IMPACT OF GREEN ECONOMY ON POVERTY REDUCTION IN NIGERIA

Mgbomene, Chukunalu
Department of Economics,
Delta State University,
Abraka Nigeria
chukunalum@delsu.edu.ng

Dim, Henry C.
Department of Insurance and
Actuarial Science,
Imo State University,
Owerri Nigeria

Corresponding author:
Mgbomene, Chukunalu
Department of Economics,
Delta State University,
Abraka Nigeria
chukunalum@delsu.edu.ng

ABSTRACT

This study examined the impact of green economy on poverty reduction in Nigeria. Quantitative approach was adopted using data on per capita income (dependent variable), renewable energy consumption, arable land cultivation and access to renewable energy (independent variables). The data were analyzed using Auto-regressive Distributed Lag approach. The result revealed that renewable energy consumption negatively affected per capita income in both short and long run periods. The effect was only significant in the long run. Arable land cultivation also affected per capita income negatively with the effect becoming significant only in the long run while access to renewable energy was the only variable that had a positive effect on per capita income in both short run and long run. The study concluded that the green economy in Nigeria has not been adequately utilized for enhancing the living standards of the people. Nigeria has a growing access to renewable energy but the actual consumption of renewable energy showed inverse relationship with per capita income which is an indication of non-usage of renewable energy which may have been propelled by low infrastructure and other externalities. It was recommended that government and individuals need to protect arable lands for cultivation, as well as improve the actual utilization of renewable energy by providing renewable energy infrastructure which is one aspect of the green economy that can enhance the income prospects of households.

Keywords: *Arable land, green economy, poverty reduction, renewable energy consumption, per capita income.*

1. Introduction

The persistent issue of poverty remains one of the most critical developmental challenges in Nigeria. Despite being endowed with vast natural resources and abundant human capital, Nigeria has struggled with widespread poverty, inequality, and stagnant economic growth (World Bank, 2022). The country's heavy reliance on oil has raised the level of environmental degradation, and insufficient diversification has exacerbated economic vulnerabilities, leading to a significant proportion of the population living below the poverty line. In response to these challenges, there is an increasing global shift toward a green economy, which emphasizes sustainable practices, renewable energy, and environmental conservation as strategies for fostering inclusive economic growth and poverty reduction (UNEP United nations Environmental Protection, 2016).

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A green economy promotes low-carbon growth, efficient resource utilization, and environmental protection while driving job creation and social equity. According to Ozturk and Al-Mulali (2020), investments in renewable energy and environmental sustainability are key mechanisms for improving economic welfare, particularly in resource-dependent developing countries. For Nigeria, where access to clean energy remains limited and deforestation rates are among the highest globally, the adoption of green economy principles offers a pathway to sustainable development and poverty alleviation (FAO, 2019).

One critical indicator of the green economy is Renewable Energy Consumption (%), which reflects the share of energy derived from sustainable sources like solar, wind, and hydropower. Renewable energy contributes to poverty reduction by improving access to affordable and reliable energy, particularly in rural areas, enhancing productivity, and creating employment opportunities (Rahman et al., 2021). Similarly, the conservation and sustainable management of forests, measured as Forest Area (% of Land Area), play a crucial role in poverty reduction. Forest ecosystems provide livelihoods, biodiversity protection, and resilience to climate change, which are essential for rural development and economic inclusion (FAO, 2020).

Nigeria is a country in the western region of Africa, with a coverage area of about 924,000 square kilometers (Ogunseye et al, 2024). The country is the most populous in the African continent. According to the World Population Review, (2023), Nigeria's population is about 226,000,000. Nigeria has six geopolitical zones: Northwest, Northcentral, Northeast, Southwest, South-south, and Southeast. These zones are divided into 36 States and the Federal Capital Territory Abuja. The discussion surrounding the concept of a green economy and its effect on poverty reduction has been present for a considerable duration, but it has recently garnered increased focus and interest. Despite Nigeria’s vast natural wealth, the country faces significant barriers to transitioning to a green economy. These include limited infrastructure for renewable energy, weak enforcement of environmental policies (Mgbomene, 2024), and high levels of poverty that undermine efforts for sustainable development (Adedoyin et al., 2020). Empirically, evidence abound which proves that the link between green economy initiatives and poverty reduction remains under-explored in Nigeria, creating a gap in understanding how investments in renewable energy and arable land cultivation can drive income per capita and improve living standards.

Green Economy aims for sustainable development and improved human well-being without degrading the environment. Environmental degradation weakens food sustainability and puts income earning capacity of households at risk (Mgbomene, 2024). There is also the problem of greenhouse gas (GHG) emissions causing global warming due to poor waste management. It has been established that the waste sector contributes 3-5% of the total GHG (Ilmas et al., 2018). Undoubtedly, this would increase the degradation

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of living standards if unsustainable approaches to waste management are sustained. Nigeria currently has renewable energy consumption rate of 81.7% and what this means for poverty reduction in the country is still unknown and uncertain. Also, arable land cultivation is still somewhere around 20.4% as at 2023. Ogunseye et al (2024) reported that there is high preference for processed foods which is not eco-friendly and as a result, cultivation of arable land is on a gradual decrease which puts majority of the Nigerian population at the risk of poverty and unsustainable food production. The first step towards solving problems is the identification of the problem, the second being research into the problem before the last step which is the problem solving stage. This is what this study seeks to achieve as we strive to bridge the gap in knowledge by examining the impact of green economy practices on poverty reduction in Nigeria, using GDP per capita as a proxy for poverty reduction. The specific objectives of the study are to:

1. Analyze the effect of renewable energy consumption on poverty reduction in Nigeria;
2. Investigate the extent to which cultivation of arable land impact on poverty reduction in Nigeria; and
3. Determine the relationship between access to electricity and alternative energy affect the level of poverty in Nigeria.

As stated above, specifically, the study focuses on the effects of renewable energy consumption, arable land area cultivation and access to electricity and alternative energy on per capita income of Nigerians. By analyzing data from 1990 to 2023, the study provides empirical evidence on the role of the green economy in fostering inclusive development in Nigeria. In carrying out this study, the following research questions will serve as a guide:

1. What is the effect of renewable energy consumption on poverty reduction in Nigeria?
2. To what extent has arable land cultivation impacted on poverty reduction in Nigeria?
3. How has access to electricity and alternative energy affected poverty reduction in Nigeria?

The findings from this study will offer valuable insights for policymakers, highlighting the need for increased investments in renewable energy infrastructure, sustainable forestry practices, and supportive environmental policies to achieve poverty alleviation and economic resilience. The hypotheses assumed no significant relationship between renewable energy consumption, arable land cultivation, access to electricity and poverty reduction in Nigeria.

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2. REVIEW OF RELATED LITERATURE

This section explores the conceptual framework, relevant theories, and empirical evidence related to the green economy and its impact on poverty reduction. It focuses on GDP per capita as a proxy for poverty reduction, with renewable energy consumption and forest area as indicators of green economy practices. The review provides a comprehensive understanding of how these variables influence economic growth and poverty alleviation.

Green Economy

The green economy is a framework for sustainable development that emphasizes economic growth while minimizing environmental degradation and fostering social inclusion. According to the United Nations Environment Programme (UNEP, 2016), a green economy is defined as low-carbon, resource-efficient, and socially inclusive. The key pillars of the green economy include promoting renewable energy, sustainable land management, waste reduction, and environmental conservation to achieve long-term economic and social development goals.

The transition to a green economy offers significant benefits, particularly in developing countries like Nigeria, where poverty, unemployment, and environmental challenges are prevalent. For instance, investments in renewable energy technologies and sustainable forestry create jobs, improve income, and enhance resilience to climate change (UNEP, 2018). The green economy also provides pathways to reduce economic dependence on fossil fuels and mitigate environmental risks, such as deforestation and greenhouse gas emissions (Bina, 2013).

GDP Per Capita

Gross Domestic Product (GDP) per capita measures the average economic output per person in a country and is widely used as a proxy for poverty reduction. A higher GDP per capita indicates improvements in living standards, access to essential services, and economic well-being (World Bank, 2020). In the context of the green economy, GDP per capita is expected to increase as investments in green sectors, such as renewable energy and sustainable land use, stimulate economic growth and create employment opportunities.

For instance, a study by Ozturk and Al-Mulali (2020) found a positive relationship between renewable energy adoption and GDP per capita in developing countries. By reducing energy costs and expanding access to electricity, renewable energy supports productivity and economic inclusion. Similarly, forest

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conservation efforts contribute to GDP growth by enhancing ecosystem services, such as agriculture, water management, and tourism (Dasgupta, 2021).

Renewable Energy Consumption

Renewable energy consumption refers to the share of energy derived from sustainable sources, such as solar, wind, hydropower, and biomass. As a key driver of the green economy, renewable energy plays a vital role in reducing greenhouse gas emissions, improving energy access, and promoting inclusive growth (Rahman et al., 2021). Renewable energy also drives agricultural production (green economy) by powering agricultural machineries for efficient production (Ibeaja, Amadi and Dim, 2022).

In Nigeria, where energy poverty remains a significant challenge, renewable energy offers a cost-effective solution for electrifying rural areas and supporting small-scale enterprises (Adedoyin et al., 2020). Studies have shown that increased adoption of renewable energy reduces household energy costs, creates employment opportunities, and stimulates economic activities in underserved communities (Sarkodie & Adams, 2018). For example, hydropower projects provide reliable electricity for agriculture and manufacturing, while solar energy solutions improve livelihoods in off-grid rural areas (IRENA, 2022).

Forest Area and Land Cultivation

Forest area, expressed as a percentage of total land area, is a key measure of environmental sustainability and resource conservation. Forests provide critical ecosystem services, such as carbon sequestration, biodiversity conservation, water regulation, and soil protection (FAO, 2020). They also support rural livelihoods by providing timber, fuelwood, non-timber forest products (e.g., food and medicine), and employment opportunities.

Sustainable forest management aligns with the principles of the green economy by ensuring the long-term availability of forest resources while mitigating deforestation and land degradation. According to Martinez et al. (2020), preserving forest areas reduces vulnerability to climate change and supports agricultural productivity, which is vital for poverty alleviation in rural communities. Forest-dependent communities, particularly in Nigeria, rely heavily on forests for income and subsistence, making forest conservation essential for poverty reduction (FAO, 2021). Furthermore, forest conservation contributes to economic growth through activities like eco-tourism, which generates revenue and employment. Countries like Costa Rica and Brazil have successfully demonstrated how forest preservation initiatives can boost local economies while achieving environmental sustainability (Dasgupta, 2021).

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Alongside forest cultivation is arable land cultivation. Arable land cultivation is defined as the practice of growing crops on land that is mapped out and considered suitable for agriculture (World Bank, 2023). Arable land is a significant factor in green economy sustainability because of its ability to withstand climate change, decrease carbon emissions and provide healthy food for the teeming population (World Bank, 2023). Prevention of land degradation is another aspect of arable land cultivation because when adequately planned, incessant deforestation will be checked just as land will be mapped out for specific purposes thus safeguarding the economy and providing food security. Arable land in Nigeria was reported at 40.5% in 2022 and 40.15 in 2023 according to World Bank (2023).

Relationship between Green Economy and Poverty Reduction

The green economy fosters economic growth while addressing environmental sustainability, making it a key strategy for poverty reduction. Investments in renewable energy and forest conservation have a dual impact: improving economic output and promoting environmental resilience. Renewable energy enhances productivity by providing affordable electricity for businesses and households, thereby increasing GDP per capita and reducing poverty (Rahman et al., 2021). Similarly, sustainable forest management enhances agricultural productivity, rural income, and climate resilience, supporting poverty alleviation efforts (FAO, 2019).

Ozturk and Al-Mulali (2020) argue that renewable energy significantly reduces energy poverty and supports economic inclusion, particularly in developing countries. By creating jobs, improving energy access, and reducing carbon emissions, the green economy enhances living standards and accelerates poverty reduction. Martinez et al. (2020) further emphasize that investments in forest conservation generate multiple benefits, including ecosystem restoration, rural development, and long-term economic growth.

In Nigeria, where poverty rates remain high, the adoption of green economy practices is critical for achieving inclusive growth. Addressing energy poverty through renewable energy initiatives and mitigating deforestation through sustainable forest management can significantly improve GDP per capita and reduce poverty levels.

Theories of Green Economy and Poverty Reduction

This section discusses relevant economic theories that provide a theoretical foundation for understanding the relationship between the green economy and poverty reduction. The key theories explored include the Sustainable Development Theory, Endogenous Growth Theory, and Ecological Modernization Theory.

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Sustainable Development Theory

The Sustainable Development Theory is a central framework underpinning the green economy. It emphasizes achieving economic growth while ensuring environmental sustainability and social equity. The theory originated from the Brundtland Commission Report (1987), which defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs".

In the context of poverty reduction, the theory advocates for the integration of environmental policies, resource efficiency, and renewable energy to achieve inclusive economic growth. According to Sachs (2015), transitioning to a green economy can address poverty by fostering employment opportunities, improving energy access, and enhancing resilience to climate change. For example, investments in renewable energy reduce energy poverty, particularly in rural areas, while sustainable forest management preserves natural resources that support rural livelihoods (Rahman et al., 2021).

This theory highlights the importance of balancing economic growth and environmental conservation to ensure that poverty reduction efforts are sustainable and equitable. For Nigeria, adopting green economy strategies aligns with global goals such as the United Nations' Sustainable Development Goals (SDGs), particularly Goal 1 (No Poverty) and Goal 7 (Affordable and Clean Energy) (United Nations, 2016).

Ecological Modernization Theory

The Ecological Modernization Theory (EMT) argues that economic growth and environmental sustainability can coexist through technological innovation and institutional reforms. Developed by scholars like Huber (1982) and Mol (1995), this theory challenges the traditional view that economic development inevitably leads to environmental degradation.

EMT posits that societies can achieve sustainable development by adopting clean technologies, promoting renewable energy, and implementing environmental regulations that incentivize eco-friendly practices. The theory highlights the role of governments, businesses, and civil society in driving the transition to a green economy.

In Nigeria, the adoption of renewable energy and forest conservation strategies aligns with EMT principles by addressing environmental challenges while fostering economic growth. For instance, policies supporting solar energy initiatives can reduce energy poverty and promote economic activities in underserved regions, while sustainable forest management ensures the long-term availability of resources for rural communities (FAO, 2020; Rahman et al., 2021).

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The theory underscores the importance of leveraging technological advancements and institutional reforms to achieve poverty reduction and environmental sustainability simultaneously. By integrating green economy principles into national development policies, Nigeria can achieve inclusive growth and reduce poverty levels effectively (Sarkodie & Adams, 2018).

Review of Empirical Literature

Rahman et al. (2021) examined the relationship between renewable energy consumption and economic welfare in developing countries, with a specific focus on poverty alleviation. Using panel data from 1990 to 2018, they employed a Generalized Method of Moments (GMM) estimator to account for potential endogeneity in the model. GDP per capita was used as the dependent variable, while the independent variables included renewable energy consumption, carbon dioxide emissions, and access to electricity. The results indicated a significant positive relationship between renewable energy consumption and GDP per capita, highlighting the potential of renewable energy investments to reduce poverty by improving access to affordable and sustainable energy sources.

Adedoyin et al. (2020) analyzed the growth impact of renewable energy adoption in Nigeria using time series data from 1980 to 2017. The study employed the Auto-Regressive Distributed Lag (ARDL) model to examine both short-run and long-run relationships between renewable energy consumption, GDP per capita, and environmental quality. Their findings revealed that renewable energy had a significant positive effect on GDP per capita, particularly in the long run. The authors emphasized that renewable energy adoption enhances productivity, reduces energy poverty, and stimulates economic activities, which are critical for poverty reduction. In Kazakhstan, Raihan and Tuspekova, (2022) examined the role of renewable energy use, technological innovation (environmental sustainability) on economic growth. They employed dynamic ordinary least square (DOLS) method and time series data from 1996 to 2018. The results indicated that increase in technological innovation significantly lowers CO2 emission and help to achieve environmental sustainability or economic growth.

Martinez et al. (2020) explored the role of forest conservation in enhancing economic resilience and reducing poverty in forest-dependent communities in sub-Saharan Africa. The study employed cross-sectional data from 15 African countries, including Nigeria, to analyze the impact of forest area on rural incomes and ecosystem services. Using a fixed-effects model, the authors found that a 1% increase in forest area was associated with a 0.8% increase in rural household incomes, underscoring the importance of sustainable forest management in poverty alleviation. The study also highlighted the role of forests in climate regulation and biodiversity conservation, which contribute to long-term economic growth.

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Sarkodie and Adams (2018) investigated the effects of renewable energy and environmental sustainability on economic growth in developing economies. Using a panel dataset of 25 countries, including Nigeria, from 1990 to 2016, the researchers employed a panel co-integration technique to examine the long-term dynamics. Their results indicated that renewable energy consumption positively influenced GDP per capita, while deforestation and environmental degradation had adverse effects. The authors concluded that green economy initiatives, such as renewable energy adoption and forest conservation, are essential for achieving sustainable economic growth and poverty reduction.

Dasgupta (2021) examined the economic implications of biodiversity conservation and sustainable development in developing countries. The study focused on the dual role of forest conservation in providing ecosystem services and supporting economic activities. Using data from Nigeria and other sub-Saharan African nations, the study found that forest conservation initiatives contributed significantly to GDP growth and poverty alleviation. The author recommended increased investments in sustainable forestry practices to enhance economic resilience and reduce vulnerability to environmental shocks.

Furthermore, the study of Attahiru and Ibrahim (2019) did a study on poverty to alleviation: green economy and sustainable development in Nigeria. The researchers did a literature review based study and found that in Nigeria, 54.80% of the people are experiencing critical poverty, hunger, and food insecurity. They concluded that Greenhouse gas emissions, and subsidies for fossil fuels should be reduced in order to promote sound renewable energy, nuclear-powered energy, and coal fired power stations. Nwokike (2024) explored the opportunities and challenges for Nigeria to transition to a green economy while promoting sustainable development. The findings of revealed that the transition to a green economy could create new job opportunities and stimulate economic growth. However, limited awareness and understanding of green economy concepts, corruption and inadequate infrastructure to support sustainable development were some challenges identified in the study.

Ogunseye et al (2024) explored the nexus between waste recycling and the green economy, examining how waste recycling can be leveraged to foster a green economy in Nigeria. Using descriptive qualitative approach, their results indicated that waste recycling has not been fully embraced in Nigeria, especially at the household level. Therefore, waste recycling is primarily driven by the informal sector and entrepreneurs. Furthermore, the study revealed the diverse opportunities available through implementing a green economy. It recommended a green economy policy that promotes equity, economic incentives for household waste recycling, and support for entrepreneurs interested in partnering with the government.

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Zaria and Ismail (2024) examined the impact of ecological sustainability on poverty alleviation in Nigeria. Data for the study included poverty alleviation (dependent variable), social sustainability (urban growth annual), economic sustainability (school enrolment rate) and environmental sustainability (agricultural value added). Employing Autoregressive Distributed Lag Model (ARDLM) to analyze the impact of social and economic sustainability on poverty reduction based on ecological policies perspectives from 1981-2021, they found that ecological policies perspectives correlated with social and economic sustainability in alleviating poverty. In addition, social sustainability was positive and significant, while economic sustainability was negative and insignificant in the short- and long run on poverty alleviation.

Qudrat-Ullah & Nevo, (2021) estimated the effects of renewable energy consumption and environmental sustainability on economic growth. Used panel data for 37 African countries and employed the system of Generalized Method of Moments technique. The results found that renewable energy adoption and development increased economic growth in Africa. Baajike et al., (2022) employed the system estimation of Generalized Method of Moments (system-GMM), pooled ordinary square (POLS), fixed effect, the random effect and the difference generalized method of moments (D-GMM) techniques, from 2005 to 2018. The empirical results revealed that environmental sustainability adversely affected economic growth.

Empirical evidence shows that green economy has been widely researched Ogunseye et al., 2024; Attahiru and Ibrahim, 2019; Adedoyin et al., 2020) but the focus has been on its impact on sustainable development, while green economy variables have always tilted towards renewable energy and its associated variables. There is a wide gap in knowledge regarding green financing variables and this may have resulted in relatively uncertain effect of its role in poverty reduction. The exploration of other variables such as arable land cultivation in addition to access to renewable energy gives a wider but narrower perspective to the study of green economy and poverty reduction in Nigeria.

3. Research Methodology

This investigation uses an ex-post-facto design. The study relies on secondary data, making this approach appropriate. Ex-post-facto design establishes a linear relationship between dependent and independent variables using secondary data that are outside the manipulations of the researcher (Nworgu, 2006). The suitability of this research design is made possible through the application of robust econometric techniques in answering the research questions. This methodological approach allows the study to establish the relationship between green economy variables (renewable energy consumption, arable land area and access to renewable energy) and poverty reduction (income per capita), through empirical analysis of Nigeria's economic and environmental data over the period 1990 through 2023.

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Model Specification

The model is adapted from previous research and modified to align with the current objectives. Here, the study of Zaria and Ismail (2024) is perused and found to be closely related to this present study. Zaria and Ismail (2024) used data on poverty alleviation as the dependent variable while social sustainability was proxied with urban growth annual, economic sustainability was proxied with school enrolment rate and environmental sustainability was proxied with agricultural value added.

By way of modification, income per capita serves as the dependent variable, representing poverty reduction, while the independent variables include renewable energy consumption, arable land area and access to renewable energy as indicators of green economy in Nigeria. The functional model for this study is specified as:

$$IPC = f(REC, ARL, ARE) \quad [i]$$

Equation [i] above is further expanded to include the unknown coefficients and error term as follows:

$$IPC = \beta_0 + \beta_1 REC + \beta_2 ARL + \beta_3 ARE + U_t \quad [ii]$$

Where:

IPC = Income per capita (proxy for poverty level)

REC = Renewable Energy Consumption (% of total final energy consumption))

ARL = Arable land cultivated (% of land area)

ARE = Access to renewable energy (% of population)

β_0 = Intercept of the model

$\beta_1 - \beta_3$ = Coefficients of the independent variables yet to be determined

U_t = Stochastic error term

A-Priori Expectation and Decision Criteria

The model expects positive coefficients for renewable energy consumption, arable land area cultivation and access to renewable energy. In other words, the coefficients of $\beta_1 - \beta_3$ are expected to be positive i.e. increase income per capita. This is because increase in income per capita is a signal of poverty reduction based on economic theory.

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- $\beta_1 > 0$: Renewable energy consumption is expected to contribute positively to income per capita by reducing energy costs, creating jobs, and improving access to electricity.
- $\beta_2 > 0$: Arable land area is anticipated to positively influence income per capita by supporting rural livelihoods, providing ecosystem services, and fostering environmental sustainability.
- $\beta_3 > 0$: Access to renewable energy is expected to positively impact income per capita because increased access to renewable energy helps households to diversify their source of income which increases their living standards.

Sources of Data

Data for this study are sourced from reliable secondary sources to ensure accuracy and comprehensiveness. The following data sources were utilized:

1. World Bank Open Data: For time-series data on income per capita, renewable energy consumption (%), arable area (% of land area), and access to renewable energy (% of population). The data covers the period 1990 to 2023 and provides a comprehensive analysis of trends and relationships between green economy and poverty reduction in Nigeria.

Estimation Techniques

To analyze the data and achieve the study objectives, the following estimation techniques were employed: Augmented Dickey Fuller Unit Root Test, Johansen Cointegration Test, Auto regressive Distributed lag (ARDL) model and Pearson Correlation Coefficient.

4. Data Analysis and Discussion

Starting with the descriptive statistics, the analysis involved the test for stationarity, cointegration, model stability and the error correction mode estimation.

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Table 1: Descriptive Statistics

	IPC	REC	ARL	ARE
Mean	1409.876	84.66294	36.79500	47.88618
Median	1457.000	84.61500	37.10000	48.98500
Maximum	3220.000	88.68000	40.48000	59.50000
Minimum	238.0000	80.64000	30.82000	27.30000
Std. Dev.	994.5937	2.423719	2.840905	8.154456
Skewness	0.156142	-0.038007	-0.220448	-0.491386
Kurtosis	1.491409	1.721763	1.773146	2.447532
Jarque-Bera	3.362271	2.322865	2.407710	1.800669
Probability	0.186162	0.313037	0.300035	0.406434
Sum	47935.80	2878.540	1251.030	1628.130
Sum Sq. Dev.	32644152	193.8557	266.3345	2194.340

Source: *Result Extracted from Eviews Output*

Table 1 above shows that the average values for income per capita (IPC) for the period reviewed is $1,409 which is comparably low among developing nations. Renewable energy consumption (REC) averaged 84.7% indicating appreciable number of population consuming renewable energy. However, arable land cultivation (ARL) is only 36.8% on the average for the period 1990 through 2023. Access to renewable energy (ARE) averaged 47.9%. The implication is that with 47.9% of the population have access to energy while nearly all of the population (84.7%) actually consume renewable energy. While data for income per capita is positively skewed, the data for REC, ARL and ARE are negatively skewed. The probability value for the Jaque Bera statistics are greater than 0.05 critical value, this implies that the data are not normally distributed since their *p-values* are greater than 0.05 critical value. Thus, the data used in the modeling do not follow a normal distribution therefore, we normalize by taking the first difference of the data in the estimation.

Table 2: Unit Root Test

Variable	ADF @Level	ADF @First Diff.	Order of Integration
Income per capita (IPC)	**-1.4082**	**-4.2954***	**Stationary at First**
	[0.8398]	**[0.0095]**	**Difference *I(1)***
Renewable Energy Consumption (REC)	**-2.6903**	**-5.7689***	**Stationary at First**
	[0.2467]	**[0.0002]**	**Difference *I(1)***
Arable Land (ARL)	**-1.8048**	**-4.7892***	**Stationary at First**
	[0.6795]	**[0.0028]**	**Difference *I(1)***
Access to Renewable Energy (ARE)	**-6.4249***	**-6.8189***	**Stationary at Level *I(0)***
	[0.0000]	**[0.0000]**	

Source: *Result Extracted from Eviews Output*

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Evidence from Table 2 above shows that there is a mixed order of integration. This is because access to renewable energy (ARE) attained stationarity at level I(0) while the other data attained stationarity at first difference I(1). Consequently, the long run test follows the Auto-regressive distributed lag (ARDL) bounds test approach to cointegration.

Table 3: Long run Cointegration Test

Test Statistic	**Value**	**k**
F-statistic	10.48652	3
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
5%	3.23	4.35

Source: *Result Extracted from Eviews Output*

Given that the F-statistic value of 10.487 is greater than the I(0) and I(1) critical value bounds at 5% (Table 3), the study concludes that there is long run relationship between green economy and poverty reduction in Nigeria. In other words, there is ample time for green economy variables to interact to bring about the desired changes in poverty level in Nigeria.

Table 4: Correlation Matrix

	IPC	**REC**	**ARL**	**ARE**
IPC	1	-0.6258	0.5293	0.8247
REC	-0.6258	1	-0.6647	-0.7442
ARL	0.5293	-0.6647	1	0.7022
ARE	0.8247	-0.7442	0.7022	1

The correlation analysis indicates that arable land and access to renewable energy correlates positively with income per capita except for renewable energy consumption which has negative correlation with income per capita. This implies that increase in arable land and access to renewable energy directly affects income per capita while increase in renewable energy consumption indirectly affects income per capita.

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Table 5: Short Run and Long Run Model Estimation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(IPC(-1))	0.387228	0.134174	2.886018	0.0103
D(REC)	-1.2123347	0.2417565	-5.014691	0.0001
D(REC(-1))	5.3933208	2.8199066	1.912588	0.0728
D(REC(-2))	-2.4217020	1.8545088	-1.305845	0.2090
D(ARL)	-2.3969902	2.6285544	-0.911904	0.3746
D(ARL(-1))	9.8713795	4.7495770	2.078370	0.0531
D(ARL(-2))	10.5601805	3.9199232	2.693976	0.0154
D(ARE)	3.7294940	1.3339751	2.795775	0.0124
D(ARE(-1))	1.3425787	1.0559004	1.271501	0.2207
CointEq(-1)	-0.500116	0.097363	-5.136627	0.0001

Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
REC	-9.3502570	5.5642098	-1.680429	0.1112
ARL	-2.33123510	0.3968304	-5.874638	0.0000
ARE	1.60898877	1.4420876	11.157358	0.0000
C	9.99168180	5.9585340	1.676869	0.1119

R-squared	0.791813	F-statistic	15.84247
Adjusted R-squared	0.785553	Prob(F-statistic)	0.000000
Durbin-Watson stat	1.714698	Akaike info criterion	12.68999

The short run and long run estimates of the model are summarized in Table 5 above. The results show that in the short run, renewable energy consumption decreased income per capita significantly by 1.212 units (*p-value* 0.0001< 0.05). The decrease was also noticeable in the second lagged period. The previous year's coefficient was positive which indicates inconsistent effect of renewable energy consumption on income per capita in the short run period. The negative effect was also sustained in the long run as it decreased income per capita but not significantly this time (*p-value* 0.1112>0.05). Similarly, arable land for cultivation showed negative effect on income per capita in the short run decreasing it by 2.397 units but the decrease was not statistically significantly (*p-value* 0.3746 > 0.05). In the long run, arable land for cultivation significantly decreased income per capita by 2.331 units (*p-value* 0.0000<0.05). The first and second lag periods for arable land were positive showing previous period's positive effect which culminated in negative effect in the current year.

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Only access to renewable energy (ARE) showed positive strides as it exerted positive effect on income per capita in the short run increasing it significantly by 3.729 units (*p-value* 0.0124<0.05). In the long run, access to renewable energy still increased income per capita significantly by 1.609 units (*p-value* 0.0000<0.05). The intercept shows that there was positive movement in income per capita (coefficient = 9.992) occasioned by other stochastic variables not included in the model. The model estimated a speed of adjustment of 50.01% which implies that the model correct the disequilibrium in the previous period at an estimated speed of 50.01% annually.

Further analysis of the results shows that green economy variables explain up to 78.56% of the changes in per capita income of Nigeria. There is joint effect of the variables on per capita income based on the probability value of the F-statistics (F-stat = 15.84; *p-value* = 0.0000). There was no serial autocorrelation in the model and as such the model was not spurious since the Durbin Watson statistic is greater than the R-squared value. The a-priori expectation of the model is summarized in Figure 1 below:

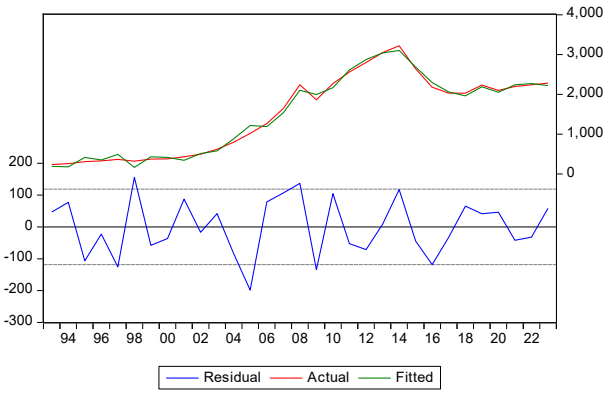

Fig 1: Plot of expected and actual regression result

Figure 1 above shows that there is close movement between the actual regression line and the fitted regression line. This implies that the regression estimate fits the data and the expected outcome since renewable energy and arable land exerted negative effect on income per capita while access to renewable energy exerted positive effect. This implies that the result is close to reality and the expected result given the data obtained.

Discussion of Findings

The discussion is focused on the three variables of interest namely renewable energy consumption, arable land and access to renewable energy. The short run analysis showed that renewable energy consumption negatively affected income per capita significantly in both short and long run periods. The effect was only significant in the long run. This finding is not in agreement with Rahman et al. (2021) who found

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significant positive relationship between renewable energy consumption and GDP per capita. Also, findings from Adedoyin et al. (2020) revealed that renewable energy had a significant positive effect on GDP per capita, particularly in the long run. Other studies that found positive effect of renewable energy consumption include Sarkodie and Adams (2018), Nwokike (2024), Qudrat-Ullah & Nevo, (2021). The reason for the difference between these studies and the present research is the period of observation. While they collected data for a shorter period of time but in a panel regression form (Qudrat-Ullah & Nevo, 2021; Sarkodie and Adams, 2018), the study of Adedoyin et al. (2020) collected data that is limited to the year 2017. The negative effect of renewable consumption found in this present research goes a long way to prove that Nigeria has not fully explored renewable energy. With only lower percentage of the population having access to renewable energy, its consumption offers many households an opportunity to diversify their income base and explore new business opportunities but this has not been so based on the result obtained.

Furthermore, arable land for cultivation showed negative effect on income per capita in the short run and in the long run, the decrease became even significant. This may have been a result of deforestation going on in many parts of Nigeria. With only less than 30% of land in Nigeria being arable land (World Bank, 2023), there is danger of depletion of the green economy as forest reserves are fast turning into timber (Baajike et al., 2022) while economic sustainability of the green economy is on a negative trend (Zaria and Ismail, 2024). The implication is that many households will be further plunged into low income per capita due to non-availability of forest resources for sustenance and this poses serious threat in the long run.

The access to renewable energy was the only variable that showed positive effect per capita income in both short run and long run. Evidently, the positive effect may have been over-shadowed by the other two main variables since access to renewable energy may not necessarily mean consumption of renewable energy. Since consumption of renewable energy is negative, it implies that fewer households have access which is not significant to grow their income per head. However, with a considerable number of the population having access to renewable energy and showing great potential in raising the per capita income of the households, efforts only need to be intensified to make the needed infrastructure available for actual consumption of renewable energy which provides alternative source of power for households to engage in business activities and earn a decent living.

5. Conclusion and Recommendations

There is ample evidence to conclude that the green economy in Nigeria has not been adequately utilized for enhancing the living standards of the people. Nigeria has a growing access to renewable energy but the

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actual consumption of renewable energy showed inverse relationship with per capita income which is an indication of non-usage of renewable energy which may have been propelled by low infrastructure and other externalities. The percentage of arable land is fast depleting which has negatively affected per capita income. Households may not have sustainable income and livelihood in the near future due to the depletion of arable land for cultivation. The green economy is in danger and this calls for serious actin to retrace this inverse trend. To this effect, the following recommendations are germane:

1. The government of Nigeria as well as individual households that have the capacity needs to step into situation to protect the green economy by providing access to renewable energy consumption through the provision of renewable energy infrastructure which enhances consumption of renewable energy. When the percentage of the population who have access to renewable energy actually utilize the energy, their means of livelihood will be enhanced through alternative power supply which drives businesses and their income per capita will rise thus leading them out of poverty.
2. With depletion of arable land leading to loss of income for livelihood, forest protection laws should be made efficient and local authorities should be equipped by the government to protect arable land against deforestation and depletion of forest. Cultivation of arable land is a critical part of the green economy and it serves as the most decent and sustainable source of income for rural households. The arable lands should be protected at all cost.
3. There is need for researchers to foster discussions on green economy as it is the first point of call for rural households in earning a living. This will help harness the benefits associated with the green economy

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