to climate change, estimating that between 2030 and 2050 it could lead to 250,000 additional deaths. The health of individuals is highly impacted by changes in the climate globally, with developing countries showing high vulnerability. The occurrence of weather shocks, flood, heat waves, storms and temperature change anomalies increases the occurrence of diseases like malaria, cholera, diarrhoea, dengue fever and vector-borne diseases – that is direct. However, climate change indirectly could affect health through food, water, migration and economic development (Michael et al., 2001).

Studies have shown that climate change affects health. Wu, Lub, Zhou, Chen and Xua (2016) reviewed the literature on climate change and human diseases and identified two schools of thought. Firstly, those studies that viewed an increase in health risk through climate change and secondly, studies that considered the array of climate variations or weather conditions that causes certain pathogens and hosts to thrive. Tol (2002a) estimated that an increase in global mean temperature leads to a corresponding change in mortality rate which is caused by vector-borne diseases. Wu et al. (2016) also found out that a relationship exists between weather conditions and certain water and vector-borne diseases (Diarrhoea, Nile Fever, respiratory diseases, Hemorrhagic Fever) but this is not accepted by other researchers who try to desist from establishing a definite causal relationship between climate change and health.

Studies have used climate change measures like cyclones, drought, famine and floods to establish the relationship between climate change and health (Wang, Minnis, Belant & Wax, 2010; Kan, 2011; Shultz, Russell & Espinel, 2005). Shultz et al. (2005) found out that cyclones increase the occurrence of cholera and Sanders, Jose, Smits, Deseda and Vorndam (1999) has attributed the increases in leptospirosis in Puerto Rico to a cyclone that occurred in 1966. The health threat linked to climate change contributes to increasing probability of mortality and morbidity and there is enough empirical evidence to support this. Bai, Cirendunzhub, Woodward, Dawa and Liu (2014) investigated the effects of hot and cold temperature on death and the result suggested a robust temperature effect on heart-related death compared to the others with sociodemographic characteristics associated with vulnerability to hot and cold temperature effects. In Germany, Hübler, Klepper and Peterson (2008) focus on the effects of temperature on human well-being by employing possible climate scenarios. They concluded that temperature changes lead to casualties by a factor of 3.7. This is so because the elderly are believed to suffer from heat waves which is confirmed by Bai et al. (2014) whose study linked death tolls to sociodemography.

In the summer of 2003, 70,000 death tolls were associated with global warming in Europe which accounted for a major distortion in the age and gender structure of Europe (Robine, Cheung, Roy, Sophie, Oyen, Griffiths, Michel, Herrmann, François, 2008). This was further confirmed by Amengual, Homar, Romeroa, Brooks, Ramis, Gordaliza and Alonsoa (2014) who established a positive association between mortality rate and heat wave for the year 2003 in Europe. Majority of these studies tended to find a high mortality rate among the elderly population to heat waves compared to the youthful population.

The health risk posed by climate change also tends to translate into low productivity ultimately affecting the overall progress of the economy. Langkulsen (2010) examined the link between heat exposure and productivity among five industries namely pottery, power plant,

construction, knife and agriculture using the Wetbulb Globe Temperature (WGBT). They found out that the agriculture industry showed the highest result at a 34.6° celcius during the hours of 12:00 pm and 1:00 pm with pottery and construction exhibiting low productivity between the range of 10% and 60%. Kjellstrom, Holmer and Lemke (2009) comment that climate change affects occupational health thus substantially reducing labour productivity and the working capacity of people. Thus, they found that workers are affected by hotter working environment which exceeds their normal body temperature. The other implication of this is that, workers worked for long periods of time to achieve the similar levels of output as before.

### **2.2.2 Climate Change and Agriculture**

The agriculture sector of developing countries accounts for a greater proportion of employment, employing 60% to 80% of the population. With the agricultural sector depending heavily on natural methods of irrigation (rainfall and water bodies), a change in the weather could have far-reaching consequences. This together with other factors like a low investment, poor access to services, agro-ecological features and poor irrigation schemes tends to affect agricultural sector development (Calzadilla, Zhu, Rehdanz, Tol and Ringler, 2013)

Studies suggest a direct link between climate change and agriculture, with climate change negatively affecting crops yields and livestock. A study by Li, Takahashi, Suzuki and Kaiser (2015) establish that maize production for the period 2008 and 2030 was affected by climate change. A combination of temperature changes and precipitation both had a positive and negative impact on maize yield with the economic condition and regional climatic conditions contributing to differences in impacts across different regions. Barrios, Ouattara, and Strobl (2008) conclude that rainfall and temperature determined the in Sub-Saharan Africa's total agriculture production, however, the opposite was true for non-Sub-Sahara Africa.

It affects the net revenue in maize production under different climate scenarios (Coster & Adeoti, 2015). Jones and Thornton (2003) indicates that Latin America and Africa should experience a 10% decrease in maize production should by 2055. For other crops like sorghum, millet, wheat, rice, yam, cassava and sugarcane, Knox, Hess, Daccache and Wheeler (2012) projected that climate impact by crop type (in both Asian and African sub-region) would lead to a yield of 8% in the both region by 2050.

In an earlier examination, Adejuwon (2006) studied the response of crop yield to temperature, humidity, radiation and carbon dioxide concentration while at the same time looking at variations in crop yields. This was replicated using 1961-1990 as a baseline for mean conditions. He predicted that crop yield will increase in first half of the 21<sup>st</sup> century and fall during the second half.

The implication of climate change on agriculture has consequences for food security through the reduction of net crop production (Connolly-Boutin & Smit, 2016; Zwedie, 2014; Felix & Romuald, 2012).

Maddison, Manley and Kurukulasuriya (2007) examined climate threat on the perceived value (the productive value and sale value) of farmlands by farmers or land owners (thus with reference to soil quality and runoff) and confirms that the landscape of Africa's agriculture is particularly vulnerable to climate such that by providing the necessary adaptation strategies they predict that loses of agriculture production will be reduced.

### **2.2.3 Climate Change and Economic Growth**

Climate change has been established to have a socio-economic impact pervading every sector of an economy. Scheraga et al. (1993) have affirmed that climate-sensitive sectors of an economy affect growth. The assessment of its effects on economic growth has seen the use of the enumerative approach in most studies according to Fankhauser and Tol (2005). But such

studies fail to incorporate the dynamic intertemporal effects and also provide information on the effects of climate change on the welfare of an individual.

Temperature change has the potential of reducing GDP growth by 0.25% at a 3° Celsius warming scenario in the US (Nordhaus, 1994). At a temperature rise of 2°-3° Celsius in the next 50 years (Stern, 2006), it has the potential of impacting GDP growth. In their paper, using data from 1990-2009, Abidoyea and Odusola (2015), confirm that an increase in temperature accounts for a 0.67 percentage decrease in GDP growth.

Maddison (2007) examines how farmers adapt to climate change using eleven African countries, concluding that agricultural is particularly sensitive to climate risk. Alagidede and Adu (2014) by using kernel regression method in estimating the link between temperature and economic performance, conclude that the relationship between the two are intrinsically linear and monotonically decreasing at a constant proportionate rate, thus the rise in temperature considerably decreases economic outcomes.

Using temperature and precipitation for a 50 year period, Dell, Jones and Olken (2013) establish that the economic growth is vital to weathering the potential damage a country could suffer from climate change impact. In other words, poor nations possess a low tendency to withstand its impacts. Milliner and Dietz (2011) affirm this by asserting that the economic development of a nation predicts the ability of a nation to withstand climate change threats. However, they also make a case that channelling climate finance for the purpose of adaptation is of no significance because they do not amount to much. Generally, the above empirical study show that temperature, precipitation and extreme weather events have an economic implication, substantially influencing economic outcomes (Dell et al., 2013).

O'Brien & Leichenko (2000) adopts the combined effect of climate change and globalization as a framework. They use the concept of double exposure based on the reasoning that

discussions on those who benefit and those who lose from climate change and globalization do not take into account both process simultaneously. Mideksa (2010) by using sector-wise disaggregated general equilibrium model, estimates economic wide climate change effect and concludes that decrease in the agricultural sector output, as well as sectors linked to the sector, decreases Ethiopia's GDP by 10% and Gini – coefficient rises by 20% widens income inequality resulting in poverty and economic growth reduction.

### **2.3 INCLUSIVE GROWTH: THEORETICAL LITERATURE**

Despite the recorded economic growth amongst developing countries, growth is said to be uneven because this growth results in income inequality. GDP increase, for instance, could suggest a healthy economy but the public's view on wellbeing might suggest otherwise (Stiglitz, 2009). Consequently, the measurement of economic progress has become a subject of keen interest among politicians. Discussions today have centred on welfare measurement away from the traditional macroeconomic measurement (Stiglitz, 2009). The concept of Inclusive growth has rapidly caught up with policymakers and is increasingly becoming prominent in policy discussions and research, yet a working definition remains elusive among researchers (Ranieri & Ramos, 2013). For Suryanarayana (2013), the concept of inclusive growth can be viewed from multiple dimensions. With particular emphasis on dimensions such as the number of people that participates in the growth process, the reduction of poverty and inequality, a reduction in the number of disadvantaged, distributional value judgment and policy priorities.

Inclusive Growth is defined as the pace and process of growth. In other words, it is growth that allows people to partake in the process towards growth and benefit from growth outcomes (Ianchovichina & Lundstrom, 2009). Anand, Mishra and Peiris (2013) rather put it this way, that 'inclusive growth refers to the pace and distribution of economic growth'. Inclusive growth

considers two strands of measurement, thus economic outcomes and social welfare. By so doing it looks at achieving economic outcomes that is undergirded by the strong structural transformation. The implication of this is that there is a broad-based transformation that cuts to every member of the society particularly the poor and the disadvantaged. Although similar to pro-poor growth, it differs in that, whereas pro-poor growth highlights incomes of the poor, inclusive growth highlight social welfare needs that cover non-income dimensions. The concept of inclusive growth, therefore, focuses on gender, ethnic and the geographical rather than economic outcomes alone (Ranieri & Almeida Ramos, 2013).

Inclusive growth and Pro-poor growth are used with the same meaning but both are different. Pro-pro growth ensures that the poor benefits from growth (Ali, 2007) and it is achieved at the expense of benefits to other groups (Ranieri & Ramos, 2013). Pro-poor growth reduces poverty through the channel of income redistribution or bridging the income inequality gap to benefit those with lower income. As a result, growth is uneven (Cord, Lopez & Page, 2003) and this occurs when the benefit to the poor exceeds that of the non-poor. Therefore, for pro-poor growth, two broad definitions emerge (Cord et al., 2003). First, Pro-poor growth is growth that is largely in favour of the poor, with emphasis on reducing inequality (Dollar & Kraay, 2002; Mcculloch & Baulch, 2000; Kakwani & Pernia, 2000; Kakwani & Son, 2000) or growth reducing poverty in unconditional terms (Klasen, 2008; Grosse, Harttgen & Stephan, 2008; Ravallion & Chen, 2003)

The connection between inclusive and pro-poor growth is brought to light when relative pro-poor growth is in view (Ranieri & Ramos, 2013). Relative pro-poor growth robes in the poor and rich at the same time. However, Rauniyar and Kanbur (2009) believe the contrary. They remark that if poverty reduction is associated with inclusive growth then they both mean the same thing. Accordingly, they suggest that inclusiveness focuses on reducing income inequality thereby making it more or less pro-poor growth in nature. Rauniyar and Kanbur

(2009) rather coin a different term for inclusiveness in emphasizing this difference by calling it inclusive development. Ali and Zhuang (2007) understand inclusive development to mean growth associated with equal opportunities, thereby increasing the potential for growth.

The concept of Pro-poor growth is exclusive to the poor while inclusive growth considers both the poor and non-poor (Klasen, 2010). There are other terms like shared growth and broad-based growth that also describe the concept of inclusive growth. Klasen (2010) uses “nondiscrimination” as a way of better capturing the very nature of inclusive growth (i.e. nondiscriminatory growth and nondiscriminatory access to growth). Also, Inclusive growth looks not only at engaging the masses in the growth process but covers the non-income dimensions of well-being (Klasen, 2010), leading to what others have called inclusive development (Gupta & Vegelin, 2016; McKinley, 2010; McKinley, 2009;).

Ali and Yao (2004) emphasise the importance of inclusive growth by looking at a balanced regional growth and structural transformation within a country. This is observed in the work of Ianchovichina and Lundstrom (2009) when they consider inclusive growth to be the pace and pattern of growth which then focuses on long-term sustainability and structural transformation. This may require that growth pervades every sector of the economy. Thus to ensure an enduring growth process there is the need to shift from income distribution approach to poverty alleviation which is short-term in nature to inclusive growth which has the potential to ensure long term sustainable development by focusing on production employment. In other words, utilizing the labour force that is trapped in unemployment to drive poverty reduction and equity.

Bhalla (2007) concurs by asserting that employment is a major part of inclusive growth. The Asian Development Bank and the World Bank has also stressed the importance of employment opportunities in shared growth. Ianchovichina and Lundstrom (2009) go further to stress productive employment and not just employment. For that matter, while new employment

opportunities are being created productivity must improve. Increasing employment is necessary for sustainable growth because the poor depends on labour as an important asset. In this way, countries are able to undertake structural transformation and regional growth that ensures sustainability ultimately.

Inclusive growth ensures equity by offering equal access to opportunities besides creating new opportunities (Ali & Son, 2007). It mainly looks at the poor participating actively in the economic growth process through productive employment. This leads to empowerment, security and sustainable development. It emphasise more on equality at every level in society whether rich or poor. This notwithstanding, economic growth proves to be a necessary condition for inclusive growth and should not be ignored. Therefore the economic growth process is to be seen in two strands when examining social progress. That is the participation of a broad category of people and people benefiting from economic outcomes. Inclusive growth also puts emphasis on the process that produces economic outcomes besides the pace of growth (World Bank, 2009). By process, it mean the participation and contribution of the labour force to economic outcomes.

Klasen (2010) adds that inclusive growth is also outcome oriented in addition to the process. Following from this, the question that needs to be asked in the event of growth episodes is whether it is characterized by the nondiscriminatory participation of all and whether it benefits all. Inclusive growth is characterized by the integration of poverty reduction and growth in its analysis (World Bank, 2009). However, Ianchovichina and Lundstrom (2009), remark that, rather than focusing on income redistribution as an approach to narrowing the inequality gap, it uses a long-term approach with an emphasis on productive employment as pointed out by the World Bank (2009). The benefit of inclusive growth cannot be overemphasized and has been recognized in many strategic documents as the way forward for shared growth.

With this said the concept of inclusive growth is beginning to gain grounds in the development literature arousing interest among scholars and policymakers because, at its heart, it looks at the reduction of poverty and inequality (Ranieri & Ramos, 2013). The sudden advocacy for inclusive growth in recent times is traceable to the core value of most society (Dabla-Norris, Kochhar & Ricka, 2015). Without this, a social fallout of rising levels of inequality and poverty could serve as a high ground for insecurity. This makes the current economic model for socioeconomic development ineffective and unsustainable because of the threat of civil unrest, war, and conflict caused by inequalities and this could reverse any already achieved economic outcomes (Pottebaum, 2005).

#### **2.4 INCLUSIVE GROWTH: EMPIRICAL LITERATURE.**

Empirical studies have examined the nexus between poverty reduction, inequality and growth. By re-examining and using more comprehensive data, Deininger and Squire (1998) compare the outcome of using income redistribution approach proxied by the redistribution of land to the creation of a new asset (investment). Their findings suggest that a deviation in land inequality yields a 1.05% growth rate rise in income whereas a one standard deviation change will yield a 1.08% increase in income and in their view the creation of new assets will contribute significantly to poverty reduction compared to the redistribution of an already existing asset. However, earlier research by Birdsall and Londono (1997) seems to suggest otherwise. By controlling for initial asset inequality, they conclude that income inequality does not affect growth. This is in line with Kuznet (1955) who points out that at the beginning of economic growth, a growing or widening inequality is experienced but later improvement in later stages of growth. In the test of the Kuznets hypothesis, a greater emphasis has been given

to the use of cross-sectional time series data as a better tool for tracking inequality within an economy.

Despite support by studies for the Kuznet's hypothesis, other studies have yielded varying outcomes (Kanbur, 1993; Saith, 1983; Oshima, 1962). Studies have also shown how important economic growth is for poverty reduction. Dollar and Kraay (2002) found out that there is a proportionate increase in the incomes of the poor and that of averages of income. This was true for all regions, time periods, income levels and growth rates they examined. The result suggests that a necessary ingredient in poverty reduction is economic growth. They further remark that the extent of poverty reduction defer across regions and countries. This is due to the difference in the various determinants of growth as concluded by their study. These cross-country differences due to growth determinants according to studies are attributable to asset inequality, income and poverty as well as demography, governance, politics, social considerations and existing policies (Ianchovichina & Lundstrom, 2009).

The World Bank (2008) points out that even though the fundamentals of an economy are necessary for growth they do not depict the entire picture of poverty reduction. The effective distribution of growth is also very important (White & Anderson, 2001). This suggests that economic growth and poverty reduction can be achieved together unlike the widely held notion that both cannot be achieved concurrently. As Ianchovichina & Lundstrom (2009) perfectly put it, a high sustained growth rate and poverty reduction can both be achieved when the roots of growth and labour employment are growing. Lopez and Serven (2007) also stresses that the poorer a country the important the growth component.

## **2.5 DETERMINANTS OF INCLUSIVE GROWTH**

As indicated earlier, Inclusive growth considers economic growth that gives particular attention to the poor in society. Even though fast economic growth is necessary, it has to robe in the masses that ensures long-run sustainable growth. Inclusive growth links the macro and micro determinants of growth (Ianchovichina & Lundstrom, 2009). This notwithstanding, almost whatever inclusive growth conceptual discussion has focused on two main areas namely growth process and growth outcomes. inclusive growth carries with it the notion of benefitting from growth outcomes and growth process (Klasen, 2010). Inclusive growth goes beyond meeting the needs of those beyond the poverty line to include the non-poor as well. It ensures that in the distribution and contribution to growth episodes there is equal participation across every demography and geographical characteristics.

### **2.5.1 Openness of Trade**

Several studies have shown that trade openness is crucial to the wealth of countries, especially developing countries, although results have been mixed and inconclusive. The mixed result in literature is considered to be attributable to differences in the level of analysis in the openness of trade and economic growth relationship (Siddiqui & Iqbal, 2010). The benefit of trade liberalization cannot be overemphasized. The openness of trade presents countries with the opportunity to trade internationally with other countries opening it to new markets, increasing production which in turn increases employment. Dollar and Kraay (2004) have established that countries that removed trade barriers experienced an increase in volumes of trades. According to them, whereas the growth rates of developed rich countries are slowing down, that of developing countries picked up pace from the 1970s through to the 90s. China and India have been good examples. They comment that trade volumes changes have a positive association with growth rates which in turn has shown benefits to the poor. In assessing the effects of global

integration on the economy of China and India, Marelli and Signorelli (2011) discovered there is a positive outcome of economic growth for the two countries resulting from their integration with the world economy. Keho (2017) and Marelli and Signorelli (2011) conclude that it has a positive effect both in the long and short-run. Comparatively, developing nations benefit more from trade liberation than developed nations Rassekh (2007). It has been observed that observe that seven out of ten free trade indices influence economic growth (Zarra-Nezhad, Hosseinpour & Arman, 2014). Despite the advantages that accrue to trade liberalization, it worthy to note that trade liberalization may have a negative implication for poor nations. Zarra-Nezhad et al. (2014) determined that domestic investment, foreign direct investment and black market premium are the channels through which trade openness influence economic growth. This is corroborated by Kim, Lin & Suen (2011) when they establish that “greater trade openness tends to have strong beneficial effects on real income for high-income countries but detrimental impacts for low-income ones”.

There is a negative effect on countries that tend to have low financial development Keho (2017). This may further contribute to the problem of inequality (Kim et al., 2011). Anand et al. (2013) observe that foreign trade reward those that are able to compete on the global market. Consequently, the benefit of trade openness can be reaped if the necessary favourable environment such as technology, infrastructure and human capital are put in place especially for developing countries.

### **2.5.2 Fixed Investment/Capital Formation**

The neoclassical and the endogenous growth model identifies investment as a vital component in economic growth. Ongo and Vukrnkeng (2014) refer to capital formation as an investment in a fixed asset used for production, capital stock, human capital accumulation and labour force. Empirically, evidence show that high investment rate is linked to high growth rate. Capital

formation "is the acquisition (including purchases of new or second-hand assets) and creation of assets by producers for their own use, minus disposals of produced fixed assets" OECD (2018). Examples include the construction of road, machinery, building (schools, hospitals) etc. Majority of study has offered strong support for the link between fixed capital formation and growth rate (Podrecca & Carmeci, 2001). Uneze (2013) observed a bi-directional causality between economic growth and capital formation using panel cointegration and causality testing techniques. In other words, whereas economic growth feeds capital formation, it in turns feeds economic growth. We also observe this in the work of Bal et al. (2016) using India as a case study for the period 1970 to 2012. The studies show a significant positive relationship both in the long and short-term. The benefit of capital formation is that it solves the problem of the balance of payment deficit, by way of substituting the primary industry. Also, it increases technical progress, adequate exploitation of natural resources and foreign debt (Ongo & Vukrnkeng, 2014). Literature suggests that gross capital formation is influenced by foreign direct investment both directly and indirectly and has the potential of building capital stock. However, Gorg and Greenaway (2004) point out that there is a negative implication for developing countries because foreign firms making an investment in foreign countries drive indigenous firms out of business. Consequently, the literature has lent support for the positive relationship that exists between economic outcomes and capital formation. Capital formation increases the potential of a country for production which in turn increases gross GDP growth. The role of Capital formation is a key component in economic growth and in this regard inclusive growth.

### **2.5.3 Foreign Direct Investment**

The movement of investment from one country to another is termed foreign direct investment. Evidence indicates that the benefits of FDI are numerous. It increases capital stock formation, creates employment, facilitates the transfer of innovation and technology and the reduction of poverty among others. This ultimately feeds into the overall economic growth of a country. FDI is capable of contributing to growth that is inclusive and reducing poverty. According to Klein (2001), FDI is the channel through which economic development can be translated into broad-based growth making it a central element in the World Bank poverty reduction goals. In the studies of Iamsiraroj (2016), by examining the FDI-economic growth nexus, his conclusion suggests that economic growth can determine and be determined by FDI. He concludes that labour force, conducive investment environment and trade openness are necessary elements that influence FDI. In the case of China, Gunby, Jin and Reed (2017) attribute a surge in economic growth to increase in FDI.

### **2.5.4 Financial Openness**

Financial openness deals with the the removal of restriction in the financial market to allow for accessibility. Financial openness occurs when a system opens up to foreign capital inflow with its system structured to meet foreign demands (Estrada et al., 2015). This augments the flow of cash to priority sectors of an economy which spurs growth. Bekaert et al. (2009) splits economic growth into capital stock and total factor productivity growth and observed that openness of the financial system increases total factor productivity. Their result did not show temporary effects only but showed permanent effects as well. The opening of the equity market accounts for strong economic outcomes. For instance, Bekaert et al. (2005) highlight that the opening of the equity market contributed to a 1% significant increase in GDP per capita annually. They explain that the large significance is possibly due to the connection

between macroeconomic reforms and financial development. Beck and Levine (2002) showed that stock markets and banks enhance economic growth substantially. The development of banks and the level of liquidity in the stock markets yield a positive economic outcome, capital accumulation and the improvements in productivity (Beck & Levine, 2002; Levine & Zervos, 1998; King & Levine, 1993). Again, we observe this in the work of that a positive relationship exists between both variables.

This notwithstanding, financial openness and development could be detrimental to developed countries. For instance, Estrada, Park and Ramayandi (2015) pointed out that for developing countries, financial openness tends to be beneficial, but in a situation where financial openness turns to be very high, it may show a weaker effect. For them, in order to harness the potential benefit of financial openness, there is a need to ensure sound regulation in the financial sector. Also, financial openness has shown to be weaker in poor countries and the reason is that funds may not be allocated to productive sectors of the economy which could have a repercussion for economic growth (Estrada et al., 2015). This, therefore, suggests that financial openness is important for developing countries compared to advanced countries which are also an important element for the inclusive growth agenda.

### **2.5.5 Education**

Education provides the poor with skills and know-how which has the potential of gaining them employment or entrepreneurial skills to enable them to cross the poverty line. According to Schultz (1971), it increases the income levels of individuals. In other words, education more often than not leads to human capital development leading to productivity and a rise in income levels. This is a key component for ensuring inclusive growth. Mundra (2012) looked at education and the economic status of women in the elite groups in India and showed that the

top caste who had a high level of literacy showed an increased economic status. Bloom, Canning, Chan and Luca (2014) find that tertiary education affects economic growth positively because it increases technological progress and puts a country in a position to maximize its potential. Having confirmed the importance of education for economic growth in literature by most studies, what most studies failed to do is look into details the component part of education that affects economic growth. Keller (2008) answers this in his study by demonstrating that, primary education increases physical capital, secondary education leads to openness and decrease inflation and tertiary education was linked to political rights. Among all of them, secondary education contributed to growth per capita.

## **2.6 ASIAN DEVELOPMENT BANK KEY INDICATORS FOR INCLUSIVE GROWTH**

The studies adopted some indicators for inclusive growth from Asian Development Bank that covers five broad categories. In this, we measure inclusiveness using these indicators

### **2.6.1 Poverty and inequality Indicators**

Economic growth has not always yielded a fair income distribution but rather have served to increase inequality and compound poverty. It is should, however, be noted that the growth of an economic is necessary for inclusive growth but not adequate. Inequality and poverty indicators provides information on the poor. The following are the indicators:

- The proportion of the population living below the national poverty line
- The proportion of the population living below \$2 a day at 2005 PPP\$
- The ratio of income or consumption of the highest quintile to the lowest quintile
- 4 Average years of total schooling (youth and adults)
- Prevalence of underweight children under 5 years of age
- Under-5 mortality rate per 1,000 live births

### **2.6.2 Growth and Expansion of Economic Opportunity**

This category of indicators carries the idea that growth should be participatory, with individuals serving as agents of growth. It measures the extent to which individuals participate in the growth process and are themselves.

- The growth rate of GDP per capita at PPP (constant 2011 PPP\$)
- The growth rate of average per capita income or consumption 2005 PPP\$ (lowest quintile, highest quintile, and total)
- Employment-to-population ratio
- GDP per person engaged at constant 1990 PPP\$
- Number of own-account and contributing family workers per wage and salaried workers
- Per capita consumption of electricity
- Percentage of paved roads
- Number of mobile-cellular subscriptions per 100 people
- Depositors with commercial banks per 1,000 adults

### **2.6.3 Social Inclusion to Ensure Equal Access to Economic Opportunity**

Social inclusion indicators that ensure equal access to economic opportunity includes:

- School life expectancy (primary to tertiary)
- Pupil–teacher ratio (primary)
- Diphtheria, tetanus toxoid, and pertussis (DTP3) immunization coverage among 1-year-olds
- Physicians, nurses, and midwives per 10,000 population
- Government expenditure on education as a percentage of total government expenditure
- Government expenditure on health as a percentage of total government expenditure

- Percentage of population with access to electricity
- The share of households using solid fuels for cooking
- The proportion of the population using an improved drinking water source
- The proportion of the population using an improved sanitation facility
- Gender parity in primary, secondary, and tertiary education
- Antenatal care coverage (at least one visit and at least four visits)
- Gender parity in labour force participation
- Percentage of seats held by women in the national parliament

#### **2.6.4 Social Safety Nets**

- Social protection and labour rating
- Social security expenditure on health as a percentage of government expenditure on health
- Government expenditure on social security and welfare as a percentage of total government expenditure

#### **2.6.5 Good Governance and Institutions**

- Voice and accountability
- Government effectiveness
- Control of corruption

### **2.7 ADAPTATION**

The word adaptation was first used in the 17<sup>th</sup> Century which is the changes in the nature of things and system in order to fit the new situations. The concept of adaptation later came to be

used in the natural sciences as the ability of an organism or biological system based on its characterization, to survive environmental changes (Smit & Wandel, 2006; Kitano, 2002:). Its usage grew to include human beings and human systems, focusing on how individuals and society coped with the changing environment. We see its application in anthropology and cultural ecology. The literature on adaptation has since been increasing after the Third Assessment Report by the IPCC (Bassett & Fogelman, 2013).

The meaning of adaptation has largely been shaped in the context of vulnerability (Bassett & Fogelman, 2013). This informs how victims are to adapt to climatic stimuli (Ribot, 2011). The natural hazard school views climate risk as emanating from the interaction between natural and the human system and therefore planned adjustments to these natural events should be to moderate existing and potential damages (Bassett & Fogelman, 2013). The political economy, on the other hand, viewed this as problematic (Susman et al., 1983) and pointed out that vulnerability to climate stimuli emanates not from hazards itself and not from political and economic sources (Pelling, 2011) which in turn shapes vulnerability. They emphasise social structure and processes to be at the heart of vulnerability, thereby stressing the importance of the transformation of social structures. Scholarship in adaptation literature has tended to be guided by these views.

### **2.7.1 The Definition of Adaptation in Literature**

Smit and Pilisofova (2003) define adaptation as “...changes in processes, practices, and structures to moderate potential damages or to benefit from opportunities associated with climate change”. In their view, it looks at changing the process, structure and practices to moderate the impact as well as maximize the benefit from changes in the climate. Smit (1993) defines adaptation to be “adjustment that enhances the viability of social and economic activities and to reduce their vulnerability to climate, including its current variability and

extreme events as well as longer-term climate change”. Brooks (2003) considers adaptation as “adjustments in a system’s behavior and characteristics that enhance its ability to cope with external stress”. For Engle (2011), it simply refers to it as the inherent ability that enables one adapt to its environment. UNDP (2005) defines it to be “a process by which strategies to moderate, cope with and take advantage of the consequences of climatic events are enhanced, developed and implemented”. UKCIP, (2003) also defines it as “the process or outcome of a process that leads to a reduction in harm or risk of harm, or realization of benefits associated with climate variability and climate change”.

### **2.7.2 The Adaptation Concept in the IPCC Reports**

The First Assessment Report witnessed nothing on adaptation but the emphasis was placed on mitigation efforts to reduce greenhouse gas emissions (GHG) (Bassett & Fogelman, 2013). The second IPCC assessment report which was released in 1996 paved way for the discussion of adaptation options with increasing presence all through to the fourth IPCC assessment report. The following are the definition. The second IPCC assessment report defines adaptation as:

*“Adaptation is concerned with responses to both the adverse and positive effects of climate change. It refers to any adjustment - whether passive, reactive, or anticipatory - that can respond to anticipated or actual consequences associated with climate change. It thus implicitly recognizes that future climate changes will occur and must be accommodated in policy (IPCC, 1996).*

The third IPCC assessment report defines adaptation as:

*“adjustments in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts. It refers to changes in processes, practices, and structures to moderate potential damages or to benefit from opportunities associated with climate change” (IPCC, 2001)*

The fourth IPCC assessment report defines adaptation as:

*“Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploit beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory, autonomous and planned adaptation” (IPCC, 2007).*

The fifth IPCC assessment report defines adaptation as:

*“ The ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences” (IPCC, 2014)*

The common thread running through these definitions is the idea of adjustment of some sort that has to augment in order for a system to be resilient. This is in order so that systems are able to withstand shocks posed by extreme weather events, shocks, floods and drought.

### **2.7.3 Forms of Adaptation**

Autonomous adaptation represents a response to damages that have already occurred (Engle, 2011; Burton, Adger & Patwardhan, 2003), constituting a greater majority of adaptation efforts that take place (Tompkins & Adger, 2005). This form of adaptation may lead to maladaptation, which is any changes that serve to worsen vulnerability IPCC (2001). Planned adaptation, on the other hand, anticipates future climatic conditions and/or learn from past experience which enhances resilience and eases exposure (Engle, 2011; Burton et al., 2003). Planned adaptation could also be reactive and anticipatory (Burton et al., 2003). Reactive looks at the short-term and anticipatory looks at the medium to long-term adaptation efforts. The IPCC (2001) in

addition to the aforementioned also mentions public and private forms of adaptation. Private adaptation is “initiated and implemented by individuals, households or private companies” whereas public adaptation is “initiated and implemented by governments at all levels”.

## **2.8 ADAPTIVE CAPACITY**

The ability of a system to adapt to climate change is referred to as adaptive capacity which is vital to building resilience (Adger, 2006; Fussler & Klein, 2006). Accordingly, Smit et al. (1999) describe adaptive capacity “as the potential or capability of a system to adapt to (to alter to better suit) climatic stimuli or their effects or impacts” and this has a direct impact on how the environment and society respond to climatic conditions, stress and hazard. Adaptive capacity helps the affected to respond appropriately to changes in a system (Chapin et al., 2006). Adger (2006) refers to adaptive capacity as the ability to cope or the capacity to respond. Turner et al. (2003) indicates that there is a difference between the capacity to cope and adaptive capacity, stressing that the two terms do not mean the same thing. Smit and Wandel (2006) provides further insight, by stating that the "ability to cope" tends to be short lived compared to adaptive capacity.

Adaptive capacity, in fact, helps shape how a system can promote, inhibit, stimulate, dampen or exaggerate adaptation options or strategies (Burton et al., 2003). This has a positive influence on development (Lebel, Anderies, Campbell, Folke, Hatfield-Dodds, Steve; Hughes & Wilson, 2006) as well as augment adaptation strategies (Brooks & Adger, 2005). This enables systems to benefit from climate change (Adger, Agrawala, Mirza, Conde, O'Brien, Pulhin, Pulwarty and Smit, 2007).

Adaptive capacity tends to vary across systems. Adaptive capacity is uneven among and within nations due to the multiple stresses that shapes vulnerability (Adger et al., 2007). For example

in India, natural systems and technology has been shown to determine the outcome of vulnerability (O'Brien, Leichenko and Robin, 2004). Across districts in India, some farmers adapt well to climate change while others are not, due to the aforementioned conditions.

### **2.8.1 Adaptive Capacity in the Vulnerability Context**

The word “vulnerability” has witnessed myriad of usage and has occurred in different kinds of literature like the hazards, ecology and public health with different definition by scholars (Fussel, 2007). Vulnerability assessment becomes paramount if adaptation efforts and strategies are to yield its anticipated results. This gives a clear understanding of the negative effect posed by climate change allowing us to solicit appropriate climatic responses. What then is vulnerability? Smit et al. (1999) simply define vulnerability as the “susceptibility of a system to harm”. Adaptation options are a function of one's adaptive capacity and it helps reduces vulnerability through the augmentation of adaptive capacity. Adaptive capacity affects vulnerability (Adger et al., 2007; Eakin & Luers, 2006; Yohe & S.J.Tol, 2002), shaping biophysical factors and social element. In this sense, adaptive capacity is therefore widely considered critical and a positive desirable property (Engle, 2011; Engle & Lemos, 2010; Smit, Klein & Wandel, 2000).

### **2.8.2 Adaptive Capacity in the Resilience Context**

Gallopın (2006) and Folke, Carpenter, Walker, Scheffer, Chapin & Rockström (2010) defined resilience as “the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, feedbacks and identity...” Resilience generally looks at the ability of a system to return to its unchanging state in the face of perturbation. Stability forms the concept of resilience. In the context of resilience, adaptive capacity is called adaptability. Adaptability enhances the transformation of a system to a new

stable state other than the weak state (Engle, 2011). Adaptive capacity increase results in an increase in resilience.

## **2.9 DETERMINANTS OF ADAPTIVE CAPACITY**

Adaptive capacity has a positive implication for coping with climatic stress, increasing sustainable development (Lebel et al., 2006) and augmenting adaptation strategies (Brooks & Adger, 2005). Elements of adaptive capacity is largely informed by the vulnerability literature. With quite a handful of research, adaptive capacity can be grouped under two dimension: the generic dimension and impact-specific dimension as identified by (Adger et al., 2007). The generic dimension focuses on the development of basic human needs (Eakin, Lemos & Nelson, 2014) which may include factors like education and health (Adger et al., 2007; Jones, Ludi & Levine, 2010) whereas the specific dimension confronts specific climatic risk (Eakin et al., 2014; Adger et al., 2007). The indicators that enhance adaptive capacity include education, Infrastructure, governance, economic resources, knowledge, health according to the climate change literature (Adger et al., 2007). In the assessment of the determinants of adaptive capacity, the determinants are not independent of each other. This means that adaptive capacity results from the combination of each variable (Asante, Boakye, Egyir & Jatoo, 2012). In other words, one single determinant cannot be used as a stand-alone determinant to augment adaptive capacity. The following stresses the generic dimension of the determinants of adaptive capacity.

### **2.9.1 Economic Resources**

Economic resources enhance adaptive capacity which intends contributes to adaptation strategies and efforts. Literature abounds with findings that attest to this fact. Even though no country is immune to climate change impact, developing countries suffer most. (UNFCCC, 2007). The poorer a nation, the lower its adaptive capacity and the lower its adaptation efforts. Developing nations and poorer communities are unable to cope with climate change because resources are lacking and the institutions to do so are not present (Engle, 2011). This takes the form of assets, capital, wealth and the economic conditions of nations (Adger et al., 2007). In fact, the poor have difficulty adapting to climate change (Kates, 2000) and it has been established that they go through pain in their effort to adapt.

Fankhauser and McDermott (2013) identify that a lower adaptive capacity is associated with lower government spending, uneven income distribution and bad governance. Defiesta and Rapera (2014) found out that farmers are prone to climate risk because funds to finance adaptation are absent. In this regard, households with a high adaptive capacity exhibits a greater propensity to adjust. We see this manifest clearly when a community of farmers in Ghana are able to adapt to climate change due to remittances, access to credit and varieties of income sources (Abdul-Razak & Kruse, 2017). Thathsarani and Gunaratne (2018) found that high economic asset accounts for a high level of adaptive capacity in the face of exposure. However, it should be noted that this is not always the case. Adger, Huq, Brown, Conway & Hulme (2003) opine that despite the critical role economic resources play, they raise the issue of the legitimate entitlement of individuals and groups to those resources. We see this when Pelling (1998) suggests that a decline in the decision by individuals to act to improve their environment and decrease vulnerability is attributable to pressing demand on their resources. Indeed economic asset is one of the factors the contributes significantly and positively to adaptive capacity (Thathsarani & Gunaratne, 2018)

### **2.9.2 Infrastructure**

The presence of hospitals, schools, water and electricity help nations, individuals and communities to adapt. For instance, the presence of communication infrastructure is necessary for the dissemination of adaptation options or alternatives (Adger & Kelly, 1999). The extent of the available adaptation options is a function of the current level of technology. Infrastructure among other factors in highly vulnerable areas helps to position these areas to anticipate, manage and be resilient to climate change (Nakhoda & Watson, 2016). Acosta, Klein, Reidsma, Metzger, Mark, Schroter & Dagmar (2013) found out infrastructure contributes more to adaptive capacity. Therefore increasing infrastructure and for that matter infrastructure that is resilient to climate change help boost adaptive capacity towards climate change vulnerability.

### **2.9.3 Education**

Studies have shown a link between formal education and adaptive capacity, with formal education determining the level of adaptability of people (Wamsler, Brink & Rentala, 2012). The observation of Skidmore and Toya (2005) suggests that education reduces vulnerability to climate change. They demonstrate that a country with higher educational attainment suffers less from natural disasters. Also, in answering the question of whether expanding the formal education of females neutralizes vulnerability to climate change, Blankespoor, Dasgupta, Laplante & Wheeler (2010) conclude that educating young women has the potential of neutralizing the impact of weather-related risk. This finding is consistent with Oxfam (2008) and Albala-Bertrand (1993). Adger, Brooks, Bentham & Agnew (2004) demonstrated a significant negative relationship between education and climate change related deaths. They found out that formal education help people to become aware and appreciate existing risk.

#### **2.9.4 Technology**

Innovation and technology provide the opportunity for limitless adaptation opportunities and options. To be innovative is crucial in building adaptive capacity (Burton et al., 2003). For instance, the ability to engineer seeds that are resilient to harsh climate boost the adaptability of small farm holders (Nantui, Bruce & Yaw, 2012). Also, the adoption of techniques that maintain soil moisture and the fertility of the soil has been found to decrease the impact of drought and flood respectively (Frank & Buckley, 2012; David, Braby, Braby, Kandjinga & Ndokosho, 2013). Burton et al. (2003) remark that many of the adaptation efforts involve technology such as weather warning systems and genetically modified crop that withstand harsh weather. In the case of warning systems, making use of earth observation systems that can forecast the weather precisely are appropriate for planned adaptation efforts (UNFCCC, 2006). Jones et al. (2010) remark that “experimentation, innovation and adoption as part of the learning process are essential in ensuring a system’s ability to cope with and respond to changing circumstances”. Since climate change is happening, a dynamic community characterized by creativity and innovation is essential for its survival.

#### **2.9.5 Institution and Governance**

Institution enhance adaptive capacity by ensuring that everything is being held together according to O’Riordan & Jordan (1999). Through the intervention of institutions Kelly & Adger (2000) institutional limitation makes entitlement and access to certain resources necessary for adaptation by community members. Yaro, Teye and Bawakyillenuo, (2014) found out that people respond well when formal and informal institutions are introduced. Huq and Mahtab (1999) indicated that vulnerability to climate change in Bangladesh could be traced to institutional constraints. Adger (2006) brings this out, by remarking that the extent of vulnerability does not only depend on the biophysical but also on the institutional context in which the community is found, which could be formal and informal.

Institution serves as a mediator in the flow of adaptation efforts. Agrawal (2010) remarks that the lack of openness and inclusiveness in governance structures in the intervention process for communities is typical of local governance. Governance structure or mechanism, on the other hand, is very critical to increasing adaptive capacity (Brooks & Adger, 2005). Most determinants of adaptive capacity are linked to governance and institutional processes (Engle & Lamos, 2010). A governance structure that is characterized by democracy and participation, in theory, is likely to increase adaptive capacity when those involved are allowed to participate, represented and make decisions, hence increasing the ability of those involved to respond well (Engle & Lamos, 2010).

## **CHAPTER THREE**

### **METHODOLOGY**

#### **3.1 INTRODUCTION**

The studies consider how adaptation efforts through enhanced adaptive capacity can reduce the negative impact of climate change on inclusive growth. In so doing, this chapter covers the method used and the reasons for engaging in such a method. It highlights the specified econometric model and procedures, the variables employed and covers the study's population, sample size, the source of data and method of data analysis.

#### **3.2 MODEL SPECIFICATION, DATA AVAILABILITY AND SOURCES**

The study uses panel dataset which poses some challenges. The presence of non-stationary macroeconomic variable and variables with long time dimension subject the regression to spurious results and according to Hayashi (2000), the presence of non-stationary variables abounds. The presence of non-stationarity makes forecasting and predicting difficult. The extension of time series data to panel helps deal with issues of non-stationarity and cointegration (Alagidede, Adu & Frimpong, 2014).

According to Alagidede et al. (2014) using cointegration and unit root test in panel data analysis is better, compared to using times series approach. Thus, when groups are examined the predictive power of unit root is enhanced and relevant information is made available. In the analysis for cointegration, the study checked for unit root and cointegration and then estimated the long run and short run relationship.

The data is fitted to an autoregressive model on the premise that (i) the current values of the dependent variable could depend on a linear combination of its past values as well as (ii) the past values are distributed across time in the past (Akaike, 1969). Following from the aforementioned, the study therefore uses Autoregressive Distributed lag model which allows the study to include the lagged values of both the dependent (*ING*) and independent variable(s) (*TEMP*, *COE*, *TRD*, *FDI*, *GFCF*, *POP*, *ADPC*). The ARDL model allows for flexibility which makes it possible to use variables integrated of different order except for 1(2) (Altaee, Mohamed, & Masoud, 2016)

Autoregressive distributed lag (ARDL) models:

$$\begin{aligned}
 &ING_{it} \\
 &= \beta_0 + \beta_1 ING_{it-1} + \beta_2 \Delta TEMP_{it-1} + \beta_3 TRD_{it-1} + \beta_4 FDI_{it-1} + \beta_5 GFCF_{it-1} + \beta_6 POP_{it-1} \\
 &+ \beta_7 ADPC_{it-1} + \sum_{j=1}^q \lambda_{1j} ING_{it-j} + \sum_{j=1}^p \lambda_{2j} \Delta TEMP_{it-j} + \sum_{j=1}^p \lambda_{3j} TRD_{it-j} + \sum_{j=1}^p \lambda_{4j} FDI_{it-j} \\
 &+ \sum_{j=1}^p \lambda_{5j} GFCF_{it-j} + \sum_{j=1}^p \lambda_{6j} POP_{it-j} + \sum_{j=1}^p \lambda_{7j} ADPC_{it-j} + \alpha_i + \phi_t \\
 &+ \varepsilon_{it} \dots \dots \dots (1)
 \end{aligned}$$

$$\begin{aligned}
 &ING_{it} \\
 &= \beta_0 + \beta_1 ING_{it-1} + \beta_2 COE_{it-1} + \beta_3 TRD_{it-1} + \beta_4 FDI_{it-1} + \beta_5 GFCF_{it-1} + \beta_6 POP_{it-1} \\
 &+ \beta_7 ADPC_{it-1} + \sum_{j=1}^q \lambda_{1j} ING_{it-j} + \sum_{j=1}^p \lambda_{2j} \Delta TEMP_{it-j} + \sum_{j=1}^p \lambda_{3j} TRD_{it-j} + \sum_{j=1}^p \lambda_{4j} FDI_{it-j} \\
 &+ \sum_{j=1}^p \lambda_{5j} GFCF_{it-j} + \sum_{j=1}^p \lambda_{6j} POP_{it-j} + \sum_{j=1}^p \lambda_{7j} ADPC_{it-j} + \alpha_i + \phi_t \\
 &+ \varepsilon_{it} \dots \dots \dots (2)
 \end{aligned}$$

$$\begin{aligned}
 ING_{it} = & \beta_0 + \beta_1 ING_{it-1} + \beta_2 TEMP_{it-1} + \beta_3 TRD_{it-1} + \beta_4 FDI_{it-1} + \beta_5 GFCE_{it-1} \\
 & + \beta_6 POP_{it-1} + \beta_7 ADPC_{it-1} + \sum_{j=1}^q \lambda_{1j} ING_{it-j} + \sum_{j=1}^p \lambda_{2j} \Delta TEMP_{it-j} \\
 & + \sum_{j=1}^p \lambda_{3j} TRD_{it-j} + \sum_{j=1}^p \lambda_{4j} FDI_{it-j} + \sum_{j=1}^p \lambda_{5j} GFCE_{it-j} + \sum_{j=1}^p \lambda_{6j} POP_{it-j} \\
 & + \sum_{j=1}^p \lambda_{7j} ADPC_{it-j} + \sum_{j=1}^p \lambda_{8j} (ADPC * TEMP)_{it-j} + \alpha_i + \phi_t \\
 & + \varepsilon_{it} \dots \dots \dots (3)
 \end{aligned}$$

$$\begin{aligned}
 ING_{it} = & \beta_0 + \beta_1 ING_{it-1} + \beta_2 TEMP_{it-1} + \beta_3 TRD_{it-1} + \beta_4 FDI_{it-1} + \beta_5 GFCE_{it-1} \\
 & + \beta_6 POP_{it-1} + \beta_7 ADPC_{it-1} + \sum_{j=1}^q \psi_{1j} ING_{it-j} + \sum_{j=1}^p \lambda_{2j} \Delta TEMP_{it-j} \\
 & + \sum_{j=1}^p \lambda_{3j} TRD_{it-j} + \sum_{j=1}^p \lambda_{4j} FDI_{it-j} + \sum_{j=1}^p \lambda_{5j} GFCE_{it-j} + \sum_{j=1}^p \lambda_{6j} POP_{it-j} \\
 & + \sum_{j=1}^p \lambda_{7j} ADPC_{it-j} + \sum_{j=1}^p \lambda_{8j} (ADPC * TEMP)_{it-j} + \alpha_i + \phi_t \\
 & + \varepsilon_{it} \dots \dots \dots (3)
 \end{aligned}$$

Where  $it$  refers to the country  $i$  and in time  $t$ .  $ING_{it}$  is the dependent variable denoting inclusive growth that captures key indicators developed by the Asian Development Bank (2014). The explanatory variable  $\Delta TEMP_{it}$  and  $COE_{it}$  represent climate change measured by temperature change anomalies for meteorological a year and CO<sub>2</sub> emissions (metric ton per capita) respectively. The following are control variables that have the potential of augmenting growth:  $ADPC_{it}$  represents the outcome for adaptive capacity;  $FDI_{it}$  is the foreign direct investment measured by FDI inflows as a percentage of GDP;  $TRD_{it}$  is the outcome for trade openness;  $GFCE_{it}$  is the gross capital formation which captures investment;  $POP_{it}$  is the population

outcome measured by the population of age 15-64 as a percentage of total population;  $\alpha_i$  is the country fixed effect which captures the time-invariant unobserved country characteristics;  $\phi_t$  is time fixed effects and  $\varepsilon_{it}$  is the disturbance term of the equation.

Data is sourced for the study from the World Development Indicators (WDI), Food and Agriculture Organization (FAO) World Governance Indicators (WGI) and Notre-Dame Global Adaptation Index. Data on inclusive growth indicators are sourced from the WDI; data on temperature change is sourced from the FAO; temperature indicator for climate change is the observed mean surface temperature from the period 1995-2015. Temperature changes here represents temperature anomalies with respect to 1951-1980 as the baseline climatological year. Data on the control variables ( FDI, TRD, GFCF, POP and ADPC) are also sourced from the WDI. The data collected are annual data for a 22 year period from 1995 to 2016 for countries providing us with a panel dataset. Data from these sources are combined to carry out this study. We pool data for all African countries; the sample consist of Algeria, Comoros, Guinea, Mauritania, Angola, Guinea-Bissau, Mauritius, Sierra Leone, Benin, Djibouti, Ivory Coast, Morocco, Botswana, Kenya, Mozambique, South Africa, Burkina Faso, Lesotho, Namibia, Eritrea, Liberia, Cameroon, Ethiopia, Nigeria, Swaziland, Gabon, Madagascar, Tanzania, Central African Republic, Gambia, Malawi, Chad, Ghana, Mali, Senegal, Togo, Tunisia, Uganda, Zambia, Zimbabwe. The selection criteria for the countries was availability of data. Therefore, the study omitted countries with missing data.

**Table 3.1 Variables and Indicators**

Variable	Description	Indicator(s)
ING	Inclusive Growth	The measure of inclusive growth is made up of key indicators that were adopted from the Asian Development Bank (2014). The indicators fall under 5 broad categories namely: Poverty and inequality; Growth and Expansion of Economic Opportunity; Social Inclusion to Ensure Equal Access to Economic Opportunity; Social Safety Nets;

		Good Governance and Institutions. Out of this, we obtain a variable using Principal Component Analysis
TEMP/COE	Climate Change	Climate change is represented by temperature change and CO <sub>2</sub> emissions.
ADPC	Adaptive capacity	Table 3.2
POP	Population	Population ages 15-64 (% of total)
TRD	Trade Openness	Sum of imports and export (% of GDP)
GFCF	Gross Capital Formation	Gross fixed capital formation (% of GDP)
FDI	Foreign Direct Investment	Foreign direct investment, net inflows (% of GDP)
ADPC*ΔTEMP ADPC*COE	Interactive term	

Data was sourced from WDI (Key indicators for inclusive growth), FAO (temperature change anomalies)

**Table 3.2 Adaptive Capacity Components**

<i>Description</i>	<i>Component</i>
Food	Agriculture capacity (fertilizer, irrigation, pesticide, tractor use) and child malnutrition
Water	Access to reliable drinking water and dam capacity
Health	Medical staffs (physicians, nurses and midwives) and Access to improved sanitation facilities
Ecosystem Services	Protected biomes and engagement in international environmental conventions
Human Habitat	Quality of trade and transport-related infrastructure and Paved roads
Infrastructure	Electricity access and disaster preparedness
Economic Readiness	Doing business indicators
Governance Readiness	Regulatory quality
Social Readiness	Innovation

Source: ND-Gain (2015)

### 3.2.1 Short and Long run Relationship Estimation

The presence of autoregression and cointegration allows the study to fit the data to an autoregressive distributed lag (ARDL) model

The generalized ARDL model:

$$Y_{it} = \alpha_0 + \sum_{j=1}^q \psi_{ij} Y_{i,t-j} + \sum_{j=0}^p \lambda_{ij} X_{i,t-j} + \varphi_i + \phi_t + \varepsilon_{it} \dots \dots \dots (5)$$

The re-parameterised ARDL error correction model:

$$ECM = \theta_i [\lambda_i Y_{t-j} - \gamma_i X_{it}] + \sum_{j=1}^q \xi_{ij} Y_{i,t-j} + \sum_{j=0}^p \lambda_{ij} X_{i,t-j} + \varphi_i + \phi_t + \varepsilon_{it} \dots \dots \dots (6)$$

Where  $Y_{it}$  is the dependent variable, where  $X_{it}$  is a  $k \times 1$  vector that are allowed to be purely  $I(0)$ ,  $I(1)$  or co-integrated.  $\xi_{ij}$  represents the coefficient of the lagged dependent variable;  $\delta_{ij}$  are  $k \times 1$  coefficient;  $p, q$  are the optimal lag orders;  $\varphi_i$  is the unit specific fixed-effects;  $\phi_t$  is the country fixed effect and  $\varepsilon_{it}$  is the error term;  $[\lambda_i Y_{t-j} - \gamma_i X_{it}]$  is the error correction term;  $\xi_{ij}$ ,  $\delta_{ij}$  is the short-run dynamic co-efficient and  $\gamma_i$  is the vector of long-run relationship.

### 3.3 A PRIORI EXPECTATION

The following outcomes are sourced from the economic growth literature due to the limited literature in inclusive growth. There is little or no studies in the area of climate change impact on inclusive growth, but evidence indicates that climate change stifles economic growth (Abidoyea & Odusola, 2015; Dell et al., 2010). Developing countries suffer more from climate risk even though their carbon footprint is low. The impact is largely felt because developing economies are largely driven by primary manufacturing sectors that are influenced by the climate. Climate change outcomes have tended to affect agriculture like farming, energy, tourism and fishing through drought, flood, temperature variability and famine. Without the

necessary adaptation strategy, climate change could reverse the gains made in poverty reduction through inclusive growth. We, therefore, infer that climate change will affect inclusive growth negatively. Even though climate change is not a contributor to poverty it worsens poverty and affects poverty reduction effort (Leichenko & Silva, 2014). Poor usually have limited adaptation options because of their low level of adaptive capacity, unlike wealthy countries who are characterized by high economic resources, technology and infrastructure.

foreign direct investment is expected to influence inclusive growth positively due to capital accumulation or fixed investment (Klein, 2000; Iamsiraroj, 2016). In the transfer of technology (Alfaro, 2013) and resources, FDI has been marked to play a vital role in economic outcomes and poverty reduction. Empirical evidence for this effect has largely been mixed. Studies have shown a bi-directional relationship, uni-directional relationship and no relationship. This notwithstanding, the importance of FDI cannot be overemphasized. The positive impact of FDI is recorded in the manufacturing sector (Alfaro, 2013). However, we do not see this play out in the primary and the service sector. The study also expects the relationship between gross capital formation and inclusive growth to be positive. For population growth and economic growth the relationship is expected to be positive since it is associated with human capital accumulation through education. However, the opposite is true if population growth is not characterized by human capital accumulation, especially through primary and secondary education (Keller, 2008; Schultz, 1971). Trade openness is expected to take on either a negative or positive sign.

### 3.4 STATISTICAL TESTS

#### 3.4.1 Hausman Test

The possible correlation between the time-invariant unobserved effect and error in a model has the possibility of occurring in the panel data set. Thus in the use of panel data, there is the assumption that there could be a correlation between  $\alpha_i$  and  $\varepsilon_{it}$ . According to Wooldridge (2002) the correlation between the time-invariant unobserved effect and the error term form the basis for choosing between the fixed effect model and the random effect model, this necessitates the test of this assumption. In the fixed effect model estimate, the correlation between  $\alpha_i$  and  $\varepsilon_{it}$  is said to be consistent whereas in the random effect model the correlation between the  $\alpha_i$  and  $\varepsilon_{it}$  is inconsistent. The Hausman specification test proposed by Hausman in 1978 help to compare the estimators between the fixed effects and the random effects models in order to choose the appropriate model. The random effect, in this case, is unbiased, consistent and efficient as well as BLUE, therefore a correlation of the error term and the effects of the independent variables would render the error term inappropriate to use making the fixed effect model to be preferred.

#### 3.4.2 Stationarity Test

Stationarity is a common assumption in the estimation of a model. A stationary time series is one with mean, covariance, variance, autocorrelation and other statistical properties constant over time or when the data generating process is constant over time. A time series, especially for macroeconomic variables, has the tendency to contain a unit root (Nelson & Plosser, 1982). Therefore testing for non-stationarity helps to decipher the presence of unit root. Glynn, Perera and Verma (2007), a time series data with a unit root is characterized by a long-run mean and finite variance whereas non-stationary process does not have the tendency to return to the long-run mean or a deterministic path and therefore suffers from shocks, thus following a random walk. The stationarity or non-stationarity of a series affect outcomes of the parameters of a

model. Thus, a time series variable is non-stationary, it affects the validity of the outcome. That means that the t-ratio will not follow the usual t-distribution and therefore a hypothesis test about the parameters will be spurious. A non-stationary time series data can be made stationary by differencing. By differencing a non-stationary time series data, the data mean becomes stabilized by removing changes in the levels of the non-stationary time series thereby eliminating trend and seasonality (Adam & Owusu, 2017). Integration of order is denoted by  $I(d)$  with  $d$  standing for the number of integrations in order to make it stationary. A time series integrated of order zero is denoted by  $I(0)$  meaning stationarity and  $I(1)$  indicates an integration of order 1. Therefore, by first differencing a non-stationary series, we get a stationary series. We, therefore, employ the Augmented Dicker-Fuller Fisher type test which was developed by Dicker and Fuller (1979) to test for the presence of a unit root. The test has the null hypothesis to be the presence of a unit root and the alternative hypothesis to be the presence of stationarity. In order to control the problem of non-stationarity, we do this by computing the differences between the consecutive observations. The number of differencing required is determined by the unit root. Said and Dickey (1984) developed the Augmented Dickey-Fuller test that complements the Dickey-Fuller test. An alternative stationarity test to the Dickey-Fuller test is the Phillips-Perron test which was developed by Phillips and Perron (1988).

### **3.4.3 Correlation Test**

The test for correlation helps to demonstrate the strength of a relationship between two variables of interest. This test is useful because it helps to avoid the problem of multicollinearity. Multicollinearity occurs when two variables of interest are strongly correlated, which when not managed will lead to inaccurate estimation results. The correlation coefficients fall between two variables lies between -1 and +1. A correlation of -1 and +1 shows a perfectly negatively correlated and perfectly positively correlated respectively whiles a

correlation of zero shows the absence of a relationship. The direction or sign shows the relationship between the two variables. Examples of correlation analysis that are used are the Pearson product-moment correlation, Spearman Rank correlation and Autocorrelation. The correlation analysis we employ in this study is the Pearson product-moment correlation.

#### **3.4.4 Autoregressive Distributed Lag Co-Integration Test**

Co-integration according to Kumar (2018) “is a statistical property possessed by some time series data that is defined by the concepts of stationarity and the order of integration of the series”. A stationary series statistical property do not differ over time, meaning that in the event of a shock or fluctuation the series will revert to its mean value, whereas for a non-stationary series, there will be an exhibition of a time-varying mean. Kumar (2018) remarks that the order of integration of a series is shown by the number of times the series is differenced in the process of generating a stationary series. In the absence of differencing the order of integration is represented by  $I(0)$  suggesting that the series is stationary at level. In the case of generating a stationary series from a non-stationary series by first differencing it is denoted by  $I(1)$ , thus integrated of order one. Therefore, co-integration test is carried out after variables have been tested for stationarity. It is worthy of note that the use of a non-stationary time series in a regression analysis leads to spurious regression.

The study employs the bounds co-integration testing approach as proposed by Pesaran and Shin (1995). This approach allows the study to carry out a co-integration test in the presence of  $I(1)$  and  $I(0)$  series. identify that the ARDL co-integration test is good for determining co-integrating vectors which are then reparameterized into an error correction model to determine the short-run and long-run relationship among the variables in the single model (Nkoro & Uko, 2016). The decision criteria has it that the F-statistics of the Wald test should be greater than

the critical value band for a long-run relationship is said to exist. When the f-statistics lies between the lower and upper bound the results are inconclusive. Any value below the lower bound suggests no co-integrating relationship and anything above the Upper bound suggests a co-integrating relationship.

### **3.4.5 Principal Component Analysis (PCA)**

Principal Component Analysis is a “statistical technique and explorative tool that converts a number of potentially correlated variables with some shared attribute into a set of variables that are uncorrelated and capture variations in a dataset” (Abson, Dougill & Stringer, 2012 ). The importance of this technique is that it extracts essential information from the dataset representing it with a set of new orthogonal dimensions (Abdi & Williams, 2010). In a bid to measure inclusive growth we generate a single score using the key indicators of inclusive growth from the Asian Development Bank (2014).

This paper employs Principal Component Analysis (PCA) technique which is used to reduce the dimensionality of these variables in the dataset and then generate a single score which will then be used to represent a single dimension termed inclusive growth. PCA, therefore, is a dimension reduction tool that can be used to reduce the large dataset to a small set that contains a lot of information or variation. This is referred to as the principal components.

The principal component (PC) refers to a linear combination of variables weighted by their contribution to explaining variation in a particular orthogonal dimension. The first principal component ( $PC_1$ ) forms a larger part of the variation and is deemed to hold much information. The remaining principal component explains the remaining variability which is orthogonal to the previous PC till the last component is equal to the total number of variable, thus every succeeding PC account for a much smaller variation the than the previous component. In so doing principal component analysis removes the variation explained by the previous

component and leaves the remaining variation to be explained by the next PC (Abson et al., 2012).  $PC_1$  is used to represent the weights of the variables and is used to calculate the index. The factor loading associated with each variable gives us the weights of the variables in the computation of the index. Variables with the highest factor loadings depict how sensitive they are to a particular principal component (Europa, 2018). Also, the factor loading or component coefficient is the correlation between the variables and the principal component. Therefore the factor loading of each variable associated with  $PC_1$  is used as a score to generate the inclusive growth index. The single variable generated from this computation is used in the regression analysis together with other variables

#### **3.4.7 Lag Length Selection Test**

The study determined the appropriate lag for the model, by performing a lag selection test using the Akaike Information Criteria test (AIC) to obtain the maximum lag length in order to obtain a model with a margin of estimation. For robustness, we also employ the Schwarz criterion and the Hannan-Quinn criterion.

## CHAPTER FOUR

### DATA ANALYSIS, FINDINGS AND INTERPRETATIONS

#### 4.1 INTRODUCTION

This section presents the data analysis, findings and interpretation and analysis of the preliminary tests including the Hausman test, stationarity test, co-integration analysis, long-run estimation analysis, the Principal component analysis in preparing the data for analysis and also carries another diagnostic test.

#### 4.2 PRINCIPAL COMPONENT ANALYSIS

To begin with the analysis, we begin with Principal Component Analysis in order to generate a single variable for the Inclusive growth which is sourced from the Asian Development Bank. This single indicator termed Inclusive Growth (*ING*) is the independent variable on which the other variables are regressed on. In the analysis of the variables to be used to generate the inclusive growth variable, the study uses the factor loading of the component score correlation matrix and those with the highest factor loading are those correlated with the first principal component. The factor loading represents the correlation for each variable on the principal component and the extent to which each is sensitive to the principal component. In this work, six principal components were extracted using the eigenvalues. We extract the first principal component because it has the highest eigenvalue of 2.336 and accounts for the highest level of variation. The principal component qualifies for selection if their eigenvalue is greater than 1.

**Table 4.1 Factor loadings of the first principal component**

Inclusive Growth Indicators	Score
Contributing family workers, total (% of total employment)	0.385
Labor force participation rate, female (% of female population ages 15+)	0.558
GDP per capita growth (annual %)	0.162
GDP growth (annual %)	0.199
Employment to population ratio, 15+, total (%)	0.580
Mortality rate, under-5 (per 1,000 live births)	0.371

Those with a high component score are those with a high factor loading. Labour force participation rate for female and Employment to population ratio exhibits high value in PC<sub>1</sub>. It can be observed that the variables exhibiting high factor loading can be seen to cover the bottom line or cover an individual in terms of assessing the extent of inclusiveness which is the main the goal of inclusive growth. GDP growth and GDP per capita growth has lower weights. This is due to the fact that they do not give an accurate picture or measure of the extent of individual well-being in the face of growth.

### 4.3 SUMMARY STATISTICS

**Table 4.2 Descriptive Statistics**

	ING	TEMP	COE	TRD	FDI	GFCF	POP	ADPC
Mean	0.013	0.760	0.353	80.204	4.365	21.908	54.630	0.685
Median	0.225	0.743	0.295	70.449	2.288	20.840	53.509	0.695
Max.	6.209	2.248	1.186	531.737	161.824	219.069	70.780	0.892
Min.	-3.474	-0.356	0.032	27.972	-8.589	-2.424	47.678	0.431
Std.Dev.	1.537	0.389	0.214	47.652	9.920	16.910	4.898	0.103
Skewness	-0.193	0.371	1.197	4.362	8.723	7.185	1.473	-0.560
Kurtosis	2.540	3.895	4.219	32.955	112.484	72.786	4.819	2.869
Prob.	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Obs.	924	924	924	924	924	924	924	924

From the table, the maximum change in temperature given the dataset indicates 2.248 and with a standard deviation of 0.389. The changes in temperature are not widely spread from each other suggesting that there is not much variability in the data for temperature changes. This demonstrates that individual countries may have experienced similar temperature change anomalies. The standard deviation (0.1109) for adaptive capacity tended to be close to the mean (0.6754) of the dataset suggesting that the observations are not spread out over a wider range of values. This is made clear visually in the trend analysis supplied in Appendix 2.1. This indicates the capacity of the countries in the region to climate change hover around the same value. The descriptives for inclusive growth demonstrates that there is a high level of variability among observations.

#### 4.4 CORRELATION

We consider the correlation coefficient that might exist between the variables. Giving us an indication of the direction and strength of the relationship. However, it should be noted that correlation does not suggest or indicate causality.

**Table 4.3 Correlation Matrix**

VARIABLE	ING	ΔTEMP	COE	TRD	FDI	GFCF	POP	ADPC
ING	1							
ΔTEMP	-0.289	1						
COE	-0.380	0.207	1					
TRD	-0.139	0.003	0.104	1				
FDI	0.071	0.006	-0.043	0.578	1			
GFCF	0.007	0.095	-0.033	0.720	0.652	1		
POP	-0.653	0.277	0.420	0.216	-0.045	0.127	1	
ADPC	0.629	-0.230	-0.462	-0.180	0.030	-0.166	-0.768	1

#### 4.5 HAUSMAN TEST

The Hausman considers the possible correlation between the error term and the regressors. We run both the fixed effect and the random effect and use the Hausman specification test to decide

between the two. If the probability chi-square is less than the significant level of 5% we use the fixed effect model.

**Table 4.4 Hausman Test Results**

Variable	Fixed	Random	Var. (Diff.)	Prob.
<b>ΔTEMP</b>	0.092	-0.013	0.003	0.048
<b>TRD</b>	0.006	0.007	0.000	0.001
<b>FDI</b>	-0.025	-0.027	0.000	0.007
<b>GFCF</b>	0.034	0.034	0.000	0.228
<b>POP</b>	-0.022	-0.023	0.000	0.638
<b>ADPC</b>	-2.424	-2.307	0.004	0.056
<b>Test Summary</b>	<b>Chi-Sq. Stat.</b>	<b>Chi-Sq. d.f.</b>	<b>Prob.</b>	
<b>Period random</b>	16.710	6	0.010	

Source: Author's Estimation

The Hausman specification test yields a probability value of 0.010, which is less than the 5% significant level, therefore we reject the null hypothesis that prefers the random effects over the fixed effects.

#### 4.6 PANEL UNIT ROOT TEST

Stationarity test is conducted on each of the series to verify whether they are stationary or not. We do this in order to avoid spurious regression (Engel & Granger, 1987). By so doing, it allows us to uncover the presence of cross-sectional dependence, unit roots and co-integration. For robustness, we also employ the Im, Pesaran, and Shin, Phillip Perron and ADF Fisher test. The hypothesis test for the following methods is as follows

##### 1. Im, Pesaran, and Shin:

**Null:** Panel data has unit roots (non-stationary)

**Alt:** Panel data does not have unit roots(stationary)

**2. Phillip Perron:**

**Null:** Panel data has unit roots (non-stationary)

**Alt:** Panel data does not have unit roots(stationary)

**3. ADF Fisher test:**

**Null:** Panel data has unit roots (non-stationary)

**Alt:** Panel data does not have unit roots(stationary)

For the test some of the variables were stationary at levels whiles some were stationary at first difference. No variable was integrated at order 2.

**Table 4.5 ADF Fisher Type, PP-Fisher Type and Im, Pesaran and Shin Unit Root Tests**

<b>Variables</b>	<b>ADF - Fisher Chi-square</b>	<b>PP - Fisher Chi-square</b>	<b>Im, Pesaran and Shin W-stat</b>
ING	I(1)	I(0)	I(1)
TEMP	I(0)	I(0)	I(0)
COE	I(0)	I(0)	I(0)
TRD	I(1)	I(1)	I(1)
FDI	I(0)	I(0)	I(0)
GFCF	I(1)	I(1)	I(1)
POP	I(0)	I(0)	I(0)
ADPC	I(1)	I(0)	I(1)

From the table above, the study carries out a unit root test to determine the presence of I(0) and I(1) variables. For ADRL cointegration approach to be used there must be the presence of I(0) and I(1) variables or both. The approach cannot be adopted if any one of the variables are integrated of order two (I(2)). The above table demonstrates the use of multiple unit root test for robustness. The output from the test indicates that the variables are either I(0) or I(1). None of the variables are integrated of order 2.

#### 4.7 LAG LENGTH SELECTION TEST

To determine the optimal lag for the estimation of the ARDL model, we use the Akaike Information Criterion (AIC), Schwarz criterion (SC) and the Hannan-Quinn (HQ) criterion. In the optimal lag selection we use three criterion for robustness purposes. In selecting the optimal lag given we select the lag with the lower value for each criterion. The results are as follows:

**Table 4.6 Lag Length Selection Results for the Model**

##### Model 1

lag selection criterion	Lag 1	Lag 2	Lag 3	Lag 4	Lag 5	Lag 6	Lag 7
AIC	2.791	2.463	2.206	2.181*	2.215	2.188	2.399
SC	2.892	2.620	2.427*	2.473	2.588	2.653	2.921
HQ	2.830	2.524	2.292*	2.295	2.362	2.371	2.605

##### Model 2

lag selection criterion	Lag 1	Lag 2	Lag 3	Lag 4	Lag 5	Lag 6	Lag 7
AIC	2.950	2.637	2.436*	2.463	2.501	2.445	2.637
SC	3.049	2.79	2.647*	2.74	2.851	2.876	2.921
HQ	2.988	2.697	2.518*	2.572	2.638	2.614	2.605

##### Model 3

lag selection criterion	Lag 1	Lag 2	Lag 3	Lag 4	Lag 5	Lag 6	Lag 7
AIC	2.792	2.468	2.206	2.185*	2.223	2.204	2.267
SC	2.906	2.647	2.457*	2.518	2.649	2.734	2.912
HQ	2.836	2.538	2.304*	2.316	2.390	2.413	2.522

##### Model 4

lag selection criterion	Lag 1	Lag 2	Lag 3	Lag 4	Lag 5	Lag 6	Lag 7
AIC	2.792	2.468	2.206	2.185*	2.223	2.204	2.267
SC	2.906	2.647	2.457*	2.518	2.649	2.734	2.912
HQ	2.836	2.538	2.304*	2.316	2.390	2.413	2.522

The table above shows that the optimal lag length required for the estimation of the ARDL model 1,2,3 and 4. The optimal lag length for the model 1,2,3 and 4 is lag 3 for all models as seen from the table above. From the above, we use the AIC, SC and the HQ criterion. The study, in determining the optimal lag, uses lag beginning from 1 to 7, with the optimal being lag 3 for each model.

#### 4.8 BOUNDS CO-INTEGRATION TEST RESULTS

In carrying out the bounds test we compare the Pesaran critical value at 5% significant level using no intercept and no trend. The Pesaran upper and lower bound is given below together for each model together with the f-statistics of the Wald test. We reject the null hypothesis of no co-integration when the Wald test f-statistics is greater than the upper bound, we do not reject when it is below the lower bound and it remains inconclusive when it falls between the upper bound and the lower bound. We, therefore, test for co-integration for each level.

**Table 4.7 ARDL Co-integration test results**

<b>Model</b>	<b>Optimal lag length</b>	<b>Upper Bound</b>	<b>Lower Bound</b>	<b>F-statistics</b>
<b>Model 1</b>	3	3.63	2.45	13.836
<b>Model 2</b>	3	3.63	2.45	14.732
<b>Model 3</b>	3	3.63	2.45	9.057
<b>Model 4</b>	3	3.63	2.45	8.961

The figures in the table compare the Pesaran critical value to the F-statistics and all the models reject the null hypothesis of no co-integration since the f-statistics are greater than the upper bounds as seen from the table above.

#### 4.8 ESTIMATION AND INTERPRETATION OF THE LONG-RUN AND SHORT-RUN RELATIONSHIPS.

Having established the presence of co-integration, we estimate the long-run and short-run relationship using the ARDL model for the short-run relationship between the variables and the Vector Error Correction model to decipher the long-run relationship. Table 4.8 presents the findings under the four models and their long-run and short-run relationship. Model 1 and model 2 are different from each other, in that while climate change in model one is measured by temperature, model two uses carbon-dioxide emission. Model 3 and 4 differs from the rest in that both contain the interactive variable ADPC\*TEMP and ADPC\*COE to ascertain the moderating role of adaptive capacity in the climate change/inclusive growth relationship. The discussion of the results follows after table 4.8.

**Table 4.8 Long-run and short-run estimates of the models**

VARIABLE	Model 1	Model 2	Model 3	Model 4
$\Delta$ TEMP	0.201***		0.576	
COE		-0.001		0.863
TRD	0.001	0.002	0.001	0.002***
FDI	0.001	0.005	0.001	0.005
GFCF	-0.021*	-0.004	-0.021*	-0.005
POP	0.017	0.009	0.013	0.008
ADPC	0.774	-0.682	1.291	-0.226
ADPC* $\Delta$ TEMP			-0.627	
ADPC*COE				-1.295
<b>Short-run co-efficient</b>				
TEMP	-0.184		-0.234	
COE		-1.390		
TRD	0.009*	0.009*	0.009*	0.009*
FDI	-0.032*	-0.028*	-0.032*	-0.028*
GFCF	0.035*	0.035*	0.035*	0.035*
POP	-0.015	-0.032	-0.015	-0.031
ADPC	1.908	-0.310	1.865	0.316
ADPC* $\Delta$ TEMP			0.074	

ADPC*COE				-2.161
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**Table 4.9 Long-run and short-run estimates of the models: Mortality rate, under-5 (per 1,000 live births)**

VARIABLE	Model 1	Model 2	Model 3	Model 4
ΔTEMP	0.002		-0.099	
COE		0.002		-0.008
TRD	0.000	-5.31E-06	7.38E-05	1.45E-05
FDI	-0.000	-0.000	-0.000	-0.000
GFCF	-1.050	-0.000	4.95E-05	-0.000
POP	-0.004*	-0.002	-0.003**	-0.002
ADPC	-0.058	-0.023	-0.201	-0.030
ADPC*ΔTEMP			0.159	
ADPC*COE				0.023
Short-run co-efficient				
TEMP	-7.776*		15.605 ***	
COE		-8.094		152.715
TRD	0.074*	0.051*	0.077*	0.071
FDI	0.022	-0.034	0.028*	-0.023*
GFCF	-0.196*	-0.118	-0.206*	0.035
POP	-5.385*	-5.556*	-5.528*	-5.487*
ADPC	639.019*	631.117	659.018	700.094*
ADPC*ΔTEMP			-34.701	
ADPC*COE				-238.125*

**Table 4.10 Long-run and short-run estimates of the models: Contributing family workers, total (% of total employment)**

VARIABLE	Model 1	Model 2	Model 3	Model 4
ΔTEMP	0.041		0.302	
COE		-0.141		0.486
TRD	0.001	0.001	0.001	0.001
FDI	-0.006	-0.005	-0.006	-0.006
GFCF	-0.002	-0.002	-0.002	-0.003
POP	-0.008	-0.005	-0.009	-0.007
ADPC	0.298	0.210	0.648	0.633
ADPC*ΔTEMP			-0.414	

<b>ADPC*COE</b>				-0.965
<b>Short-run co-efficient</b>				
<b>TEMP</b>	-0.505*		-0.024	
<b>COE</b>		-0.268		0.060
<b>TRD</b>	0.003*	0.002**	0.003*	0.002**
<b>FDI</b>	0.003	0.002	0.003*	0.002
<b>GCFC</b>	-0.009*	-0.007*	-0.010*	-0.007*
<b>POP</b>	0.023	0.019	0.020	0.019
<b>ADPC</b>	6.276*	3.542*	6.688*	3.682*
<b>ADPC*ΔTEMP</b>			-0.714	
<b>ADPC*COE</b>				-0.486

Note: items indicated in bracket are the p-values

Given that the empirical literature on climate change in the context of inclusive growth is scanty if none existent, discussions will, therefore, employ studies that have examined climate change in the context of economic growth literature, we do this because economic growth is a necessary precursor for inclusive growth (Dollar et al., 2013). In the short-run as observed from table 4.8, climate change has a significant effect on inclusive growth only in the short-run but not in the long-run. This is observed in model 2 and 3.

ΔTEMP and COE showed a significant impact on inclusive growth/shared growth with COE showing a higher level of significance in model 3 and model 2 respectively in the short-run. This implies that an increase in climate change leads to a decrease in inclusive growth. This corroborates with other studies (Abidoyea & Odusola, 2015; Fankhauser & Tol, 2005) suggesting that climate change has a negative impact on inclusive growth. Thus, climate change and inclusive growth tend to be inversely related. However, in the long-run climate change does not affect inclusive growth except for model 2 which showed a negative impact of COE on inclusive growth, but this was not significant.

Trade openness measured by the sum of imports and exports showed a significant positive relationship with inclusive growth in the short-run but not in the long-run, this positive influence loses its significance. The positive contribution of trade openness is in line with Dollar and Kray (2004) who pointed out that countries that remove barriers to trade tend to pick up pace in growth. This position is also observed in the studies of Kim et al. (2011) when they indicate that trade openness affects real incomes and has positive effects on economic development.

Foreign direct investment, showed a negative significant relationship with inclusive growth in all the models, which means that increases in FDI lead to a reduction in inclusive growth in the short-run. However, the study observes an insignificant positive influence of FDI on inclusive growth in the long-run. This is contrary to studies that have indicated that FDI leads to employment creation, capital stock formation and poverty reduction (Iamsiraroj, 2016; Klein, 2001). The negative effect of FDI on inclusive growth could possibly be due to the fact that these investments may largely be private investments which are managed by a few private individuals. However, over time, this leads to employment creation which ultimately contributes to inclusive growth.

Gross capital formation investment identifies with human capital formation, plants, capital stock and labour force. In this study, the result exhibited a positive influence of gross capital formation on inclusive growth in all the models. This corroborates with a vast body of literature that has found a strong positive relationship between fixed capital formation and growth rate. Like Uneze (2013) who established a bi-causal relationship between fixed capital formation and economic growth and Bal et al. (2106) who demonstrated s a significant positive relationship in the short-term. The role of capital formation is therefore crucial to inclusive growth as observed in this study but only in the short-run. On the contrary, Gross capital

formation has a significant negative impact on inclusive growth in the long-run in model 1 and 3.

Population growth in the studies demonstrated a negative influence on inclusive growth. This may stem from the fact that population growth in the short-run puts pressure on existing resources necessary for ensuring shared growth. In other words, as population increases, the number of people who have to participate and benefits from inclusive growth increases which in turn reduces available resources.

Adaptive capacity in this study showed a positive relation in all the models except for model two. The positive influence has been observed by Smit et al. (1999) and Adger et al. (2007) but in the context of inclusive growth, this was not significant. The moderating role of adaptive capacity on climate change had a mixed result. In relation to temperature (model 3), there was a moderating effect but not significant, this was however not true for model 4 in terms of carbon dioxide emission. This suggests that in the short-run adaptive capacity's influence on inclusive growth is minimally felt and not significant.

In determining the individual response of inclusive growth indicators to climate change and adaptive capacity, we run the dependent variables of the model on each component of inclusive growth. Of all the variables, mortality rate under five (per thousand live births) and contributing family worker (percentage of total employment) showed a significant response to Carbon dioxide emission, temperature change anomalies and adaptive capacity.

To begin with,  $\Delta\text{TEMP}$  significantly influences mortality rate negatively such that a rise in carbon dioxide accounts for a rise in mortality rate as observed in model 3 in table 4.9. This is also true for COE in model 4. It can, therefore, be generally concluded that climate change affects mortality rate negatively in the short-run. These findings suggest a positive influence by adaptive capacity on mortality rate in all the models except model 3, signifying that adaptive

capacity reduces mortality rate meaningfully in the short-run. We also observe a rather insignificant negative effect of  $\Delta$ TEMP and COE in the long-run in model 1 and 2 of table 4.9 suggesting that climate change impact on mortality rate is felt in the short-run more than in the long-run. In addition, we also observe that the moderating role of adaptive capacity in the context of mortality rate in the short-run (model 3 and 4) is crucial to mitigating climate change impact.

With regard to contributing family worker, climate change influence on it exhibited mixed results. In the short-run, model 1 showed a high level of significance of the negative influence of  $\Delta$ TEMP on contributing family worker. Model 2 and model 3 showed a negative influence of  $\Delta$ TEMP and COE but these were not significant. Model 4 showed a positive influence of  $\Delta$ TEMP. With respect to Adaptive capacity, it showed a significant positive influence on inclusive growth in the short-run in all models but in the long run, the power of adaptive capacity to influence contributing family worker deteriorates. In terms of the moderating role of climate change impact,  $ADPC*TEMP$  and  $ADPC*COE$  showed no influence in mitigating the impact both in the short-run and long-run in all models.

## CHAPTER FIVE

### SUMMARY, CONCLUSION AND POLICY RECOMMENDATION

#### 5.1 SUMMARY

In summary, the study examined the impact of climate change on inclusive growth and the role adaptive capacity plays in reducing such potential risk. It examined this in the long and short run context by fitting the data to an Autoregressive Distributed Lag (ARDL) model.

The findings of the study point out that climate change as measured by temperature and CO<sub>2</sub> emission has a negative implication for inclusive growth. By implication, it has the potential of stifling shared growth effort. Also, adaptive capacity moderates this negative impact.

In order to safeguard such efforts, we examined the contribution of adaptive capacity to fostering inclusive growth and its role in ameliorating the impact of climate change on inclusive growth. Evidence from the studies suggests that adaptive capacity does contribute to climate change and also play a role in ameliorating the impact of climate change but rather mildly when the key indicators of inclusive growth are considered as a composite but significantly when they are considered individually

A major premise of this study is that adaptation efforts through adaptive capacity are an essential ingredient in sustainable growth in Africa. Consequently, for development goals and targets to be met and maintained, it is necessary to ensure that the adaptive capacity of developing countries is enhanced. Thus, it is paramount that attention be given to infrastructure, economic resources, institutions and technology that enhance adaptive capacity and ensure that poverty alleviation effort and equity efforts such as the inclusiveness of growth are not reversed.

The study finds evidence of a negative impact of climate change on inclusive growth in the short-run. Also, we observe a significant influence of climate change on inclusive growth when the individual components are considered and in this case mortality rate and contributing family worker. This suggests that the true picture of the negative impact of climate change is witnessed when inclusive growth indicators are considered in isolation than when they are put together. Thus, an inverse relationship has been shown to exist between climate change and inclusive growth, suggesting that inclusive growth responds negatively to temperature anomalies and CO<sub>2</sub> emission significantly. This goes to affirm how climate change has a potential of reversing efforts to reduce poverty as pointed out by the World Bank (2016).

In the long run, we also find evidence of inclusive growth responding positively to climate change both for temperature and CO<sub>2</sub> emissions. This could be attributable to adaptation and coping mechanism that may nullify the impact of climate change on inclusive growth.

Secondly, we conclude that inclusive growth responds positively to adaptive capacity both in the short and long-term but not significantly when inclusive growth indicators are taken together. Adaptive capacity contributes to climate change both in the short and long-run but more so in the short-run, however, this is not significant. In terms of looking at the indicators of inclusive growth in isolation, we observe a significant contribution of adaptive capacity to contributing family worker. In terms of the moderating role of adaptive capacity in the climate change/inclusive growth relationship, mortality rate, better and significantly responds to the mitigating role of adaptive capacity. Therefore, we conclude that the moderating power of adaptive capacity to mitigate climate change impact is rather observed when indicators are taken individual and examined.

## **5.2 POLICY IMPLICATION AND RECOMMENDATION**

Based on the conclusion, the study suggests that in an efforts to build resilience and reduce vulnerability to climate change by governments and policymakers, particular attention should be given to indicators that are sensitive to climate change and that respond well to adaptive capacity. Put differently, certain indicators used in measuring inclusive growth are not responsive to climate change and therefore channelling adaptation efforts to moderate the negative impact of climate change may prove to be ineffective. Consequently, this empirical evidence helps governments and policymakers ensure that climate-sensitive indicators of inclusive growth are targeted. The study, therefore, recommends that climate change adaptation efforts through the enhancement of adaptive capacity should be channelled to specific indicators of inclusive growth that are sensitive to climate change threats and at the same time responsive to adaptation efforts.

Secondly, the study recommends that due to the sensitive nature of some inclusive growth indicators to the negative impact of climate change in the short-term as well as the positive influence of adaptive capacity in the short-run, Adaptation efforts and strategies should always be ready at all times in order to respond quickly and effectively in the event of climate change shocks. This means that adaptive capacity should be enhanced in order to augment adaptation efforts and strategies in the short-term in order that individuals and communities are ready and prepared to respond appropriately to climate change threats.

Governments and policymakers should ensure barriers to trade are removed, ensure that there is the right business environment that attracts investment and invests in capital formation because they serve as a foundations for inclusive growth.

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**APPENDIX**

**Appendix 1**

Principal Components Analysis

Sample: 1995 2016

Included observations: 917

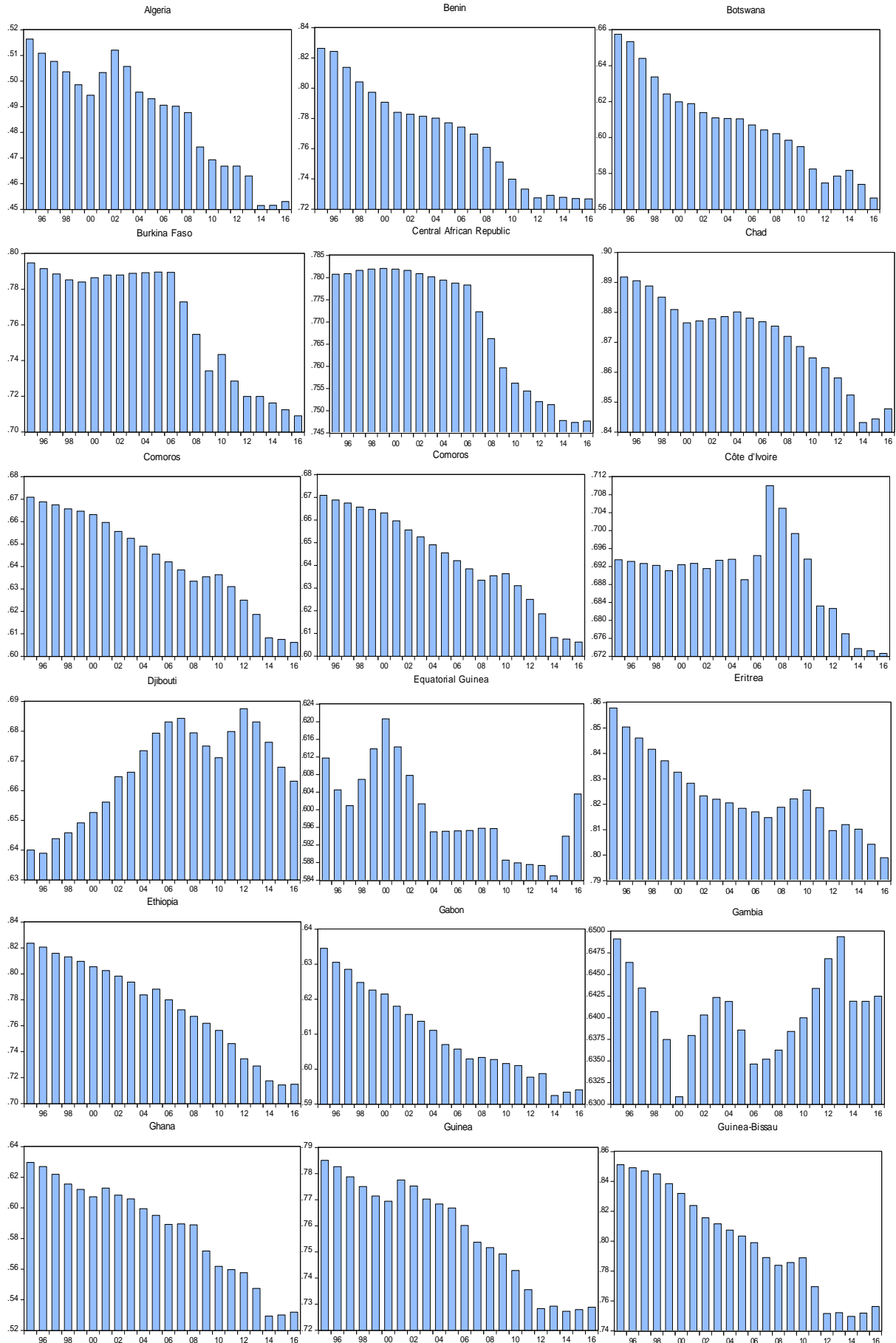
Extracting 6 of 6 possible components

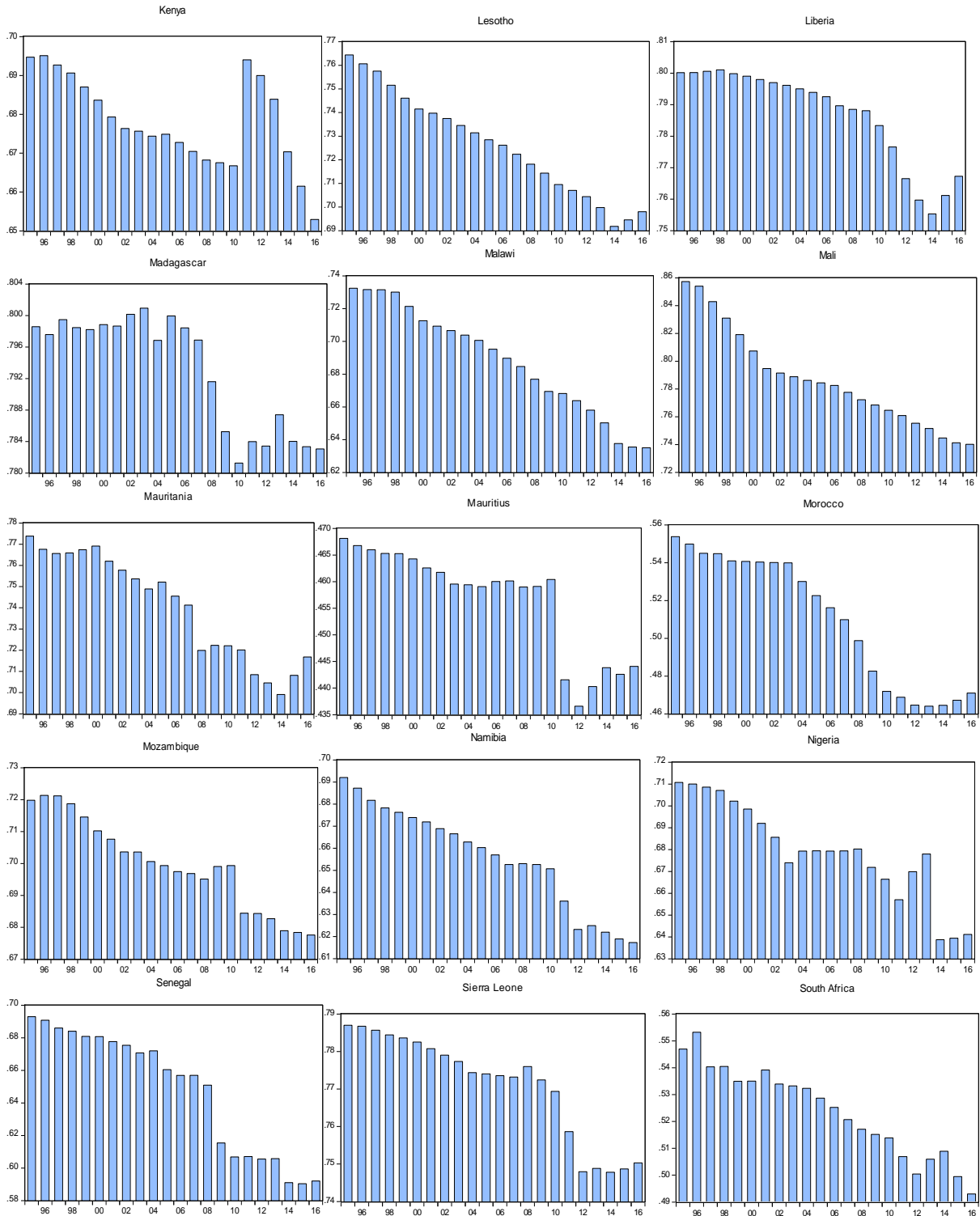
Number	Value	Difference	Proportion	Cumulative Value	Cumulative Proportion
1	2.336266	0.382012	0.3894	2.336266	0.3894
2	1.954254	1.158921	0.3257	4.290519	0.7151
3	0.795333	0.038218	0.1326	5.085853	0.8476
4	0.757116	0.632594	0.1262	5.842968	0.9738
5	0.124522	0.092012	0.0208	5.967490	0.9946
6	0.032510	---	0.0054	6.000000	1.0000

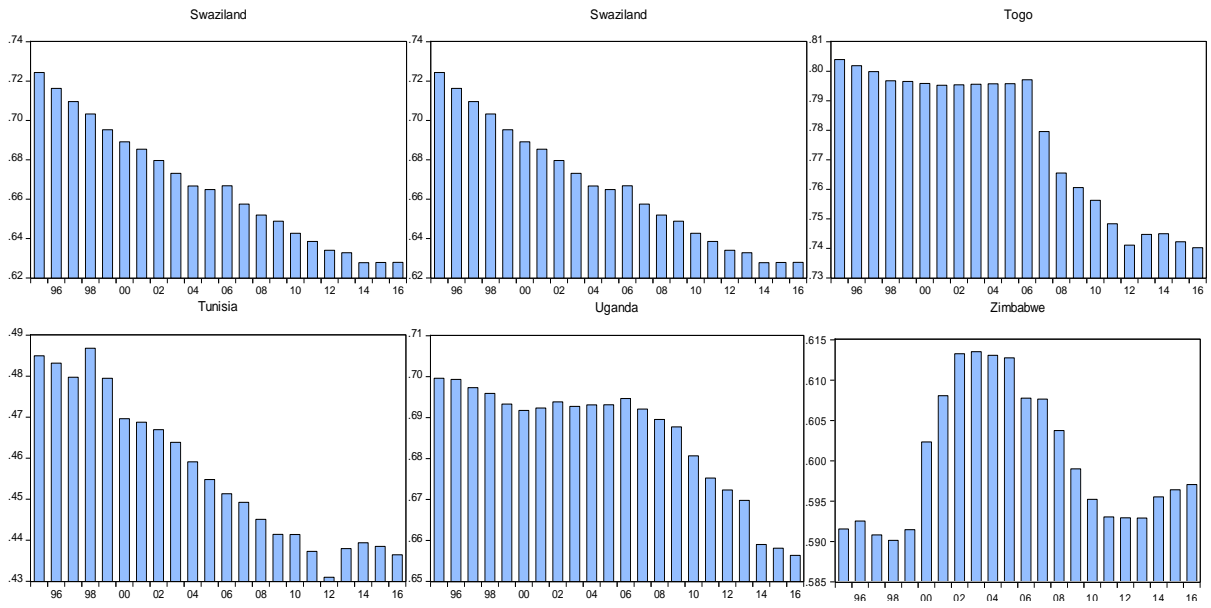
Eigenvectors (loadings):

Variable	PC 1	PC 2	PC 3	PC 4	PC 5	PC 6
LABOR_FORCE						
_PARTICIPATIO	0.5588	-0.178571	-0.014701	-0.446778	0.675267	0.002451
MORTALITY_R						
ATE__UNDER_5	0.370859	0.004225	0.838799	0.396360	-0.025412	0.033401
GDP_PER_CAPI						
TA_GROWTH__	0.162262	0.684250	-0.072494	-0.065083	-0.000533	0.704260
EMPLOYMENT_						
TO_POPULATIO	0.579599	-0.190476	-0.141206	-0.288703	-0.724155	0.009761
CONTRIBUTING						
_FAMILY_WOR	0.384864	-0.095790	-0.518261	0.744831	0.137614	0.019984
GDP_GROWTH_						
_ANNUAL__	0.199463	0.674122	-0.049109	-0.030509	-0.005485	-0.708803

## Appendix 2: Trend analysis of Adaptive Capacity for African Countries







Source: Author's own generation. Data from ND-Gain Index