# POVERTY , RENEWABLE ENERGY AND ECOLOGICAL FOOTPRINT IN NIGERIA (2000-2022)

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## CERTIFICATION

This is to certify that the research was carried out by Babalola Victor Tioluwani with the martic number 20/15ECC001 as part of the requirement for the award of Bsc.(Economics) in the Department of Economics, Faculty of management and social sciences, Thomas Adewumi University, Oko, Kwara state, Nigeria.

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## DEDICATION

I dedicate this write up to almighty God who is the giver of life.

# Acknowledgment

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TABLE OF CONTENT

**LIST OF TABLES**



**LIST OF FIGURES**

## Abstract

The study investigates the moderating role of renewable energy in the relationship between poverty and ecological footprint in Nigeria between 2000-2022. Using an Auto Regressive Distributed Lag (ARDL) model, the research examines co-integration among variables including government expenditure, pollution, urbanization, poverty, and renewable energy consumption. Findings indicate that government expenditure and pollution positively affect ecological footprint, while urbanization, poverty, and renewable energy have significant negative effects. The study recommends prioritizing renewable energy to enhance environmental sustainability and reduce Nigeria's ecological footprint by leveraging its renewable resources for economic development and also removing any constraint in transitioning into renewable energy and instead should provide incentives likes Tax breaks or subsidies that will help for more investment in the renewable energy sector in Nigeria.

## CHAPTER ONE

## INTRODUCTION

### 1.1 Background to the Study

The problem of poverty and environmental sustainability has gained increasing attention, particularly following significant global conferences such as the United Nations (UN) World Summit on Sustainable Development in 1992 and the UN Conference on Environment and Development in 2002 (Cheng et al., 2018). Poverty alleviation and environmental protection have become top priorities of the UN Sustainable Development Goals (SDGs), emphasizing the need for combined efforts to address these challenges (Haider et al., 2018). Despite initiatives to achieve SDGs and reduce poverty, many underdeveloped countries continue to struggle with high poverty rates, highlighting the complexity of these issues (Baloch et al., 2020). Poverty eradication is one of the hot topics of debate at both national and international levels (Wang and Li 2019).

One potential solution proposed is the formulation of policies that promote economic development, with the belief that fostering economic growth can also benefit poverty reduction efforts (Dhrifi et al., 2020). However, these advancements often come with trade-offs, placing additional strain on ecological resources and systems, thereby complicating the poverty-environmental relationship further.

The intersection of poverty and ecological degradation raises significant concerns, as economic growth may involve activities that contribute to environmental degradation, such as increased resource extraction and infrastructure development. Impoverished communities, in particular, may resort to unsustainable practices like deforestation or intensive agriculture to meet their basic needs, further exacerbating ecological degradation.

In recent times, renewable energy has emerged as a topic of discussion, with many viewing it as a potential solution to address both poverty and environmental degradation. (Sarkodie and Strezov 2019) argues that renewable energy solutions are superior to fossil energy because they place less pressure on the environment. Most countries rely on traditional energy sources such as coal, oil, and gas to boost economic growth, which pollute heavily. Many countries neglect environmental quality and the ecological footprint while intensifying economic development (Ahmad et al., 2020)

Transitioning to renewable energy sources, such as solar, wind, hydro, and biomass, offers clean and sustainable alternatives to fossil fuels, thereby reducing greenhouse gas emissions and mitigating climate change. Moreover, renewable energy projects, especially decentralized systems like solar panels or mini-grids, have the potential to provide affordable and reliable energy services to off-grid and marginalized communities. This not only enables income-generating activities but also improves access to education, health-care, and overall quality of life.

Additionally, renewable energy production has a lower environmental impact compared to fossil fuel-based energy generation. By replacing coal, oil, and natural gas with clean energy sources, countries can reduce their carbon footprint, mitigate air and water pollution, and conserve natural resources. Furthermore, renewable energy projects can create opportunities for sustainable land use practices, such as agroforestry or bio-energy production, which contribute to ecosystem restoration and biodiversity conservation.

Addressing the intertwined challenges of poverty alleviation and environmental sustainability requires multifaceted approaches, with renewable energy emerging as a promising solution. By prioritizing renewable energy adoption and implementing policies that promote inclusive and sustainable development, we can work towards achieving the goals of poverty reduction and environmental preservation.

In the context of Nigeria's pursuit of sustainable development, renewable energy emerges as a pivotal factor in moderating the relationship between poverty and ecological footprint. With abundant renewable energy resources such as solar, wind, hydro, and biomass, Nigeria possesses vast potential to harness clean energy alternatives, diversify its energy mix, and mitigate the environmental impacts associated with conventional fossil fuel-based energy generation (IRENA, 2021)

The World Bank in (2019) posits that renewable energy initiatives hold promises for poverty alleviation in Nigeria by expanding access to affordable and reliable electricity, particularly in rural and under served communities. Off-grid solar systems, mini-grids, and decentralized renewable energy solutions offer off-grid communities access to electricity for productive uses, such as lighting, refrigeration, and small-scale enterprises, thereby enhancing livelihood opportunities and income generation.

Moreover, renewable energy deployment creates employment opportunities across the value chain, from manufacturing and installation to operation and maintenance, bolstering local economies and fostering skills development . By reducing energy poverty and enhancing socio-economic resilience, renewable energy initiatives contribute to poverty reduction and social inclusion, empowering marginalized communities to improve their quality of life and well-being (IRENA, 2021).

In addition to its socio-economic benefits, renewable energy plays a crucial role in mitigating environmental degradation and reducing ecological footprints in Nigeria (IEA, 2020). Unlike conventional fossil fuel-based energy generation, renewable energy sources such as solar and wind power produce minimal greenhouse gas emissions and pollutants, thereby mitigating air and water pollution and curbing carbon emissions responsible for climate change.

## 1.2 Statement of the Problem

The Global Footprint Network (2022) analyzed data from 182 countries, revealing that 122 of these countries experienced an ecological deficit, with 32 of them located in Sub-Saharan Africa. Nigeria emerged as one of the countries with a notably high ecological deficit, marked by a total ecological consumption of 0.8 and a bio-capacity of 0.4. This deficit was among the highest recorded among the 48 Sub-Saharan African countries included in the analysis. Furthermore, the Human Development Report (2023) highlighted that out of 1.1 billion people living in poverty globally, 534 million reside in Sub-Saharan Africa. This observation raises the question of whether there is a correlation between poverty and the prevalence of ecological deficits in the region.

According to the World Bank (2022), approximately 4 in 10 Nigerians live below the country's poverty line, totaling around 88 million individuals. This poverty group often relies on outdated cooking methods, fossil fuel consumption, and unsustainable farming and fishing practices, all of which contribute significantly to ecological footprint deficits. The sheer size of Nigeria's poverty group magnifies their environmental impact, posing a significant threat to the ecosystem.

Addressing poverty becomes imperative as it directly influences environmental degradation. While existing literature has explored the complex relationship between poverty and ecological footprints, few studies have proposed solutions incorporating renewable energy sources. The integration of renewable energy presents a viable solution to mitigate the environmental impact of poverty. Transitioning to renewable energy sources not only provides safer energy alternatives but also aids in environmental conservation efforts. By providing access to renewable energy, the poverty group can reduce their reliance on wood burning for cooking, thus minimizing deforestation and air pollution. Additionally, improved access to renewable energy can enhance water availability and overall sustainability efforts.

### 1.3 Research Questions

Following the statement of the research problems, this study therefore aims to answer the following questions:

1. What is the pattern of poverty ecological footprint and renewable energy consumption in Nigeria?
2. What is the relationship between poverty and ecological footprint in Nigeria?
3. What is the relationship between renewable energy and ecological footprint in Nigeria?

### 1.4 Objective Of The Study

The broad objective of the study is to examine the role of renewable energy in the poverty-ecological footprint nexus. The specific objectives are to;

1. Examine the trend of poverty, ecological footprint and renewable energy consumption in Nigeria.
2. Analyze the effect of poverty on ecological footprint in Nigeria
3. Investigate the effects of renewable energy on ecological footprint in Nigeria.

### 1.5 Justification Of The Study

In recent times, there have been a more conscious efforts by governments to reduce poverty while also sustaining the environment.The study in line with the united nations goal 1,7 and 11 which are Zero poverty, clean and affordable energy and sustainable cities and communities will help answer the question as to how to achieve the said objectives which will help the government plan adequately towards this goals.

Also, the study will help the ministry of energy and environment in Nigeria to plan accordingly and understand the intricate relationship between renewable energy and environmental sustainability, it will also help the government understand how renewable energy can help mitigate poverty and ensure sustainable development.

## 1.6 Scope of the Study

This study focuses on Nigeria as the primary geographic area of interest. The study will primarily focus on the period from 2002 to 2022, covering a span of 22 years. The study will cover the following themes: Poverty, ecological footprint and renewable energy deployment.

# CHAPTER TWO

## Literature Review

This chapter reviewed the conceptual, theoretical and empirical literature relevant to the study.

### 2.1 Conceptual Literature.

### 2.2 2.1.1 Ecological Footprint.

The Global footprint network(2022) defines ecological footprint as all the biologically productive areas for which a population, a person or a product competes. It measures the ecological assets that a given population or product requires to produce the natural resources it consumes (including plant-based food and fiber products, livestock and fish products, timber and other forest products, space for urban infrastructure) and to absorb its waste, especially carbon emissions.

Hayden (2024) defines ecological footprint (EF) as the measure of the demands made by a person or group of people on global natural resources. It has become one of the most widely used measures of humanity's effect upon the environment and has been used to highlight both the apparent unsustainability of current practices and the inequalities in resource consumption between and within countries.

### 2.12Ecological Footprint Per Global Hecters

A global hectare (gha) is a standardized unit of measurement that represents the amount of biologically productive land and water area with world average productivity. It is used to compare ecological footprints across different regions and nations.

Components of the Ecological Footprint

i. Carbon Footprint: The amount of land required to sequester CO2 emissions from fossil fuel use.

ii. Forest Footprint: The area of forest land required to produce timber and paper products and to absorb the $CO_2$ emissions from fossil fuel use.

iii. Cropland Footprint: The area of land required to grow crops for food, fiber, and animal feed.

iv. Grazing Land Footprint: The land needed for grazing livestock.

v. Fishing Grounds: The area of ocean required to sustain the fish catch.

vi. Built-up Land: The area covered by infrastructure, including urban areas.

- Calculation Method

The ecological footprint is calculated by multiplying the amount of each product consumed by its corresponding land area requirement. This is then summed across all products and activities to provide a total footprint.

### 2.1.3 Poverty

Poverty is defined according to the Oxford dictionary(2022) as the state of being poor; that is, lacking the basic needs of life such as food, health, education, and shelter.

Townsend (1979) definition of poverty emphasizes the relative nature of poverty. He argues that poverty is not just about having insufficient income but about lacking the resources to participate fully in society. This definition shifts the focus from mere subsistence to social exclusion, considering how societal standards impact individuals' lives. Townsend's work laid the groundwork for understanding poverty in terms of social disadvantage and deprivation beyond mere economic metrics

Similarly, according to the United Nations(2022), Poverty entails more than the lack of income and productive resources to ensure sustainable livelihoods. Its manifestations include hunger and malnutrition, limited access to education and other basic services, social discrimination and exclusion, as well as the lack of participation in decision-making.

The World Bank (2022)  also defines poverty as the inability to attain a minimum standard of living, often associated with a lack of access to basic necessities such as food, shelter, education, and health care. It's a complex and multifaceted phenomenon that can manifest in various forms. The World Bank classifies poverty into different types based on its severity, duration, and underlying causes. Some of the key types of poverty according to the World Bank:

i. Extreme Poverty: Extreme poverty, also known as absolute poverty, refers to living below the international poverty line, which is set by the World Bank at $1.90 per day (as of 2021). Individuals or households in extreme poverty struggle to meet their basic needs for survival, including food, shelter, and sanitation.

ii. Moderate Poverty: Moderate poverty refers to living on incomes slightly above the extreme poverty line but still below the national poverty line. While individuals in moderate poverty may have access to some basic necessities, they often face challenges in meeting other essential needs such as education and healthcare.

iii. Chronic Poverty: Chronic poverty refers to long-term or persistent poverty that persists over extended periods, often spanning multiple generations. Individuals or households experiencing chronic poverty may lack the resources, opportunities, or support systems needed to escape poverty traps.

iv. Cyclical Poverty: Cyclical poverty refers to poverty that fluctuates over time due to factors such as economic downturns, natural disasters, or other external shocks. Individuals or communities experiencing cyclical poverty may temporarily fall into poverty during periods of crisis but may recover once conditions improve.

v. Structural Poverty: Structural poverty refers to poverty resulting from systemic or institutional factors such as inequality, discrimination, lack of access to resources, and limited economic opportunities. Addressing structural poverty requires addressing underlying social, political, and economic barriers that perpetuate inequality and exclusion.

vi. Rural Poverty: Rural poverty refers to poverty concentrated in rural areas, where a significant portion of the population relies on agriculture or informal economies for their livelihoods. Rural poverty may be exacerbated by factors such as limited access to markets, infrastructure, education, and healthcare services.

vii. Urban Poverty: Urban poverty refers to poverty concentrated in urban areas, where rapid urbanization and informal settlement growth can lead to overcrowding, inadequate housing, unemployment, and social exclusion. Urban poverty may be driven by factors such as rural-urban migration, lack of affordable housing, and limited access to formal employment opportunities.

#### 2.1.3.1Poverty Headcount Ratio:

The percentage of people in a given population whose income or consumption level is below the poverty line. The poverty line is typically defined as the minimum level of income required to meet basic living standards, including food, clothing, and shelter.

Calculation

Formula: Poverty Headcount Ratio= number of people living below the poverty line/total number of the populationx 100

### 2.1.4 Renewable Energy

According to the Cambridge dictionary (2022), renewable energy is the energy that is produced using the sun, wind, etc., or from crops, rather than using fuels such as oil or coal.

Similarly, the Collins dictionary (2021) also defined  renewable energy as a form of energy that can be derived from a natural source, such as the sun, wind, tides, or waves, without exhausting natural resources or causing severe ecological damage.

Also, according to the United Nations (2023), renewable energy is energy derived from natural sources that are replenished at a higher rate than they are consumed. Sunlight and wind, for example, are such sources that are constantly being replenished. Renewable energy sources are plentiful and all around us. A few common sources of renewable energy includes:

i. Solar Energy: Solar energy is the most abundant of all energy resources and can even be harnessed in cloudy weather. The rate at which solar energy is intercepted by the Earth is about 10,000 times greater than the rate at which humankind consumes energy. Solar technologies can deliver heat, cooling, natural lighting, electricity, and fuels for a host of applications. Solar technologies convert sunlight into electrical energy either through photo-voltaic panels or through mirrors that concentrate solar radiation.

ii. Wind Energy: Wind energy harnesses the kinetic energy of moving air by using large wind turbines located on land (onshore) or in sea- or freshwater (offshore). Wind energy has been used for millennial, but onshore and offshore wind energy technologies have evolved over the last few years to maximize the electricity produced - with taller turbines and larger rotor diameters.

iii. Geothermal Energy: Geothermal energy utilizes the accessible thermal energy from the Earth's interior. Heat is extracted from geothermal reservoirs using wells or other means. Reservoirs that are naturally sufficiently hot and permeable are called hydro-thermal reservoirs, whereas reservoirs that are sufficiently hot but that are improved with hydraulic stimulation are called enhanced geothermal systems.Once at the surface, fluids of various temperatures can be used to generate electricity. The technology for electricity generation from hydrothermal reservoirs is mature and reliable, and has been operating for more than 100 years.

iv. Hydropower: Hydro-power harnesses the energy of water moving from higher to lower elevations. It can be generated from reservoirs and rivers. Reservoir hydro-power plants rely on stored water in a reservoir, while run-of-river hydro-power plants harness energy from the available flow of the river. Hydro-power reservoirs often have multiple uses - providing drinking water, water for irrigation, flood and drought control, navigation services, as well as energy supply. Hydro-power currently is the largest source of renewable energy in the electricity sector.  It relies on generally stable rainfall patterns, and can be negatively impacted by climate-induced droughts or changes to ecosystems which impact rainfall patterns. The infrastructure needed to create hydro-power can also impact on ecosystems in adverse ways. For this reason, many consider small-scale hydro a more environmentally-friendly option, and especially suitable for communities in remote locations.

v. Ocean Energy: Ocean energy derives from technologies that use the kinetic and thermal energy of seawater - waves or currents for instance -  to produce electricity or heat. Ocean energy systems are still at an early stage of development, with a number of prototype wave and tidal current devices being explored. The theoretical potential for ocean energy easily exceeds present human energy requirements.

vi. Bioenergy: Bio energy is produced from a variety of organic materials, called biomass, such as wood, charcoal, dung and other manures for heat and power production, and agricultural crops for liquid bio fuels. Most biomass is used in rural areas for cooking, lighting and space heating, generally by poorer populations in developing countries. Modern biomass systems include dedicated crops or trees, residues from agriculture and forestry, and various organic waste streams. Energy created by burning biomass creates greenhouse gas emissions, but at lower levels than burning fossil fuels like coal, oil or gas. However, bio energy should only be used in limited applications, given potential negative environmental impacts related to large-scale increases in forest and bio energy plantations, and resulting deforestation and land-use change.

## 2.2 Theoretical Literature.

### 2.2.1 Theories Of The Environment

#### 2.2.1.1 Environmental Kuznets Curve

The Kuznets curve expresses a hypothesis advanced by economist Simon Kuznets in the 1950s and 1960s. According to this hypothesis, as an economy develops, market forces first increase and then decrease economic inequality.

Subsequently, other people began to apply his theory to the environment, the environmental Kuznets curve (EKC) is a hypothesized relationship between environmental quality and economic development: various indicators of environmental degradation tend to get worse as modern economic growth occurs until average income reaches a certain point over the course of development. The EKC suggests, in sum, that "the solution to pollution is economic growth."

Although subject to continuing debate, there is considerable evidence to support the application of environmental Kuznets curve for various environmental health indicators, such as water, air pollution and ecological footprint which show the inverted U-shaped curve as per capita income and/or GDP rise.

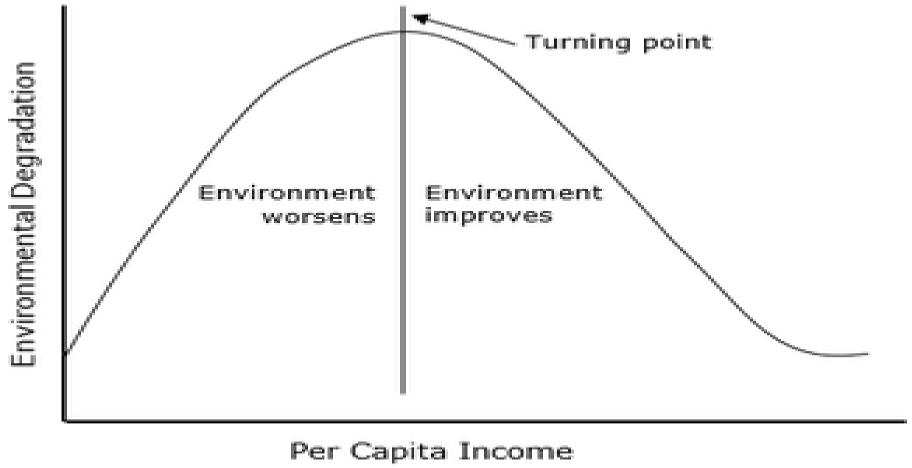



Figure 2.1 Graph showing the environmental kuznet curve

#### 2.2.1.2 Ecological Modernization Theory

The Ecological Modernization Theory was first proposed by Joseph Huber in 1982 and was later developed by Martin Jänicke (1985) and Arthur P.J. Mol (1995). Ecological Modernization Theory (EMT) posits that economic development and environmental protection are not mutually exclusive and can, in fact, reinforce each other. The theory emerged in the early 1980s as a response to the pessimistic views of the relationship between industrialization and environmental degradation. EMT suggests that advanced industrial societies have the potential to restructure their economies to become more environmentally sustainable through technological innovation, improved regulatory frameworks, and shifts in production and consumption patterns. The Theory has evolved since its inception, incorporating insights from various disciplines and adapting to new environmental challenges. It has influenced environmental policy-making, particularly in Europe, where many countries have adopted strategies that align with the principles of EMT. The theory has been instrumental in shaping policies that promote sustainable development, green technologies, and the integration of environmental considerations into economic planning.

EMT has also been subject to criticism, particularly regarding its emphasis on technological solutions and the belief in the compatibility of economic growth and environmental sustainability. Critics argue that EMT may overlook deeper structural issues and the need for more radical changes in consumption patterns and lifestyles.

**2.2.1.3 Safe Minimum Standard Theory(SMS).**

The theory was first introduced by S.V. Ciriacy-Wantrup in 1952 in the context of groundwater management and later elaborated by Richard C. Bishop in 1978. The theory suggests that, in situations where there is significant uncertainty and the potential for catastrophic and irreversible environmental damage, it is prudent to adhere to a safe minimum standard of conservation. This approach emphasizes the precautionary principle and argues against the typical cost-benefit analysis when dealing with non-renewable or critical natural resources.

The key concepts of the theory

i. Ir-reversibility: SMS theory focuses on preventing irreversible environmental changes. It argues that some natural resources and ecological systems, once degraded or lost, cannot be recovered or replaced.

ii. Scientific Uncertainty: Given the complexity of ecological systems, there is often significant uncertainty regarding the impacts of human activities. SMS advocates for erring on the side of caution in the face of such uncertainties.

iii. Precautionary Principle: The theory aligns with the precautionary principle, which states that the absence of complete scientific certainty should not be a reason for postponing measures to prevent environmental degradation.

iv. Minimum Standard: SMS proposes setting a baseline or minimum standard that must be maintained to ensure the continued functioning and existence of critical ecological systems. This standard should be non-negotiable and protected regardless of economic costs.

v. Economic Considerations: While economic costs and benefits are considered, SMS theory posits that the potential costs of irreversible damage outweigh the benefits of exploiting the resource. It prioritizes long-term ecological sustainability over short-term economic gains.

vi. Policy Implications: SMS provides a framework for policymakers to justify conservation measures that might not pass a traditional cost-benefit analysis but are crucial for preventing irreversible harm.

Critics argue that SMS might impose significant economic costs that could be unsustainable for certain communities or economies, especially when the probability of the feared catastrophic event is low. They also emphasised about the operationalization of the theory, determining what constitutes a "safe minimum standard" can be challenging due to the lack of precise scientific data and the complexity of ecological systems. Also, Implementing SMS often involves balancing environmental goals with social and economic needs, which can be politically and practically challenging

**2.2.1.4 Theory of Political Ecology.**

Traditional environmental studies often presented a sanitized picture, focusing on the technical aspects of environmental degradation without delving into the actual realities of power, economics, and social inequalities. Political ecology emerged in the 1970s as a critical response to this sanitized approach. It unveils the intricate complexity woven from political, economic, and social factors that shapes environmental issues and changes.

Central to political ecology is the concept of power and its unequal distribution. It lays bare how marginalized communities, often in developing nations, bear the brunt of environmental damage caused by resource extraction practices of wealthier countries or corporations. The framework examines how decisions about resource use and environmental management are made, highlighting the voices often silenced in traditional environmental narratives. Political ecology sheds light on how powerful actors, driven by economic interests, prioritize profit over environmental sustainability, leading to deforestation, pollution, and biodiversity loss. The field takes a nuanced approach to scale. It analyzes environmental issues across different levels, from the local struggles of a community against a polluting factory to the global forces of trade and investment that drive resource exploitation. Political ecology demonstrates how policies and economic forces at a larger scale, often driven by powerful nations and corporations, can have devastating consequences for local communities and ecosystems on the ground. Furthermore, political ecology recognizes the invaluable knowledge held by local communities regarding their environment. Traditional knowledge systems, honed over generations of living in harmony with nature, are often ignored or dismissed. Political ecology critiques top-down environmental solutions that fail to incorporate local expertise and participation. It advocates for empowering local communities to be active participants in environmental decision-making, ensuring their voices are heard and their knowledge respected. Some argue that political ecology focuses on power structures and can overshadow the agency and resilience of local communities who actively resist environmental degradation and work towards sustainable solutions. Additionally, the field is sometimes criticized for primarily offering critiques of environmental problems, neglecting to propose clear pathways towards environmental sustainability. Despite these criticisms, political ecology remains a vital framework for understanding contemporary environmental challenges. It equips us to analyze issues like climate change, resource conflicts, and the role of social movements in environmental protection through a lens that acknowledges the complex interplay of power dynamics, economic forces, and social inequalities. By bringing these factors to the forefront, political ecology empowers us to develop more just and sustainable solutions for the future, ensuring that environmental protection benefits all and not just the privileged few.

### 2.2.2 Theories On Poverty

#### 2.2.2.1 Human Capital Theory

Human Capital Theory, propounded by economist Gary Becker in the early 1960s, offers an explanation for poverty that centers on the concept of human capital. Becker argued that individuals' economic success is largely determined by their education, skills, and training—collectively known as human capital. According to this theory, people with higher levels of education and better skills are more productive and, consequently, command higher wages in the labor market.

Becker's seminal work, "Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education" (1964), laid the foundation for this theory. He posited that investments in human capital, such as education and vocational training, are similar to investments in physical capital, like machinery or buildings. Just as physical capital enhances productivity and leads to higher profits, human capital increases an individual's productivity and earning potential. This theory implies that poverty can be mitigated through policies that improve access to quality education and training programs. By enhancing individuals' skills and capabilities, they become more competitive in the job market, which can lead to higher employment rates and better wages. Becker's Human Capital Theory has significantly influenced economic policies and education reforms worldwide, emphasizing the importance of investing in people to foster economic growth and reduce poverty.

#### 2.2.2.2 Culture Of Poverty

The Culture of Poverty theory was introduced by anthropologist Oscar Lewis in the late 1950s and early 1960s. Through his ethnographic work, notably in his book "Five Families: Mexican Case Studies in the Culture of Poverty" (1959) and later "La Vida" (1966), Lewis observed that people living in impoverished conditions often develop a distinct set of cultural traits and behaviors that help them cope with their environment but also contribute to the

persistence of poverty. Lewis identified several characteristics of the culture of poverty, including a focus on the present rather than the future, a sense of helplessness and fatalism, and a strong orientation towards family and community relationships over formal economic or educational achievements. These traits, according to Lewis, are adaptive responses to the harsh realities of poverty. However, they can also become barriers to upward mobility, as they may discourage long-term planning and investment in education or skills development. The Culture of Poverty theory suggests that poverty is not just a result of economic factors but also of deeply ingrained cultural patterns that are passed down from one generation to the next. Lewis argued that to effectively address poverty, interventions must go beyond economic aid and include efforts to change these cultural patterns. This might involve community-based programs that promote new values and behaviors, encourage future-oriented thinking, and provide role models who have successfully escaped poverty.
Critics of the Culture of Poverty theory argue that it can lead to blaming the poor for their situation and overlook structural factors such as systemic inequality and discrimination. Nonetheless, Lewis's work has sparked important discussions about the interplay between culture and poverty, highlighting the need for a multifaceted approach to poverty alleviation.

### 2.2.3 Theories on renewable energy.

#### 2.2.3.1 Energy transition theory.

The energy transition theory was developed by the works of Vaclav Smil and Amory Lovins in the early 20$^{th}$ century. Energy transition refers to the global energy sector’s shift from fossil-based systems of energy production and consumption — including oil, natural gas and coal — to renewable energy sources like wind and solar, as well as lithium-ion batteries. The increasing penetration of renewable energy into the energy supply mix, the onset of electrification and improvements in energy storage are all key drivers of the energy transition.

Regulation and commitment to decarbonization has been mixed, but the energy transition will continue to increase in importance as investors prioritize environmental, social and governance (ESG) factors. The energy transition is critically important for several key reasons including environmental, social, and economic factors. Some of the key reasons we need to transition to renewable energy in more detail. In the global quest for a sustainable future, there are four major pillars of energy transition: energy access, energy efficiency, sustainability, and energy security. These pillars represent the cornerstones of the energy transition, each playing a vital role in steering our world towards a more resilient and environmentally responsible future.

### 2.3 Empirical Literature.

Baloch et al. (2020) investigated the relationship between poverty and carbon emissions in Sub-Saharan Africa from 2010 to 2016, utilizing the Driscoll-Kray regression estimator. Their study revealed that increased income inequality significantly contributes to rising CO2 emissions. Furthermore, they found that an increase in poverty has a detrimental effect on environmental pollution in Sub-Saharan African countries. This finding suggests that socioeconomic factors like income inequality and poverty exacerbate environmental issues, highlighting the need for policies that address these factors to achieve environmental sustainability.

Building on this, Khan et al. (2022) extended the analysis to 18 Asian developing countries over the period 2006–2017. Using the Driscoll-Kraay (D-K) standard error approach, their empirical results confirmed that the poverty headcount contributes significantly to environmental degradation in terms of the ecological footprint. This study reinforces the conclusions of Baloch et al. (2020) and suggests that poverty and income inequality are pervasive issues impacting the environment across different developing regions. The findings indicate that comprehensive policy interventions are necessary to address these challenges effectively.

Additionally, Salah et al. (2020) explored the trade-off between poverty and ecological footprint, utilizing time-series data spanning 2010–2016. Their study employed the Driscoll-Kray regression estimator, which is flexible for dependencies across countries, heteroscedasticity, and autocorrelation. The findings suggest that an increase in poverty reduces the ecological footprint, indicating a complex relationship between poverty alleviation and environmental sustainability. This counterintuitive result implies that efforts to reduce poverty may inadvertently increase environmental pressures, necessitating a balanced approach in policy formulation.

Conversely, Khan et al. (2021) examined the relationship between poverty, income inequality, and ecological footprint in 18 Asian developing countries over the period 2006–2017. Their empirical results, obtained from the Driscoll–Kraay (D–K) standard error approach, confirmed that poverty headcount significantly contributes to environmental degradation. Additionally, widening income inequality has a detrimental effect on the environment in these countries. The findings support the Environmental Kuznets Curve (EKC) hypothesis and emphasize the importance of targeted policies to address poverty and income inequality in the context of Sustainable Development Goals (SDGs). Furthermore, Li et al. (2023) analyzed the role of renewable energy consumption in reducing environmental pressures, such as per capita carbon emissions and per capita ecological footprint, across 130 countries from 1992 to 2019. Using a panel threshold regression estimation approach, they found that renewable energy consumption negatively impacts environmental pressures. Their results indicate that renewable energy is particularly effective in reducing the ecological footprint in low-income countries, highlighting renewable energy as a viable solution for sustainable development and addressing the environmental issues highlighted by Baloch et al.

(2020) and Khan et al. (2022). In addition, Anwar et al. (2021) focused on the impact of renewable and non-renewable energy consumption on the environment in ASEAN countries. Utilizing the Method of Moments Quantile Regression, their study indicated that while non-renewable energy consumption stimulates carbon emissions across all quantiles, renewable energy consumption helps reduce CO2 emissions. However, this association was statistically insignificant at higher quantiles, suggesting that while renewable energy is beneficial, its effectiveness may vary across different levels of energy consumption and economic development. This finding necessitates tailored renewable energy policies to maximize environmental benefits. Moreover, Musibau et al. (2020) emphasized the importance of green energy consumption and energy innovation in mitigating environmental degradation in Sub-Saharan Africa. Their study indicated that significant investment in green energy and energy innovation is necessary to reduce environmental pressures. This supports the broader narrative of sustainable energy practices, suggesting that green energy and innovation are crucial for achieving environmental sustainability in the region. Additionally, Radmehr et al(2022) studied the interplay between renewable energy consumption, ecological footprint, and economic growth in G7 economies. Their findings demonstrated bidirectional links between GDP and renewable energy, and between ecological footprint and renewable energy. The study highlighted the importance of human capital and trade openness in reducing environmental deterioration. These findings underscore the multifaceted approach needed for sustainable development, integrating economic and environmental policies. Conversely, Sasu et al. (2023) investigated the role of capital markets in enhancing the positive impacts of renewable energy on environmental sustainability in developing countries. They found that both stock and bond markets reduce carbon emissions and enhance renewable energy consumption. Their study suggests that well-developed capital markets can amplify the benefits of renewable energy, pointing to the need for integrated economic and environmental policies.

Furthermore, Nan et al. (2022) examined the impact of renewable energy consumption on the ecological footprint using the Vector Autoregressive model and quantile regression method. Their results showed that renewable energy has a long-term negative impact on the ecological footprint, particularly through wind energy consumption. The study revealed that for every 1% increase in renewable energy consumption, the ecological footprint decreases by 2.91%. This finding reinforces the potential of renewable energy to reduce environmental pressures and highlights the varying effects of different types of renewable energy. Moreover, Dada et al. (2024) explored the moderating role of financial development in the relationship between energy poverty and environmental sustainability in African nations. Their findings showed that access to clean energy and electricity reduces the ecological footprint, but financial development at higher quantiles exacerbates environmental degradation. This indicates that while financial development can aid in reducing energy poverty, it may also have adverse environmental impacts, suggesting the need for balanced policy approaches that consider both economic and environmental goals. Additionally, Ezako (2024) analyzed the interplay between environmental protection, governance, foreign aid, and human development in developing countries. Using data from 56 countries over 15 years, their research revealed that effective governance can mitigate the negative effects of foreign aid on human development, particularly in low-income countries. This study underscores the importance of strong institutions and governance in enhancing the positive impacts of socioeconomic and environmental interventions, providing valuable insights for policymakers. Conversely, Sheraz et al. (2022) examined the dynamic nexus among financial development, renewable energy, and carbon emissions in BRI countries, focusing on globalization and institutional quality as moderators. Their results revealed that while globalization exacerbates the negative environmental impacts of financial development, institutional quality mitigates these effects and enhances the positive impacts of renewable energy. This highlights the critical role of good governance and strong institutions in achieving sustainable development goals. Furthermore, Bozatli et al. (2024) investigated the effects of environmental protection expenditures, resource taxes, government effectiveness, economic growth, and renewable energy on environmental sustainability in the Netherlands from 1996 to 2021. Using a Fourier-based econometric methodology, their findings implied that environmental protection expenditures and resource taxes are effective policies for ensuring environmental sustainability. Additionally, renewable energy policies and government effectiveness contribute positively to environmental sustainability, while economic growth negatively affects it by increasing environmental pressure. This study emphasizes the need for balanced economic and environmental policies. Additionally, Aquilas et al. studied the effect of industrialization on environmental sustainability in Africa, considering the moderation effect of renewable and non-renewable energy consumption. Data collected for 46 African countries from 2000 to 2022 revealed that manufacturing value added has a negative and significant effect on environmental sustainability. However, when interacted with renewable energy consumption, manufacturing exerted a positive effect on load capacity factor. This suggests that renewable energy has the potential to support industrial growth in Africa while sustaining the environment. The findings recommend that renewable energy should be the primary source of industrial energy to achieve sustainable industrialization in Africa.

**Table 2.1 Summary of empirical literature**

| S/N | Authors | Topics focus | Estimation Techniques | Main Results and Findings |
|---|---|---|---|---|
| 1 | Baloch et al. (2020) | Relationship between poverty and carbon emissions | Driscoll-Kray regression estimator | Income inequality contributes to rising $CO_2$ emissions; poverty has a detrimental effect on pollution in Sub-Saharan |

| | | | | |
|---|---|---|---|---|
| | | | | Africa. |
| 2 | Khan et al. (2022) | Poverty, income inequality, and ecological footprint | Driscoll-Kraay (D-K) standard error approach | Poverty headcount significantly contributes to environmental degradation in 18 Asian developing countries. |
| 3 | Salah et al. (2020) | Trade-off between poverty and ecological footprint | Driscoll-Kray regression estimator | Increase in poverty reduces the ecological footprint; complex relationship between poverty alleviation and environmental sustainability. |
| 4 | Khan et al. (2021) | Poverty, income inequality, and ecological footprint | Driscoll–Kraay (D–K) standard error approach | Poverty headcount contributes to environmental degradation; widening income inequality harms the environment in 18 Asian developing countries. |
| 5 | Li et al. (2023) | Role of renewable energy consumption | Panel threshold regression estimation | Renewable energy consumption negatively impacts environmental pressures; particularly effective in low-income countries. |
| 6 | Anwar et al. (2021) | Impact of renewable and non-renewable energy consumption | Method of Moments Quantile Regression | Non-renewable energy consumption stimulates CO2 emissions; renewable energy helps reduce emissions but is less effective at higher quantiles. |
| 7 | Musibau et al. (2020) | Green energy consumption and energy innovation | | Significant investment in green energy and innovation is necessary to mitigate environmental degradation in Sub-Saharan Africa. |
| 8 | Radmehr et al. | Renewable energy, ecological footprint, and economic growth | | Bidirectional links between GDP and renewable energy; human capital and trade openness reduce environmental deterioration. |
| 9 | Sasu et al. (2023) | Role of capital markets in renewable energy and emissions | | Stock and bond markets reduce carbon emissions and enhance renewable energy consumption. |
| 10 | Nan et al. (2022) | Impact of renewable energy consumption on ecological footprint | Vector Autoregressive model and quantile regression | Renewable energy has a long-term negative impact on the ecological footprint; wind energy consumption has the most significant reduction effect. |
| 11 | Dada et al. (2024) | Financial development, energy poverty, and sustainability | | Clean energy access reduces ecological footprint; financial development at higher quantiles exacerbates |

| | | | | |
|---|---|---|---|---|
| | | | | environmental degradation. |
| 12 | Ezako (2024) | Environmental protection, governance, foreign aid, and human development | | Effective governance mitigates negative effects of foreign aid on human development, especially in low-income countries. |
| 13 | Sheraz et al. (2022) | Financial development, renewable energy, and carbon emissions | | Globalization worsens environmental impacts of financial development; institutional quality mitigates these effects. |
| 14 | Bozatli et al. (2024) | Environmental protection expenditures and policies | Fourier-based econometric methodology | Environmental protection expenditures and resource taxes are effective for sustainability; renewable energy and government effectiveness also contribute positively. |
| 15 | Aquilas et al. | Industrialization and environmental sustainability | Robust panel fixed effects regression and GLS | Manufacturing value added negatively impacts sustainability; renewable energy in manufacturing has a positive effect. |
| | | | | |

## CHAPTER THREE

## METHODOLOGY

### 3.1 Research Design.

The research design for this study is expo-facto research design. This type of design is appropriate when the data for the research already exist in various organizations and the researcher merely extracts them and analyse them to resolve whatever issues are in the research.

### 3.2 Theoretical Framework.

The theoretical framework for this study is rested on the model of Environmental Kuznets Curve (EKC) which was formulated by Simon Kuznets in 1955 but in the context of income inequality, then was later extended to environmental issues by Grossman and Krueger in 1991. The Environmental Kuznets Curve (EKC) hypothesis suggests that there exists an inverted U-shaped relationship between environmental degradation and economic development. Initially, as a country's income rises, environmental degradation increases, reflecting the expansion of industrial activities and higher pollution levels. However, after reaching a certain income threshold, further economic growth is associated with environmental improvement. This phenomenon is attributed to technological advancements, regulatory policies, and shifts in consumption patterns, which collectively reduce pollution and promote sustainability.

The theory explored the connection between economic growth and environmental quality, providing empirical support for the EKC hypothesis. The underlying mechanisms include the adoption of cleaner technologies, stricter environmental regulations, and changes in societal preferences towards cleaner production and consumption.

Empirical evidence on the EKC is mixed, with some studies confirming the inverted U-shaped relationship for various pollutants, while others find no significant link or observe different patterns across countries and regions. Factors such as the type of pollution, the level of economic development, and the effectiveness of environmental policies significantly influence the EKC's manifestation. The hypothesis has spurred extensive research, emphasizing the role of technological innovation, policy interventions, and global cooperation in achieving sustainable development and environmental conservation.

**3.3 Model Specification.**

The model for this study is built on the work of Baloch et al (2020) in which he explores the impact of poverty and income inequality on C02 emissions by incorporating economic growth, economic freedom, and access to electricity, inflation, and population as control variables in the study. The study takes advantage of applying n Driscoll and Kraay (1998) (DK) standard error method algorithm for pooled ordinary least squares (OLS) estimation through a linear model which can be expressed as follows:

$Yit = xit\beta+\varepsilon i,t, i=1; \ldots; N; t= 1; \ldots; T$……..equation(3.1)

where yi,t represents the dependent variable (CO2 emissions) and xi,t shows independent variables (poverty, income inequality, GDP per capita, access to electricity, population, inflation, and economic freedom).

This present study is built on this model but with slight modifications. The model for this study is stated as follows,

EFP = f (REW,PO,GOVex, URBmr,POL)…….equation(3.2)

Where;

EFP =per capita ecological footprint

Rew= renewable energy proxy by renewable electricity net output (% of total electricity output)

Pov= poverty proxy by Prevalence of undernourishment (% of population)

Govex= government expenditure

Urbmr= urbanization

Pol= pollution

Per capita ecological footprint (efp) as a measure for environmental degradation is the dependant variable and renewable energy(rew) proxy by renewable electricity net generation (billion kWh). poverty (Pov) proxy by poverty headcount, government expenditure (Govex),urbanization (URBmr), pollution (Pol) are all indepemndent variables.

Econometrics modeling will be written as,

$EFP = a_0 + a_1 REW + a_2 POV + a_3 GOVex + a_4 URgrwth + a_5 POl + U_i$ ……..equation(3.3)

Where Ui is the error term error term

**Objective 1: Examine the trend of poverty, ecological footprint, and renewable energy consumption in Nigeria**

In this study, objective one will be achieved by the use of line plots. The aim of this part is to find out the historical trend of poverty, ecological footprint and renewable energy consumption. To this end, the trend of this variables n variables will be analyzed for Nigeria between 2000 and 2022.

**Objective 2&3**: Analyze the effect of poverty on ecological footprint in Nigeria and Investigate the effects of renewable energy on ecological footprint in Nigeria.

Econometric Model :

$EFP = a_0 + a_1 REW + a_2 POV + a_3 GOVex + a_4 URgrwth + a_5 POl + U_i$ ……………….

Where:

EFP =per capita ecological footprint

Pov= poverty proxy by prevalence of Undernourishment.

Govex= government expenditure

Urbmr= Urban population growth rate

Pol= pollution proxy by $CO_2$ emissions

Ui= error term

### 3.4 Definition and Measurement of Variables.

Table 3.1 Definitions Of Terms

| Item | Symbol | Definitions | Data source |
|---|---|---|---|
| Ecological footprint | EFP | Per capita ecological footprint | Global footprint network |
| Renewable energy | REW | renewable electricity net output (% of total electricity output) | World bank Development Indicator |
| Poverty | POV | Prevalence of undernourishment (% of population) | World Development Indicators |
| Pollution | POL | $CO_2$ emissions (kt) | World Bank Group |
| Urbanization | Urgrwth | Urban Population growth | World Development Indicators |
| Government expenditure | GOVex | Total Expenditure of General Government for Nigeria, Percent of GDP | Federal Reserve Economic Data |

### 3.5 Estimation Techniques.

The study employs a series of econometric techniques to analyze the role of renewable energy in the relationship between poverty and the ecological footprint in Nigeria. The analysis begins with an examination of the descriptive statistics for each variable. Descriptive statistics provide a summary of the basic characteristics of the data set, including measures of central tendency (mean, median), dispersion (standard deviation, variance), and the shape of the distribution (skewness, kurtosis). This initial analysis helps to understand the general properties of the data, identify any anomalies, and ensure the quality of the data set.

The analysis will then test for stationarity  using the Augmented Dickey-Fuller (ADF) test. This test is crucial to ensure that the time series data for all variables—ecological footprint (EF), poverty headcount ratio (Pov), renewable energy consumption (RE), government expenditure (Govex), urban growth (Urgrw), and pollution (Pol)—are stationary. Stationary data have a constant mean and variance over time, which is necessary to avoid spurious regression results. If the series are found to be non-stationary, they are differenced to achieve stationarity. Once stationarity is confirmed, the next step involves co-integration testing using the Johansen co-integration test. This test checks whether there is a long-term equilibrium relationship between the variables. For the model investigating the effect of poverty on the ecological footprint, expressed as ;

$$EFP = a_0 + a_1 REW + a_2 POV + a_3 GOVex + a_4 URgrwth + a_5 POl + U_i$$

the co-integration test helps determine if these variables move together over time. If co-integration is detected, it suggests that despite short-term fluctuations, the variables share a common long-term trend.

In cases where co-integration is present, the Vector Error Correction Model (VECM) is employed. The VECM is suitable for capturing both short-term dynamics and long-term relationships, making it ideal for the study's needs. This model corrects deviations from the long-term equilibrium while modeling short-term adjustments. For instance, In the model exploring the role of renewable energy,

$$EFP = a_0 + a_1 REW + a_2 POV + a_3 GOVex + a_4 URgrwth + a_5 POl + U_i$$

the VECM would help understand how renewable energy consumption (REW) influences the long-term relationship between poverty (Pov) and the ecological footprint  (EFP).

In cases where the variables are stationarity  at levels and at first difference, Auto Regressive Distributive Lag(ADRL) is adopted.  The ARDL model is advantageous because it can handle variables with different orders of integration (I(0) and I(1)), and it is effective for small sample sizes. This model allows the analysis of both short-term and long-term relationships between variables. In the context of the moderating role of renewable energy, the ARDL approach would analyze how changes in renewable energy consumption affect the poverty-ecological footprint nexus over different time horizons.

For initial estimations and to simplify the relationships, Ordinary Least Squares (OLS) regression is applied. This method estimates the coefficients of the models . Ensuring that the residuals from the OLS regression are stationary is critical to validate the regression results, which can be checked using unit root tests on the residuals.

# CHAPTER FOUR

# PRESENTATION AND DISCUSSION OF FINDINGS

## 4.1 Results of the Descriptive Statistics

In this section, a number of variables and proxies' summary statistics for the overall sample is presented and discussed.

### 4.1.1 Summary Statistics For Poverty, Renewable Energy And Ecological Footprint.

Given the descriptive statistics as depicted in table 4.1, the basic characteristics of series in the model of the study is summarized in a meaningful way.

Table 4.1 shows the statistical distribution of all the variables in the models. From the table, the estimated mean value which is used to examine the nature of the data distribution was higher for Pollution levels and Renewable energy with (101.2914) and (4.551457) respectively while Urban growth has the lowest mean values of (4.551457). The standard deviation measures the dispersion around the mean, Urban growth has the lowest standard deviation at ( 0.398697) which indicates a lower level of dispersion around the mean and Pollution level with the highest level of dispersion with ( 11.83469). On the other hand, all variables except Pollution levels, Urban growth rate and ecological footprint are positively skewed.

TABLE 4.1 SUMMARY STATISTICS

| | EFP | GOVEX | POL | POV | REW | URGRWTH |
|---|---|---|---|---|---|---|
| **Mean** | 15.55548 | 16.00063 | 101.2914 | 9.542029 | 24.78203 | 4.551457 |
| **Median** | 16.32881 | 14.37947 | 100.9949 | 9.200000 | 21.76149 | 4.713375 |
| **Maximum** | 19.71814 | 30.85716 | 119.5441 | 15.90000 | 38.21768 | 5.007834 |
| **Minimum** | 10.68852 | 9.760705 | 76.94740 | 6.400000 | 17.59131 | 3.838623 |
| **Std. Dev.** | 2.902624 | 4.933837 | 11.83469 | 2.502609 | 7.743210 | 0.398697 |
| **Skewness** | -0.063778 | 1.432610 | -0.317185 | 1.090989 | 0.726261 | -0.414598 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Kurtosis** | 1.531089 | 4.867923 | 2.136716 | 3.562058 | 1.971841 | 1.645084 |
| | | | | | | |
| **Jarque-Bera** | 2.083387 | 11.21118 | 1.099865 | 4.865401 | 3.034976 | 2.418223 |
| **Probability** | 0.352857 | 0.003677 | 0.576989 | 0.087799 | 0.219262 | 0.298462 |
| | | | | | | |
| **Sum** | 357.7761 | 368.0145 | 2329.703 | 219.4667 | 569.9867 | 104.6835 |
| **Sum Sq. Dev.** | 185.3550 | 535.5405 | 3081.318 | 137.7871 | 1319.061 | 3.497110 |
| | | | | | | |
| **Observations** | 23 | 23 | 23 | 23 | 23 | 23 |

Source: Author's Computation, 2024

The estimated kurtosis of Government expenditure and Poverty is greater than 3, which indicate that the distribution of these variables is thicker and hence imply the presence of heterogeneity in data, however, the kurtosis statistics of every other variable in the model is less than 3, implying that the tails of distribution for these variables are thinner than normal distribution. The Jarque-bera values for all the variables pass the significance test at five percent (0.05). This indicates that all series are not normally distributed.

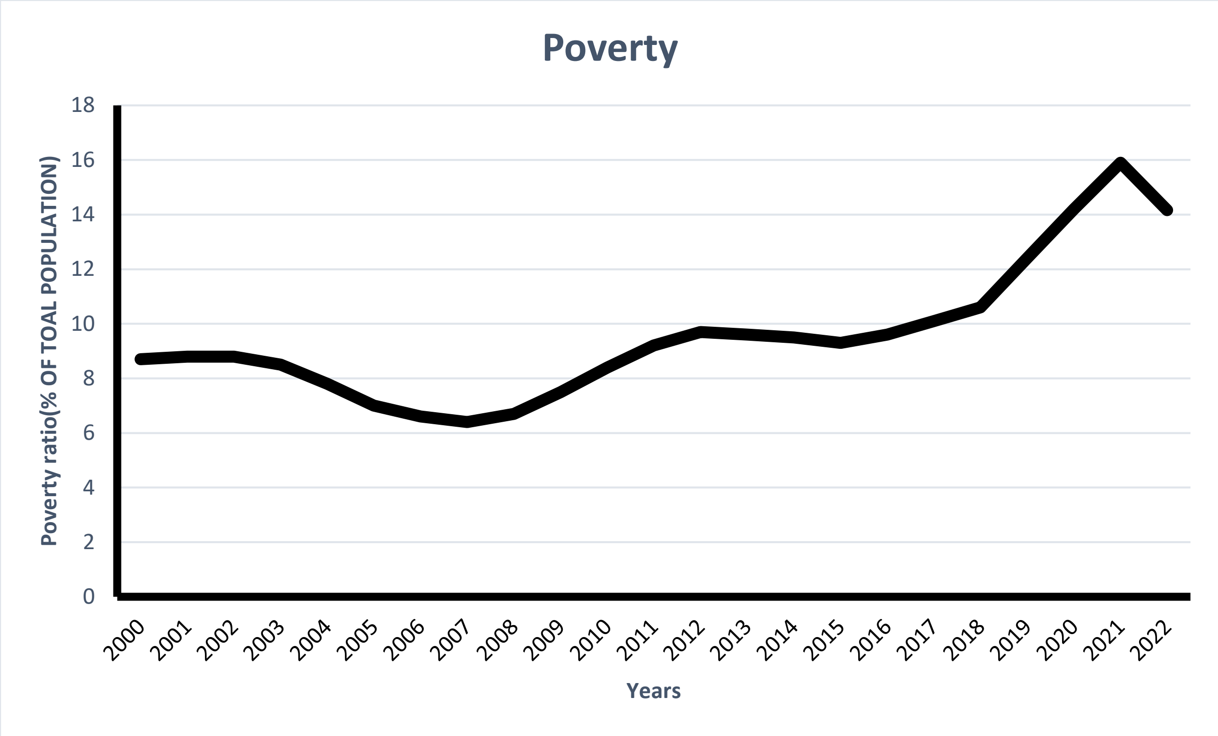
### 4.2 Trend Analysis Of Poverty, Ecological Footprint And Renewable Energy.

One of the objectives of this study is to examine the trend of Poverty, ecological footprint and renewable energy in Nigeria. The analysis makes use of line plots to achieve this objective. The time series line plot shows the trend of the selected variables.

#### 4.2.1 Trend Analysis of Poverty (2002-2022)

The trend analysis of Poverty in Nigeria is depicted in figure 4.1. In Nigeria as a whole, the trend of poverty was increasing from its lowest point of (7.0) in 2005 to its highest point of (15.9) in 2021 on average.

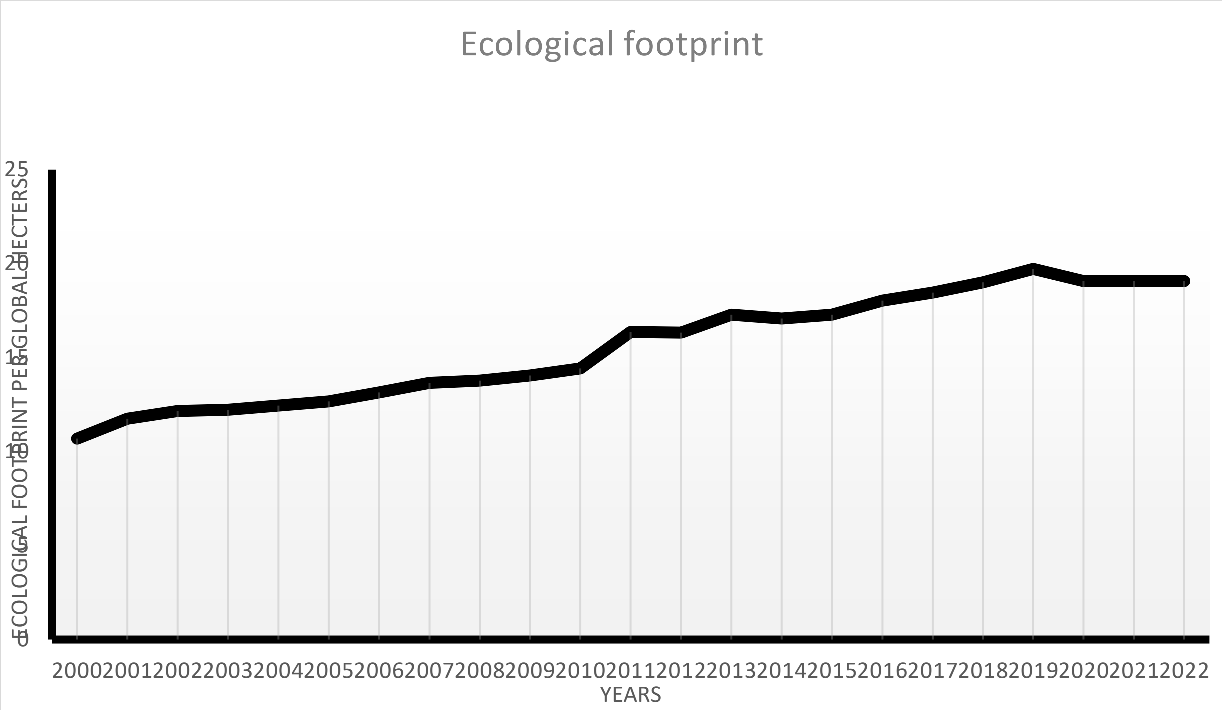
**FIGURE 4.1: Trend analysis of Poverty in Nigeria (2002-2022)**




Source: Author's Computation, 2024

### 4.2.2: Trend Analysis Of Ecological Footprint In Nigeria (2002-2022)

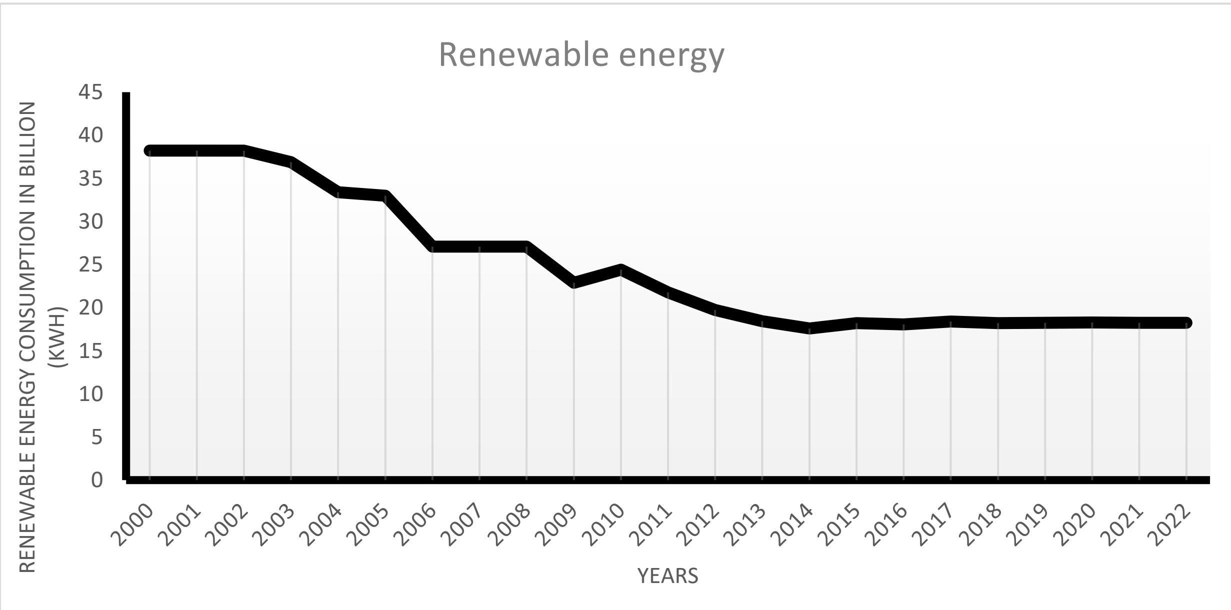
Figure 4.2 depicts the trend of ecological footprint in Nigeria. The figure shows an increasing trend for ecological footprint  Nigeria ranging from its lowest value at (10.68) in 2000 to its highest value at (19.7181) in 2019.Figure 4.2: Trend analysis of ecological footprint in Nigeria (2002-2022)




Source: Author's Computation, 2024

**4.2.3: Trend Analysis Of Renewable Energy Output In Nigeria (2002-2022).**

The trend analysis of renewable energy in Nigeria depicted in figure 4.3 below shows that renewable energy output in Nigeria is declining from its highest point (38.217) in 2000 to (17.59) in 2014. figure 4.3 Trend analysis of renewable energy output in Nigeria (2002-2022).




Source: Author's Computation, 2024

### 4.3 Correlation Metrix

| | EFP | GOVEX | POL | POV | REW | URGRWTH |
|---|---|---|---|---|---|---|
| **EFP** | 1 | -0.758329689 | 0.715770766 | 0.750203121 | -0.924938878 | -0.775992288 |
| **GOVEX** | -0.758329689 | 1 | -0.327298318 | -0.334116253 | 0.848411516 | 0.493646659 |
| **POL** | 0.715770766 | -0.327298318 | 1 | 0.762610486 | -0.480993215 | -0.750009152 |
| **POV** | 0.750203121 | -0.334116253 | 0.762610486 | 1 | -0.53013072 | -0.83177514 |
| **REW** | -0.924938878 | 0.848411516 | -0.480993215 | -0.53013072 | 1 | 0.629468317 |
| **URGRWTH** | -0.775992288 | 0.493646659 | -0.750009152 | -0.83177514 | 0.629468317 | 1 |

TABLE 4.2 Correlation metrix
**Source: Author's Computation, 2024.**

The correlation matrix reveals significant relationships between various variables in the dataset, highlighting the interconnections of environmental, economic, and social factors. Notably, the ecological footprint (EFP) shows a strong negative correlation with government expenditure (GOVEX), indicating that increased government spending is associated with a reduced ecological footprint. This relationship suggests that higher government investment in public goods and services can lead to better environmental outcomes. Additionally, EFP has a strong positive correlation with Pollution (POL) and poverty (POV), implying that higher levels of pollution and poverty are linked to a greater ecological footprint. Conversely, renewable electricity output (REW) and urban growth (URGRWTH) are negatively correlated with EFP, suggesting that advancements in renewable energy and urban development contribute to a smaller ecological footprint.

Government expenditure (GOVEX) itself exhibits interesting patterns. It has a moderate negative correlation with CO2 emissions (POL) and poverty (POV), indicating that higher government spending can help reduce emissions and alleviate poverty, although these relationships are not as strong. The positive correlation between GOVEX and renewable electricity output (REW) is quite strong, emphasizing the role of government spending in promoting renewable energy. Additionally, GOVEX has a moderate positive correlation with urban growth (URGRWTH), suggesting that government investment also supports urban development.

The correlations involving Pollution (POL) highlight its significant impact on other variables. POL has a strong positive correlation with poverty (POV), meaning that higher emissions are associated with higher poverty levels. This reflects the adverse social impacts of environmental degradation. The moderate negative correlation between POL and renewable electricity output (REW) suggests that higher emissions are linked to lower renewable energy production. Furthermore, POL's strong negative correlation with urban growth (URGRWTH) indicates that higher emissions are associated with slower urban development, highlighting the environmental challenges faced by growing cities.

Poverty (POV) demonstrates notable negative correlations with renewable electricity output (REW) and urban growth (URGRWTH). These relationships suggest that higher poverty levels are associated with lower renewable energy use and hindered urban development, highlighting the socioeconomic challenges that impede progress in these areas. The moderate positive correlation between REW and URGRWTH indicates that advancements in renewable energy are associated with urban growth, suggesting a mutual reinforcement between sustainable energy use and urbanization.

**4.4 Result Of Unit Root Test.**

The result of the stationarity tests conducted on all the data are presented in table 4.3.

**Table 4.3 Result of the Augmented dickey fuller test for unit root**

| Variable | prob-value | T-STAT | Order of integration |
|---|---|---|---|
| POV | 0.0087 | -3.901076 | I(1) |
| EFP | 0.0004 | -5.214975 | I(1) |
| GOVexp | 0.0018 | -4.582608 | I(0) |
| POV | 0.0001 | -5.784095 | I(1) |
| REW | 0.0052 | -2.944753 | I(0) |

| | | | |
|---|---|---|---|
| URGWRTH | 0.0000 | -22.58704 | I(1) |

**Statistical significance at 5 %( )**
**Source: Author's Computation, 2024**

The result for the unit root test for the  variables are presented. The result as shown in table 4.3 indicates that government expenditure and Renewable energy  are stationary at level. This means that government expenditure and pollution levels are I(0) series. While, Poverty, Urban growth,ecological footprint and Pollution are stationary at first difference, They are of the series I(1). The economic implication of stationary variable implies that any disturbance or shock to it will not be sustained for a long period of time, that is, a shock to the variable will die out over time.

### 4.5 Co-integration Test.

Having checked for stationarity in the model, it was observed that the variables were differenced at different orders [ I(1) and I(0)]. When a the variables in the model are of different orders we use the Auto Regressive Distributive Lag (ADRL) bound test to see if this variable are co-integrated . The result for the ADRL bound test is shown in figure 4.4.

**Table 4.4- ADRL test results.**

| **Short run result** | | | | |
|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| **C** | 37.00113 | 10.23185 | 3.61627 | 0.0056 |
| **EFP(-1)** | -1.206005 | 0.26404 | -4.567509 | 0.0014 |
| **GOVEX(-1)** | 0.476231 | 0.150442 | 3.165553 | 0.0114 |
| **POL(-1)** | 0.106652 | 0.034898 | 3.056094 | 0.0137 |
| **POV(-1)** | -0.34376 | 0.133319 | -2.578476 | 0.0298 |
| **REW** | -0.455715 | 0.112857 | -4.037985 | 0.0029 |
| **URGRWTH(-1)** | -4.676001 | 1.561593 | -2.994378 | 0.0151 |
| **D(GOVEX)** | 0.294201 | 0.095927 | 3.066911 | 0.0134 |
| **D(POL)** | 0.059683 | 0.018335 | 3.255187 | 0.0099 |
| **D(POL(-1))** | -0.042048 | 0.025752 | -1.632767 | 0.137 |
| **D(POV)** | 0.090736 | 0.130668 | 0.694399 | 0.505 |
| **D(URGRWTH)** | 6.51894 | 5.336124 | 1.221662 | 0.2529 |
| | | | | |
| **long run result** | | | | |
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| **GOVEX** | 0.394883 | 0.107451 | 3.674998 | 0.0051 |

| | | | | |
|---|---|---|---|---|
| **POL** | 0.088434 | 0.022768 | 3.884088 | 0.0037 |
| **POV** | -0.28504 | 0.112359 | -2.536862 | 0.0319 |
| **REW** | -0.377871 | 0.062752 | -6.021707 | 0.0002 |
| **URGRWTH** | -3.877265 | 1.07438 | -3.608841 | 0.0057 |
| **C** | 30.68074 | 6.131006 | 5.004193 | 0.0007 |
| | | | | |
| **Bound test result** | | | | |
| **Test Statistic** | Value | Signif. | I(0) | I(1) |
| **F-statistic** | 5.499373 | 10% | 2.08 | 3 |
| **k** | 5 | 5% | 2.39 | 3.38 |

**Source: Author's Computation, 2024**

The table 4.4 above illustrates the results for the ARDL, it provides a significant understanding of how various factors impact the ecological footprint (EFP) both in the short run and the long run, incorporating specific values to illustrate these relationships.

In the short run, government expenditure (GOVEX(-1)) has a significant positive effect on the ecological footprint, with a coefficient of 0.476231 (p = 0.0114). This indicates that an increase in government spending leads to a rise in the ecological footprint, likely due to higher economic activity and associated environmental costs. In the long run, this positive relationship persists, with a coefficient of 0.394883 (p = 0.0051), suggesting that sustained government spending continues to increase the ecological footprint over time. The findings opposes the work of Hazam et al (2024) which found that government spending can contribute to the improvement of environmental quality.

On the other hand, Pollution (POL(-1)) has a significant positive short-run effect on the ecological footprint, with a coefficient of 0.106652 (p = 0.0137). This means that higher pollution result in a larger ecological footprint, reflecting the immediate environmental impact of increased pollution. In the long run, the positive effect remains significant, with a coefficient of 0.088434 (p = 0.0037), indicating that pollution have a lasting impact on the ecological footprint, contributing to environmental degradation over time. This is all together not surprising as pollution contributes to environmental degradation.

Conversely, Urban growth (URGRWTH(-1)) has a significant negative short-run effect on the ecological footprint, with a coefficient of -4.676001 ($p = 0.0151$). This indicates that urban expansion can reduce the ecological footprint, potentially due to improved infrastructure and more efficient resource use in urban areas. In the long run, the negative effect remains substantial and significant, with a coefficient of -3.877265 ($p = 0.0057$), suggesting that urbanization, when managed effectively, leads to a lower ecological footprint over time through better resource management and efficiency. This contradicts with the findings of Nathaniel et al. (2020), which found that urbanization contributes negatively with environmental degradation.

Additionally, In the short run, poverty (POV(-1)) has a significant negative effect on ecological footprint, with a coefficient of -0.34376 ($p = 0.0298$). This could indicate that higher poverty reduces ecological footprint, possibly due to lower consumption and economic activity among impoverished populations. In the long run, the negative effect of poverty remains significant, with a coefficient of -0.28504 ($p = 0.0319$), suggesting that higher poverty levels consistently reduce the ecological footprint over time, reflecting a lower environmental impact from less economic activity. The findings differs from that of Khan *et al*.(2022) whose empirical results confirmed that poverty headcount contributes significantly to environmental degradation in terms of the ecological footprint, but agrees with that of Salah et al. (2020) which findings suggest that an increase in poverty reduces the ecological footprint. This unexpected result implies that efforts to reduce poverty may inadvertently increase environmental pressures, necessitating a balanced approach in policy formulation.

Further more, Renewable electricity output (REW) shows a strong negative impact on the ecological footprint in the short run, with a significant coefficient of -0.455715 ($p = 0.0029$). This suggests that increased production of renewable energy helps reduce the ecological footprint immediately. In the long run, the negative impact remains significant, with a coefficient of -0.377871 (p = 0.0002), indicating that sustained renewable energy production continues to lower the ecological footprint, highlighting the long-term environmental benefits of renewable energy sources. This agrees with the works of Li et al. (2023) whose work found that renewable energy is particularly effective in reducing ecological footprint in low-income countries, thus providing a potential solution to the environmental issues.

Finally, The F-Bounds test confirms the presence of a long-run equilibrium relationship among the variables, with an F-statistic of 5.499373, which is higher than the upper bound critical value at the 5% significance level (3.38). This indicates that there is a significant long-run relationship between the ecological footprint and its determinants, supporting the validity of the long-run coefficients in the model.

**4.6 Breusch-Godfrey Serial Correlation LM Test:**

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 2 lags

| | | | |
|---|---|---|---|
| F-statistic | 1.073328 | Prob. F(2,7) | 0.3921 |
| Obs R-squared | 4.928554 | Prob. Chi-Square(2) | 0.0851 |

Table4.5

**Source: Author's Computation, 2024**

Table 4.5 shows the result for the Breusch-Godfrey Serial Correlation LM Test, Which checks for serial Correlation in the model. The probability value and R-square are both insignificant at 5%, which indicates that there is no serial Correlation in the model. Hence, the error term for one time period is not correlated with the error term for another time period.

**4.7 Heteroskedasticity Test: Breusch-Pagan-Godfrey**

Table 4.
Heteroskedasticity Test: Breusch-Pagan-Godfrey

Null hypothesis: Homoskedasticity

| | | | |
|---|---|---|---|
| F-statistic | 1.151358 | Prob. F(11,9) | 0.423 |
| Obs R-squared | 12.27623 | Prob. Chi-Square(11) | 0.3432 |
| Scaled explained SS | 3.336093 | Prob. Chi-Square(11) | 0.9855 |

Source: Author’s Computation, 2024

Based on the results from the Breusch-Pagan-Godfrey test, there is no evidence to suggest the presence of heteroscedasticity in the regression model's residuals. All p-values are well above the typical significance levels (e.g., 0.05 or 0.10), indicating that the variance of the residuals is constant across observations. Therefore, we can proceed with the assumption of homoscedasticity in the model.

# CHAPTER FIVE

# SUMMARY, CONCLUSION, AND RECOMMENDATION

## 5.1 Summary

The study investigates the potential of renewable energy to address poverty alleviation and environmental sustainability in Nigeria.What prompted this study was that despite significant growth in Nigeria's GDP, the country continues to face substantial challenges in poverty reduction and environmental degradation causing her to have a very high ecological footprint. It was observed from the both background and literature review some challenges faced by underdeveloped countries in balancing economic growth with ecological conservation and poverty being the main issue in that regard. To that, it recognizes the significance of renewable energy in reducing greenhouse gas emissions, providing affordable energy, and enhancing socio-economic conditions, particularly in impoverished and off-grid communities and ultimately reducing Nigeria's ecological footprint.

The research employs a combination econometric methodologies to analyze the data.

An Auto regressive Distributed Lag (ARDL) model was used to test for co-integration among the variables, determining that government expenditure and pollution has a significant positive effect on the ecological footprint indicating, while Urbanization, poverty and renewable energy all share a significant negative effect on ecological footprint.

## 5.2 Conclusion

The research work has led to some conclusions which appear to be original contributions to the existing literature on the relationship between renewable energy and ecological footprint and how renewable energy can help moderate their relationship.

First, it can be concluded from the findings of this study, that poverty and ecological footprint have followed a rising trend in Nigeria under the period of review and also that renewable energy consumption in Nigeria has follow a falling trend in Nigeria under the period of review.

Secondly,Government expenditure and pollution shares a positive relationship with ecological footprint, indicating that ecological footprint is directly as a result of government spending which usually involves extraction of resources which can damage the environment if not properly executed. It shows that in Her efforts to reduced ecological footprint and improve environmental sustainability Government expenditure and pollution should be given priority.

The study also concludes that increase and urbanization can lead to lower ecological footprint significantly. Poverty also shares a significantly negative relationship with ecological footprint indicating that lower economic activities due to poverty causes less damage on the environment.

Finally, the study found a positive relationship between renewable energy and ecological footprint which affirms that renewable energy is a viable solution to ecological footprint in Nigeria, by leveraging its renewable energy resources, Nigeria can enhance energy access, stimulate economic development, and reduce its ecological footprint. The integration of renewable energy into the country's energy systems can create sustainable livelihoods, improve health and education outcomes, and foster environmental conservation.

## 5.3 Recommendation

Based on the conclusions of this study, some policy direction might be necessary for policy makers in Nigeria so as to promote their efforts in Environmental sustainability and achieve the sustainable development goals.:

i. Findings from this study have shown that renewable energy promotes a sustainable environment by reducing ecological footprint. According to the Global footprint network(2022), Nigeria has one of the Highest ecological footprint in Africa.More effective efforts should be made by policy makers to transition from non-renewable sources of energy to renewable source of energy to help reduce the ecological footprint in Nigeria.

ii. The ministry in charge of power in Nigeria should help in removing any constraint in transitioning into renewable energy and instead should provide incentives likes Tax breaks or subsidies that will help for more investment in the renewable energy sector.

iii. Nigeria should also improve her efforts in increasing Urbanization as it shows that an increase in Urbanization leads to lower ecological footprint.

### 5.4 Contribution to Knowledge

This study contributes to the existing body of knowledge by providing empirical evidence on the relationship between poverty, ecological footprints, and renewable energy in Nigeria. It offers insights into how renewable energy can serve as a moderating factor in this nexus, presenting a viable solution to the dual challenges of poverty and environmental degradation. Several studies have been carried out to address the intricate relationship between poverty and the environment incorporating several solutions but only little work has been done using renewable energy as a viable solution. Again many of the studies in this area are mostly regional studies and few are country specific therefore making it difficult to understand the role of renewable energy in addressing both poverty and economical issues in countries like Nigeria. This study has extended the frontier of knowledge in this regard.

## References


Anwar, A., Siddique, M., Dogan, E., & Sharif, A. (2021). The moderating role of renewable and non-renewable energy in the environment-income nexus for ASEAN countries: Evidence from the Method of Moments Quantile Regression. Renewable Energy, 164 , 260-269. https://doi.org/10.1016/j.renene.2020.09.128

Aquilas, N. A., Ngangnchi, F. H., & Mbella, M. E. (2023). Industrialization and environmental sustainability in Africa: The moderating effects of renewable and non-renewable energy consumption. Heliyon, 10 (1), e25681. https://doi.org/10.1016/j.heliyon.2024.e25681

Baloch, M. A., Danish, S. U. K., Ulucak, Z. Ş., & Ahmad, A. (2020). Analyzing the relationship between poverty, income inequality, and CO2 emission in Sub-Saharan African countries. Science of the Total Environment, 733 , 139867. https://doi.org/10.1016/j.scitotenv.2020.139867

Bozatli, O., & Akca, H. (2024). Effectiveness of environmental protection expenditures and resource tax policy in the Netherland's load capacity factor: Do government effectiveness and renewable energy matter? Evidence from Fourier augmented ARDL. Resources Policy, 92 , 105030. https://doi.org/10.1016/j.resourpol.2024.105030

Cheng, X., Shuai, C., Liu, J., Wang, J., Liu, Y., Li, W., & Shuai, J. (2018). Topic modelling of the ecology, environment, and poverty nexus: An integrated framework. Agricultural Systems, 267 , 1-14. https://doi.org/10.1016/j.agsy.2018.02.006

Dada, J. T., Ajide, F. M., & Al-Faryan, M. A. S. (2024). The moderating role of financial development in energy poverty–sustainable environment linkages: Evidence from Africa. Management of Environmental Quality, 35 (4), 924-944. https://doi.org/10.1108/MEQ-08-2023-0268

Dhrifi, A., Jaziri, R., & Alnahdi, S. (2020). Does foreign direct investment and environmental degradation matter for poverty? Evidence from developing countries. Structural Change and Economic Dynamics, 52, 13-21. https://doi.org/10.1016/j.strueco.2020.02.002

Ezako, J. T. (2024). The nexus between human development, official development assistance, carbon emissions, and governance in developing countries for the realization of sustainable development goals. Cogent Economics & Finance, 12 (1), Article 2330452. https://doi.org/10.1080/23322039.2024.2330452

Haider, L. J., Boonstra, W. J., Peterson, G. D., & Schlüter, M. (2018). Traps and sustainable development in rural areas: A review. World Development, 101, 311-321. https://doi.org/10.1016/j.worlddev.2017.08.010

Hazem, N., Taha, N. M., & El Husseiny, I. A. (2024). The impact of government expenditure on environmental degradation in MENA countries: An empirical investigation. International Journal of Sustainable Economy, 16 (1), 90-112. https://ideas.repec.org/a/ids/ijsuse/v16y2024i1p90-112.html

Huber, J. (1982). Die verlorene Unschuld der Ökologie: Neue Technologien und superindustrielle Entwicklung. Frankfurt, Germany: Fischer.

Jänicke, M. (1985). Preventive environmental policy as ecological modernisation and structural policy. Berlin, Germany: Wissenschaftszentrum Berlin für Sozialforschung (WZB).

Kamoun, M., Abdelkafi, I., & Ghorbel, A. (2019). Does renewable energy technologies and poverty affect the sustainable growth in emerging countries? Journal of the Knowledge Economy. https://doi.org/10.1007/s13132-018-0575-4

Khan, S., Yahong, W., & Zeeshan, A. (2022). Impact of poverty and income inequality on the ecological footprint in Asian developing economies: Assessment of Sustainable Development Goals.

Hayden, A. (2024, June 3). Ecological footprint . Encyclopedia Britannica. https://www.britannica.com/science/ecological-footprint

Khan, S. U. (2022). Environmental sustainability: A clean energy aspect versus poverty. Environmental Science and Pollution Research . https://doi.org/10.1007/s11356-020-11520-6

Koçak, E., Ulucak, R., Dedeoğlu, M., & Ulucak, Z. Ş. (2019). Is there a trade-off between sustainable society targets in Sub-Saharan Africa? Sustainable Cities and Society, 101705 . https://doi.org/10.1016/j.scs.2019.101705

Li Wang, X., Imran, A., Aslam, M. U., & Mehmood, U. (2023). Analyzing the contribution of renewable energy and natural resources for sustainability in G-20 countries: How gross capital formation impacts ecological footprints. Heliyon, 9 (1), e18882. https://doi.org/10.1016/j.heliyon.2023.e18882

Mahmood Ahmad, Jiang, P., Majeed, A., Umar, M., Khan, Z., & Muhammad, S. (2020). The dynamic impact of natural resources, technological innovations, and economic growth on the ecological footprint: An advanced panel data estimation. Resources Policy . https://doi.org/10.1016/j.resourpol.2020.101369

Masron, T. A., & Subramaniam, Y. (2019). Does poverty cause environmental degradation? Evidence from developing countries. Journal of Poverty, 23 , 44-64. https://doi.org/10.1080/10875549.2018.1500969

Mol, A. P. J. (1995). The refinement of production: Ecological modernization theory and the chemical industry . Utrecht, Netherlands: Van Arkel.

Nathaniel, S. P., Bekun, F. V., & Faizulaye, A. (2021). Modelling the impact of energy consumption, natural resources, and urbanization on the ecological footprint in South Africa: Assessing the moderating role of human capital. International Journal of Energy Economics and Policy, 11 (1), 11099. https://doi.org/10.32479/ijeep.11099

Ofori-Sasu, D., Abor, J. Y., Agyekum Donkor, G. N., & Otchere, I. (2023). Renewable energy consumption and carbon emissions in developing countries: The role of capital markets. International Journal of Sustainable Energy, 42 (1), 1407-1429. https://doi.org/10.1080/14786451.2023.2268857

Radmehr, R., Shayanmehr, S., Ali, E. B., Ofori, E. K., Jasińska, E., & Jasiński, M. (2022). Exploring the nexus of renewable energy, ecological footprint, and economic growth through globalization and human capital in G7 economies. Sustainability, 14 (19), 12227. https://doi.org/10.3390/su141912227

Rasekhi, S., Ghanbartabar Ahmadi, S., & Mehnatfar, Y. (2023). Threshold effect of renewable and non-renewable energy consumption on economic welfare in selected countries with different energy intensities. Quarterly Journal of Fiscal and Economic Policies, 11 (42). https://doi.org/10.61186/qjfep.11.42.55

Sheraz, M., Deyi, X., Sinha, A., Mumtaz, M. Z., & Fatima, N. (2022). The dynamic nexus among financial development, renewable energy, and carbon emissions: Moderating roles of globalization and institutional quality across BRI countries. Journal of Cleaner Production . https://doi.org/10.1016/j.jclepro.2022.130995

Townsend, P. (1979). Poverty in the United Kingdom: A survey of household resources and standards of living . Berkeley, CA: University of California Press.

United Nations Development Programme (UNDP). (2023). 2023 Global Multidimensional Poverty Index (MPI): Unstacking global poverty: Data for high impact action. New York, NY: United Nations Development Programme.

United Nations. (n.d.). What is renewable energy? Retrieved from https://www.un.org/en/climatechange/what-is-renewable-energy

Yu, N., Sun, R., Mei, H., Yue, S., & Yuliang, L. (2022). Does renewable energy consumption reduce energy ecological