Innovations

Environmental Sustainability and Economic Growth in West African Monetary Zone (1981-2023)

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Abstract: *The examined the impact of environmental sustainability on economic growth in West African region from 1981 to 2023.environmental sustainability were proxied by internal freshwater resources per capita and combustible renewable energy as the explanatory variables, while the gross domestic product served as economic growth Nigeria, Ghana, Côte d'Ivoire, and Senegal. Were selected purposively out of population of sixteen countries in West Africa using industrialization metrics. The specific objectives of the study are;(i) investigate the effect of internal freshwater resources per capita on gross domestic product (GDP) in West Africa. (ii) Determine the impact of combustible renewable energy from waste on gross domestic product (GDP) in West Africa. The study observed that series of studies had been carried out on environmental sustainability without an indebt long term study on factors that characterized the West African environment and its impact on her economic growth; hence the study aspires to bridge that gap by scrutinizing the manner in which these particular factors interact and influence trajectories of economic growth using ARDL model and other relevant parameter stability tests. The study revealed that(i) Internal freshwater resources per capita had non- significant impact on gross domestic product GDP in West Africa (P > 0.05 = 0.4850).(ii) Combustible renewable energy had a non-significant impact on gross domestic product GDP in West Africa (P > 0.05 = 0.1415).The study recommend that the governments within the West African Monetary Zone (WAMZ) prioritize the development of comprehensive water management systems, robust infrastructure, and strategic policies that optimize the utilization of freshwater resources and renewable combustible energy.*

Key words: *Environmental Sustainability, Economic growth, ARDL, Pollution, Degradation, Waste, Combustible renewable energy*

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1.0 Introduction

1.1 Background to the Study

The significance of environmental sustainability as a catalyst for economic development has attracted considerable scholarly attention in recent years. Local governmental authorities, policy formulators, and international entities are particularly concentrating their efforts on countries within West Africa, which are confronted with critical challenges including elevated unemployment rates, pervasive poverty, and pronounced income disparities, compounded by inadequate infrastructure (Franklin, Enoh, Angela, Eric 2022). In an effort to enhance the living standards of their populations, these nations are diligently enacting policies designed to attain sustained economic advancement and development. The historical context surrounding structural adjustment programs (SAPs) and economic recovery initiatives over the past five decades substantiates this assertion. Despite the pivotal role of agriculture in contributing to national GDP and foreign exchange revenues, the prevalence of unsustainable agricultural practices poses a threat to environmental integrity and undermines long-term economic viability (Ibrahim, 2023). The adversities introduced by climate change have the potential to disrupt agricultural production and infrastructure endeavors (Kabiru, 2023). Conversely, the adoption of sustainable methodologies to address climate change may facilitate the emergence of novel avenues for economic expansion (Jones, 2023). Moreover, effective waste management not only mitigates environmental pollution but also generates revenue, both of which are instrumental to economic development (Hassan, 2022). To achieve a harmonious equilibrium between economic advancement and environmental sustainability, West Africa must confront these challenges while capitalizing on available opportunities through the formulation of integrated policies, judicious investments, and active community participation in sustainability initiatives (Johnson, 2023).

Adhering to environmental regulations mitigates the risk of adverse legal and financial consequences while cultivating a stable business environment conducive to economic growth (Dincer& Blumberg, 2020).

The sustainability of agricultural production is fortified by the implementation of farming methodologies that align with environmental objectives and enhance resilience to climate-induced challenges (Adams, 2023). As awareness surrounding the impacts of climate change continues to grow, investments directed towards climate-resilient agricultural practices and renewable energy sources are generating new economic prospects (Turner, 2022). Strategic waste management initiatives not only advance environmental sustainability but also stimulate economic growth by creating employment opportunities and bolstering industries dedicated to resource recovery and recycling (Miller, 2023). Ultimately, the economy of West Africa

becomes more robust and well-rounded when economic growth is harmonized with environmental sustainability through the incorporation of sustainable practices in waste management, agriculture, and climate resilience (Wang, 2022). Environmental sustainability encompasses a broad spectrum of factors that are critical for sustaining the resilience and long-term vitality of the natural environment. These factors encompass initiatives aimed at mitigating climate change through the reduction of greenhouse gas emissions and the transition to renewable energy sources (IPCC, 2014), the minimization of pollution and waste, the promotion of renewable energy alternatives, and the establishment of policies and regulations that uphold sustainable practices and avert environmental degradation (Dincer & Blumberg, 2020; UNEP, 2021; UNCTAD, 2020). Such measures are vital for conserving natural resources for both current and future generations (World Bank, 2016). Furthermore, addressing social and economic equity, alongside encouraging innovation and technological advancement, are integral elements of sustainability within the ecological framework (Sachs & Reid, 2021; Porter & van der Linde, 2021).

Competing short-term economic imperatives, coupled with inconsistent or inadequate environmental policies, may precipitate actions that threaten ecological health (Anthony, 2023). Furthermore, societal disparities, a deficiency in awareness, and the interdependence of the global economy could all obstruct the advancement of sustainability (Kabiru, 2022; Taylor, 2023). A holistic approach is imperative for the attainment of economic advancement while simultaneously safeguarding environmental sustainability. This framework ought to encompass the adoption of sustainable business methodologies, the incorporation of eco-friendly policies within legislative structures, and the promotion of international cooperation to tackle the intricate and interrelated environmental challenges (Clark, 2022; Miller, 2023).

The intricate nexus between environmental sustainability and economic development has been rigorously analyzed by esteemed scholars such as Nicholas Stern, as well as by institutions including the World Bank and the Intergovernmental Panel on Climate Change (IPCC). Stern emphasizes the implications of climate change on economic systems, whereas the World Bank elucidates how sustainability influences resilience and agricultural methodologies.

1.2 Statement of the Problem: African nations, particularly those located in West Africa, have encountered significant challenges in effectively assimilating sustainable practices into their economic frameworks, which could facilitate the delicate equilibrium between ecological sustainability and economic expansion. The fundamental issue resides in the constrained comprehension of the precise quantitative impacts of environmental factors such as climate change, inadequate waste management, and inefficient agricultural practices within the West African context (Stern, 2022; World Bank, 2023).

Although the importance of sustainability is progressively acknowledged, prior initiatives aimed at addressing this issue have experienced obstacles in translating theoretical insights into implementable policies. A comprehensive approach is vital.
The obstacles associated with resource depletion, environmental degradation, and climate change in West Africa have been underscored through numerous initiatives, including academic inquiries and institutional evaluations. Nevertheless, the integration of sustainable practices into the national economic development agendas remains a formidable challenge in pragmatic terms (Ngozi, 2021; Onuoha, 2019). Persistent issues such as agricultural disruptions, resource exhaustion, and heightened environmental pollution continue to endure. These challenges signify a lack of comprehension concerning the specific quantitative ramifications of environmental sustainability on economic indicators, as well as a deficiency in the formulation of targeted strategies to effectively tackle these concerns. In spite of increasing cognizance, there remains a conspicuous absence of actionable frameworks and initiatives to weave sustainability into economic development.

1.3 Objectives of the Study: The main goal of this study is to evaluate the impact of environmental sustainability on economic growth within the West African Monetary Zone. The specific objectives are to: i. Investigate the effect of internal freshwater resources per capita on gross domestic product (GDP) in West Africa.ii. Determine the impact of combustible renewable energy from waste on gross domestic product (GDP) in West Africa.

1.4 Research Questions: To align with the specific objectives, the following research questions will guide the study: i. To what extent do renewable internal freshwater resources per capita influence gross domestic product (GDP) in West Africa?ii. How significantly does combustible renewable energy from waste affect gross domestic product (GDP) in West Africa?

1.5 Research Hypotheses: The following null hypotheses will be established to support the study's objectives and enhance the analysis:
Ho1: Renewable internal freshwater resources per capita do not have a significant effect.

1.6 Scope of the Study: The West African nations, specifically Nigeria, Ghana, Ivory Coast (Côte d'Ivoire), and Senegal, were purposively chosen for this research study spanning from 1981 to 2023, predicated upon their level of industrial development. The initial year was marked by economic difficulties, regional insecurity and political unrest across West African region.

2.0 Review of Related Literature

2.1 Conceptual Review

2.1.1 Environmental Sustainability: This investigation into the literature adopts a methodologically rigorous approach that transitions from broad to specific analyses. The extant literature predominantly suggests that infrastructure is instrumental in facilitating economic development and growth. Haughwout (2020), for example, articulates a comprehensive methodological framework for assessing the geographical ramifications of public capital investments in the context of productivity enhancements. He clarifies that infrastructure generally exerts a modest yet favorable marginal influence. Households derive greater advantages from infrastructure investments compared to enterprises, and the aggregate willingness to pay falls short of the actual expenditures incurred. Galiani, Gertler, and Schargrodsky (2020) assert that the privatization of water services in Argentina has markedly diminished child mortality rates attributable to waterborne diseases, with the majority of this effect associated with enhanced household access to the water supply network. A limited number of studies have addressed the impact of infrastructure on developmental outcomes.

Gibson and Rozelle (2021) scrutinize several pivotal studies, including the influence of road accessibility in Papua New Guinea on household poverty metrics, and illustrate that decreasing travel durations to under three hours from longer periods results in a 5.3% reduction in the headcount index. Duflo and Pande (2020) analyze the repercussions of irrigation dams in India on poverty alleviation and agricultural productivity. Their cost-benefit evaluation reveals that dams adversely affect equity and yield a particularly low rate of return. Fan, Nyange, and Rao (2020) investigate the implications of public investment and road infrastructure on household income and poverty levels through data derived from the Tanzanian household survey, uncovering exceptionally favorable outcomes, with a return ratio of 1 to 9 for investments in public capital. Ilahi and Grimard (2022) argue that the proliferation of water infrastructure significantly influences women's resource allocation.

The concept of environmental sustainability remains a contentious issue across diverse disciplines, encompassing economics, governance, and numerous professional fields. As elucidated in the Brundtland Report (2021), "We observed our planet from space for the first time in the mid-20th century." From this perspective, one perceives a small, fragile sphere embellished with clouds, oceans, vegetation, and soil, as opposed to the indications of human intervention or constructed environments. Humanity's endeavor to reconcile its activities with this natural order is fundamentally altering the planet's systems. The potential threats to human existence are evident in numerous developments. It is imperative to recognize and address this emerging reality, which appears inexorable. This scenario underscores the essential function of the environment in sustaining human life. Although sustainability

encompasses three dimensions—environmental, social, and economic—its interpretation is frequently misconstrued. The definition remains ambiguous, and there exist no definitive criteria or methodologies for its assessment (Morelli, Greenwood, Lockwood & Portillo, 2020).

2.1.2 Renewable internal freshwater resources per capita: Renewable internal freshwater resources per capita (RIFR-PC) represent a critical metric employed to assess the accessibility of water resources within a designated nation or geographical area. This metric quantifies the yearly supply of freshwater derived from indigenous sources (such as precipitation and inflows) in relation to the overall population size. This indicator is extensively utilized in the management of water resources and the planning of sustainable development, as it provides significant insights into a country's water security and the pressures exerted on its water resources. These resources encompass both surface water and groundwater originating from precipitation that occurs within the territorial confines of the country, while explicitly excluding any external water inflows.
The allocation of renewable freshwater resources exhibits considerable variability across the globe, shaped by geographical, climatic, and demographic determinants. Nations such as Canada and Iceland demonstrate elevated RIFR-PC values attributable to their abundant precipitation and comparatively modest population sizes. Conversely, countries within the Middle East and North Africa (MENA) contend with markedly low RIFR-PC values, a predicament exacerbated by arid climates and densely populated areas (World Bank, 2021). Climatic change has altered precipitation patterns, leading to an increase in both the frequency and severity of droughts in certain regions while simultaneously intensifying flooding in others. These alterations have direct implications for the availability of renewable freshwater resources.

In order for entrepreneurs at various levels to maintain ecological systems, it is imperative to establish constraints on the rate of natural resource consumption. The Brundtland Report (2021) accentuated the necessity of "fulfilling the needs of the present without jeopardizing the capacity of future generations." Consequently, it is essential to conserve natural resources and protect global ecosystems to foster health and well-being both presently and in the future, as emphasized by the Sphere Editorial Team (2020). Nonetheless, a diverse array of factors, analytical methodologies, dataset selections, and country-specific choices have been employed in the extensively researched domain of environmental pollution, economic development, and energy utilization within scholarly literature. Findings from prior investigations augment our comprehension of the interrelations among these variables and greenhouse gas emissions. Bekun et al. (2021) explored the

long-term and causal interconnections between renewable energy consumption and economic growth within a carbon function that incorporates natural resource rent.

2.1.3 Drivers of Environmental Sustainability: As articulated by Eze (2022), fulfilling community expectations is of paramount importance. Enterprises operating in West Africa are mandated to meet their obligations within the social compact by addressing local environmental issues. Furthermore, addressing the expectations of foreign investors constitutes another critical impetus. To allure investors who prioritize ethical practices and sustainability, multinational corporations must demonstrate their dedication to environmental stewardship. Fundamentally, as observed by Carroll (2023) and Bansal and Roth (2019), the rivalry among publicly traded corporations for esteemed accolades in environmental sustainability reporting serves as a motivating factor. Corporations aspire to distinguish themselves through exemplary environmental reporting and performance strategies.

The extant scholarly discourse delineates the myriad factors that shape environmental sustainability within West Africa, influenced by diverse industry-specific elements. To adeptly tackle environmental challenges and foster sustainable practices in this region, it is imperative to comprehend these influencing factors. Environmental non-governmental organizations (NGOs) in West Africa assume a pivotal role in advocating for corporate transparency and accountability concerning environmental initiatives. These organizations exert pressure on enterprises to adopt environmentally sustainable policies, disseminate ecological data, and mitigate their environmental footprint (Guthrie & Parker, 2022).

Corporations are progressively cognizant of the imperative to proactively engage with environmental concerns to avert legal repercussions and regulatory sanctions, a recognition propelled by heightened environmental consciousness and evolving regulatory frameworks (Nwokike, 2022). The Federal Ministry of Environment and the National Environmental Standards and Regulations Enforcement Agency (NESREA) constitute two principal institutions accountable for the enforcement of environmental legislation and regulations.

Numerous nations across Africa, particularly within West Africa, are contending with challenges such as deforestation, land degradation, and pollution, exacerbated by global environmental phenomena. Consequently, enterprises must adopt sustainable practices and enhance their environmental resilience to mitigate the adverse effects of these challenges on local ecosystems and communities. Businesses in West Africa, especially in Nigeria, are beginning to acknowledge the importance of environmental responsibility and accountability. They recognize their obligation to minimize their ecological impact and to engage in transparent reporting regarding environmental issues (Hasnas, 2019). Ngozi (2022) asserts that

environmental sustainability is increasingly becoming a fundamental component of corporate social responsibility (CSR) initiatives, reflecting organizations' commitment to ethical practices and environmental stewardship. This shift toward environmental accountability is fostering a culture of sustainability within the Nigerian corporate milieu. Nigerian firms are facing heightened expectations to comply with environmental performance standards established by local communities. These communities, impacted by industrial activities, are demanding accountability, transparency, and participation in environmental governance decisions.

Enterprises are engaging with stakeholders, particularly local communities, to solicit their concerns and to incorporate local perspectives into their environmental decision-making frameworks. Community-centric approaches to environmental sustainability facilitate inclusive and sustainable development, enhance the social license to operate, and cultivate trust.

2.1.4 Environmental Degradation: The author elucidates the detrimental consequences of pollution, gas flaring, and oil spills within Nigeria's Niger Delta region, accentuating the adverse effects these activities impose on livelihoods and their contribution to ecosystem degradation. Obioha (2019) further underscores that land degradation and deforestation exacerbate these environmental challenges. Oyegbami et al. (2018) advocate for integrative strategies that prioritize social inclusion, economic diversification, and sustainable resource management as mechanisms to mitigate environmental degradation in Nigeria. They underscore the necessity of fortifying institutional capacities, enforcing regulatory frameworks, and enhancing environmental governance to facilitate sustainable development and bolster resilience against environmental threats. Furthermore, Olaniyi (2017) posits that investment in renewable energy, the adoption of green technologies, and the development of environmentally sustainable infrastructure are imperative for addressing environmental degradation and promoting economic growth in West Africa. Such investments, as suggested by Olaniyi, can diminish environmental vulnerabilities, foster equitable economic growth, and generate employment opportunities. His perspective reflects the growing recognition of the imperative to transition towards a green economy as a means to address environmental concerns and propel economic development. Nevertheless, Nigeria must undertake the transition to a green economy and sustainable development to effectively address environmental degradation and catalyze economic growth. As Agwu and Nwachukwu (2020) elucidate, environmental sustainability necessitates the equilibrium of economic growth, environmental stewardship, and social equity to fulfill present requirements without compromising the capacity of future generations to satisfy their own needs. This comprehensive approach highlights the significance of

amalgamating economic, social, and environmental dimensions, which aligns with the principles of sustainable development.

To enhance environmental sustainability and food security in West Africa, it is crucial to implement sustainable agricultural methodologies and establish effective natural resource management strategies. Ogunniyi et al. (2019) emphasize that the application of agro-ecological techniques, such as soil conservation, agroforestry, and organic farming, is essential.

2.1.6 Economic Growth: Economic growth, as articulated by Jhingan (2003), is defined as a process wherein a nation's actual per capita income experiences an upward trajectory over an extended temporal span. In alignment with this perspective, economic growth is quantified by the augmentation of the quantity of goods and services produced within a nation over a designated time frame, typically on an annual basis. This growth transpires when the productive capacity of the economy expands, thereby enabling the generation of a greater volume of goods and services (Onyemachi 2012). Economic growth is evidenced by the escalation of per capita gross domestic product (GDP), which serves as an indicator of the total income generated by a nation. It is frequently assessed as a rate of change in GDP. Moreover, economic growth is perceived as the process through which the productive capacity of an economy increases over a specified duration, culminating in a higher national income level. Manifestations of economic growth include rising income levels, an expanding labor force, an increase in the overall capital stock of the nation, and heightened levels of trade and consumption. Conversely, economic development is more concerned with enhancing overall welfare through a more equitable distribution of the increased output of goods and services across the population. Economic growth predominantly emphasizes the escalation of real income (real GDP).

2.2 **Theoretical Review**

This research is fundamentally grounded in the Environmental Kuznets Curve (EKC) Theory.

2.2.1: **Environmental Kuznets Curve (EKC) Theory:**

The Environmental Kuznets Curve (EKC) signifies a pivotal transformation in the conventional perspective concerning the interplay between environmental degradation and economic advancement. The EKC hypothesis, which builds upon Simon Kuznets' seminal examination of income disparity from the 1950s, attained prominence within the domain of environmental economics during the latter part of the 20th century.

The progression of the EKC theory mirrors substantial transformations in environmental discourse pertinent to both policy and intellectual paradigms over

recent decades. In the latter half of the 20th century, escalating concerns regarding pollution, resource depletion, and ecological deterioration prompted scholars and policymakers to endeavor to reconcile environmental preservation with economic advancement. A seminal moment in this ongoing dialogue was the introduction of the EKC theory, which posited that, in certain instances, economic growth could indeed facilitate environmental enhancement. The EKC hypothesis revolutionized our comprehension of the nexus between economic activities and their environmental repercussions, thereby unveiling novel avenues for research and policy initiatives that advocate for sustainable development. Previous theoretical frameworks regarding environmental transformation and empirical data have significantly influenced the discourse surrounding the EKC hypothesis within both policy and intellectual spheres in recent decades. As apprehensions regarding pollution, resource depletion, and ecological decline intensified, academicians and decision-makers endeavored to harmonize the objectives of environmental safeguarding with economic progression. The establishment of the EKC theory signified a critical inflection point in this ongoing discourse, demonstrating that, under specific conditions, economic growth could serve as a catalyst for environmental advancement. The EKC hypothesis reconfigured the relationship between economic activities and environmental outcomes, engendering new prospects for research and policy measures aimed at sustainable development. Empirical investigations concerning the EKC hypothesis have yielded mixed yet predominantly affirmative results, elucidating the intricate interconnections between environmental sustainability and economic growth.

2.3 **Empirical Review:**

Boamah (2020) conducted an extensive review that meticulously examined the environmental responses associated with international trade dynamics through the employment of ordinary least squares analysis, covering the temporal span from 1980 to 2014. The findings revealed that exports have a favorable impact on environmental quality in Ghana; however, the immediate effects of exports were found to be minimal. Additionally, it was determined that imports have an insignificant effect on the environment.

Longe et al. (2020) executed a systematic review aimed at investigating the relationship between trade and environmental sustainability in Africa, utilizing the ordinary least squares methodology during the period from 2000 to 2014. Their analysis suggested that trade could lead to an increase in environmental pollution over the long term, with evidence indicating a positive correlation between trade and environmental degradation within the African context. Nonetheless, the study also underscored a negative association concerning environmental degradation in Africa.

Olubusoye and Musa (2020) performed a study that assessed the relationship between carbon emissions and economic growth in Africa, employing the ARDL model, thereby corroborating the findings of Adu and Denkyirah (2017). Their research established that the Environmental Kuznets Curve (EKC) hypothesis was validated in 21% of the countries analyzed, demonstrating that carbon emissions are positively correlated with economic growth in 71% of the nations, while economic growth generally associates with a reduction in carbon emissions across the majority of African countries.

Ndubuisi, Okolo Purity, Anekwe Rita Ifeoma, and EkwochiEucharia (2020) undertook research concentrating on environmental sustainability and sustainable development in Nigeria, investigating the challenges and opportunities through an exploratory research design from 2004 to 2019. The findings emphasized a significant oversight of natural resource depletion, resulting in long-term environmental degradation that poses substantial risks to sustainability.

A pertinent study by Franklin BedkiyibaBaajike et al. (2020) investigated the interplay between economic growth, trade liberalization, and financial development in relation to environmental sustainability within West Africa, while also considering the impact of institutional factors. Utilizing a System Generalized Method of Moments for the years 2015 to 2018, the results indicate that trade liberalization adversely affects environmental sustainability. However, in the presence of robust institutions and a well-regulated market, there is a positive transition towards enhancing environmental sustainability. These findings imply that policymakers should prioritize the enhancement of institutional quality and the advancement of the financial sector to effectively safeguard the environment and tackle climate change. Notably, this study represents the first comprehensive analysis of environmental sustainability across the entire West African sub-region, rendering its recommendations particularly pertinent for all nations within this area.

Tayyaba Rani, Muhammad Asif Amjad et al. (2020) reexamined the ecological repercussions of financial development on economic advancement and carbon emissions, offering analytical perspectives derived from South Asian economies through the application of Feasible Generalized Least Squares and panel data econometric methodologies for the duration spanning from 1990 to 2020. The investigation revealed a U-shaped correlation among financial development, carbon emissions, and economic growth. Consequently, it is recommended that the governing bodies of South Asian nations implement measures to stimulate economic growth; accomplishing this necessitates proficient oversight of financial development, which encompasses financial innovations, enhancements in financial efficiency, the preservation of financial stability, and the mitigation of environmental pollution.

Ismael Moya-Clemente et al. (2020) undertook a research endeavor aimed at discerning the environmental and economic development determinants that exert influence on sustainable entrepreneurship.

2.4 The Knowledge Gap

Within the contemporary research milieu concentrating on environmental sustainability and economic growth, extant studies have contributed significant insights regarding the determinants affecting environmental sustainability in relation to economic progress. Nevertheless, they frequently neglect the West African Monetary Zone, which grapples with unique environmental challenges, economic frameworks, and policy environments. Moreover, while numerous dimensions of the interaction between economic development and environmental issues have been investigated in prior research, there exists a conspicuous deficiency in the comprehensive analysis of pivotal metrics such asinternal freshwater resources per capitaand renewable energy sources. This study aspires to bridge that gap by scrutinizing the manner in which these particular factors interact and influence trajectories of economic growth. Furthermore, this research endeavors to perform an exhaustive analysis of the policy implications pertaining to the regulation ofinternal freshwater resources per capita, the advancement of renewable energy, and the enhancement of the livestock product index, all aimed at promoting sustainable economic development within the West African Monetary Zone.

3.0 Methodology

3.1 Research Design: This study has been meticulously structured with the objective of deriving conclusions and inferences, predicated upon the ex-post facto research design, which is deemed the most appropriate methodological framework. The selected research design is justified as it entails an analysis of data collected post-event, and the variables employed are those that remain beyond the researcher's influence.

3.2 Nature and Sources of Data: The secondary data utilized in this investigation were obtained from the World Development Indicators. The panel data pertinent to this study encompasses a temporal span from 1981 to 2023 (43 years), incorporating data from Nigeria, Ghana, Côte d'Ivoire, and Senegal.

3.3 Population and Sample Size: The population under examination for this research encompasses all documented panel data regarding environmental sustainability and economic growth within the West African Monetary Zone, with a particular focus oninternal freshwater resources per capitaand combustible

renewable energy derived from waste over a duration of forty-three years (43), specifically from 1981 to 2023.Nigeria, Ghana, Côte d'Ivoire, and Senegal.
Were selected purposively out of population of sixteen countries in West Africa using industrialization metrics.

3.4 Model Specification and Modification: The study has utilized the framework developed by Ismael Moya-Clemente et al. (2020), who explored the environmental and economic development factors relevant to sustainable entrepreneurship in Nigeria over time, using a partial least squares methodology from 1990 to 2020. In this research, the original model has been substituted with the Autoregressive Distributed Lag (ARDL) model to better fit the panel data set.

3.5 Description of Model Variables: This study includes both dependent and independent variables.

3.5.1 Dependent Variables: Dependent variables are those that are affected by independent variables. The main dependent variable in this analysis is economic growth, represented by Gross Domestic Product (GDP), which is the key measure of the value added through the production of goods and services in a country during a specific time period.

3.5.2 Independent Variable: Renewable Internal Fresh Water Resources Per Capita: This indicator, known as renewable internal freshwater resources per capita (RIFR-PC), is essential for evaluating the availability of water resources in a particular country or region. It calculates the annual amount of freshwater produced from internal sources (like precipitation and inflows) relative to the total population.

Combustible Renewable Energy from Waste: This term describes energy derived from burning waste materials (such as municipal solid waste, agricultural waste, or industrial waste) that can naturally replenish, mainly through processes like waste decomposition or recycling.
3.4.3 Control Variable (Inflation Rate): The control variable in this study is the inflation rate, which is kept constant. The inflation rate indicates the percentage increase in the average price level of goods and services in an economy over a defined period.

4.0 Data Presentation and Analysis

4.1 Unit root test

Table 4.1: **Unit root Table**

Variables	**ADF Start**	**Critical Value 5%**	**Order of Diff**	**P-Values**	**Decision**
CRW	-12.04788	-2.884109	1(1)	0.0000	Reject null
GDP	-2.189733	-1.942710	1(0)	0.0279	Reject null
RIFWRPC	-5.408355	2.880463	1(1)	0.0000	Reject null
INFL	-4.955901	2.878413	1(0)	0.0000	Reject null

Source: Researchers computation

GDP =Gross Domestic Product, CRW -= Combustible Renewable Energy from Waste RIFWRPC = Renewable Internal Fresh Water Resources Per capita, INFL = Inflation rate

Table4.1 displayed the results of the stationary series as tested. Our observations revealed that some of the variables like CRW and RIFWRPC are stationary at difference order one 1(1) while GDP and INFL are stationary at order zero, since the ADF values in absolute terms are more negative than the critical values at 5% level of significance for all the variables as tested. The probability value is also less than 5% level of significance (0.0000)and 0.0279, therefore all the series are regarded to be stationary at 1(0) and 1(1).The outcome requires bounds co-integration test to know if long run association exist among the variablessince the stationary level was at 1(0) and 1(1).

4.2aTest for Co-integration

CRPT/GDP = f (CRW, RIFWRPC, INFL)

Table4.2: **Bounds Co-integration Test Table**

VARIABLE	P (F-STAT)	5% SIGN	I(0) bounds	I(1) bounds
LNGDP				
LNCRW	2.230611	@5%	2.79	3.67
LNRIFWRPC				
INFL				

Source: Researchers computation

The value of F-stat is 2230611, while the value of i(0) and i(1)bounds at 5% level of significance are 2.79 and 3.67 respectively.The outcome of the test implied that there is no evidence of lung run relationship among the variables. Based on the result, Wald test is carried out to test for short run causality.

4.2b .Wald Test

Table 4.3 Wald test table

Test Statistic	Value	df	Probability	Decision
F- statistic	1522.002	(3,125)	0.0000	Reject H_0
Chi-square	4566.006	3	0.0000	Reject H_0

Source: Researchers computation

Table 4.3 indicated the outcome of Wald test using the ARDL model specified as LNGDP= F(LNCRW, RIFWRPC, INFL).The values of F-statistic and Chi-square are 1522.002 and 4566.006 ,where the corresponding probability values are 0.0000 which are less than 5% level of significance. Based on this outcome, the null hypothesis that stated C(1) = 0,C(3)=2*C(4) = 0 is not accepted which indicated that there is evidence of short run causal effect.

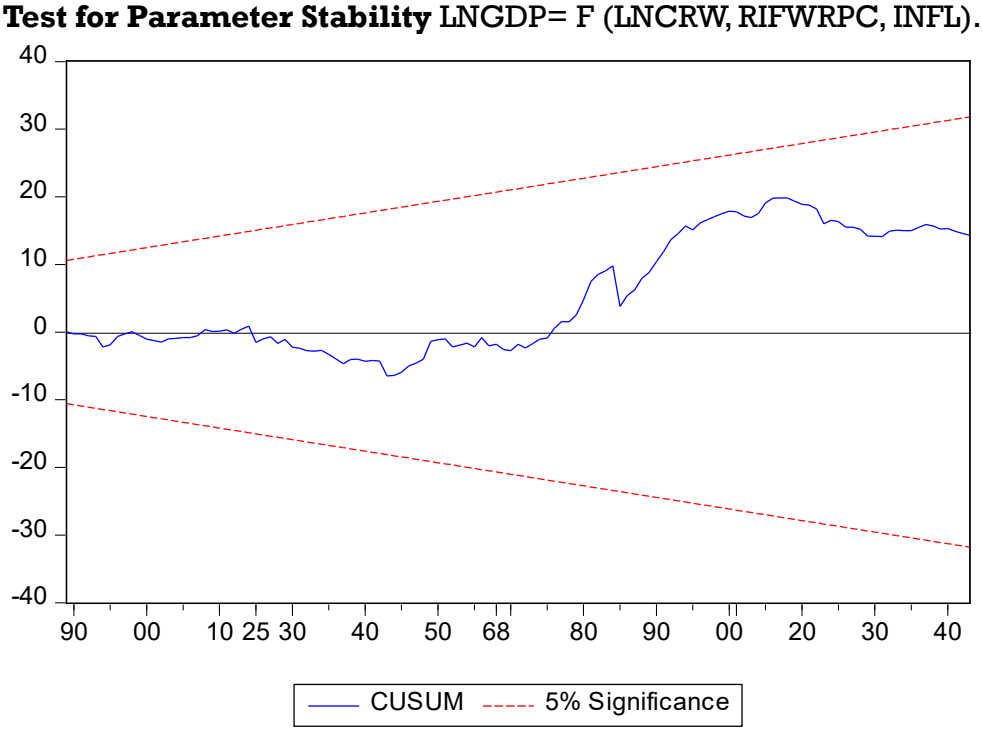

Figure 1: Parameter stability graph

Figure 1 displayed the graphical movement of all the parameters jointly tested using ARDL model. The blue line which represents CUSUM failed to cross the two red lines (5% significance) which means that estimated parameters are stable over the long period as there is no evidence of deviation over the period under study. This implied that from the point of origin or the base year of our study, to the end, we noticed that move in-between the 5% red lines.

4.3 Parameter Estimation using ARDL modelLNGDP=F (LNCRW, RIFWRPC, INFL).

Table 4.4

Variables	**Coefficients**	**t-statistics**	**p-values**	**R^2**	**P(f-stat)**	**DW stat**
LN GDP						
LNCRW(-1)	0.347265	1.479582	0.1415			
LNRIFWRPC	-0.031229	-0.700406	0.4850	97%	0.0000	1.83
INFL(-1)	0.002048	1.801884	0.0740			

Source: Researchers computation

There is evidence of 97% level of explanation on the impact of the explanatory variable on the explained variable, leaving a balance of 3 % unexplained as a result of variables not accounted for or not included in the model. The Durbin Watson statistics (1.83) indicated an absence of serial correlation since it remained 0.17 to be 2. The probability value of F-statistic (0.0000) indicate that the overall regression is statistically significant since the value is less than 5% level of significance.

4.4 Ramsey Reset and Multi-colinearity Test

Table 4.5**Ramsey Reset Test and Multi-colinearity Table**

Specification: LNGDP LNGDP(-1) LNCRW LNCRW(-1) LNRIFWRPC INFL INFL(-1) C

Test Statistic	Value	df	Prob	Decision	Variables	CVIF
t- statistic	0.326294	124	0.7448	Accept H_0	LNRIFWRPC	1.083576
f-statistic	0.106468	(1,124)	0.7448	Accept H_0	LNCRW	1.218398
					INFL	1.296820

Source: Researchers computation

Table 4.5 indicated the true specification of the variables estimated for reliable and better results that can be used to solve identified research problems. The values of t and f statistics are 0.326294 and 0.106468 respectively while their corresponding probability values are 0.7448 and 0.7448 which are not less than 5% level of significance. The study therefore accept the null hypothesis and state that the model is correctly specified, and no relevant variables or nonlinearities have been omitted. In table 4.4 ,we observed that R^2 is 97% and multi colinearity test was carried out in table 4.5 using variance inflation factor (VIF) .The is no evidence of multi colinearity

since all the corresponding values of centered variance inflation factor(CVIF) are less than 10.

4.5 Test of Hypotheses

Statement of Hypothesis One: Ho: Renewable internal freshwater resources per capita has no significant impact on gross domestic product GDP in West Africa.

Decision criteria: Accept the null hypothesis if the probability value of t-statistic is not less than 5% level of significance, otherwise, reject the null hypothesis. Applicable to hypothesis two.

Table 4.5 showed the outcome of ARDL test, where the coefficients of the explanatory variable is (-0.031229) as obtained on RIFWRPC. The coefficient value is not positively signed .This implied that there is evidence of negative impact of the variable (RIFWRPC). The corresponding probability values of the explanatory variable is not less than 5% level of significance in absolute terms.The study accept the null hypothesis and state thatrenewable internal freshwater resources per capita had non- significant impact on gross domestic product GDP in West Africa.

Statement of Hypothesis Two: Ho_2: Combustible renewable energy emanating from waste management has no significant impact on gross domestic product GDP in West Africa. Table 4.4 disclosed the outcome of ARDL estimation where the LNCRW (-1) is associated with the coefficient (0.347265) and corresponding probability value (0.1415) .The outcomes implied that Combustible renewable energy had a positive and non-significant impact on gross domestic product GDP in West Africa. The study there fore accept the null hypothesis.

4.6 Discussion of the Findings

Therenewable internal freshwater resources per capita had no significant impact on gross domestic product GDP in West Africa.The outcome of the study indicate that African countries failed to harness, utilize and maximize their naturally gifted internal freshwater resources found in their environment, hence environmental pollution sets inn through mismanagement and neglect of internal fresh water resources. See the works of Longe et al. (2020) .

Olubusoye and Musa (2020) performed a study that assessed the relationship between carbon emissions and economic growth in Africa, employing the ARDL model, demonstrating that carbon emissions are positively correlated with economic growth in 71% of the nations, thereby corroborating the findings of Adu and Denkyirah (2017).Their results are in line with the findings of our study ,indicating a positive but non-significant impact combustible renewable energy on the economic growth in West Africa. The studies were carried out in African countries at different

time which implied that African countries are associated with similar environmental characteristics.

5.1 Summary of Findings

(i) Internal freshwater resources per capita had non- significant impact on gross domestic product GDP in West Africa (P > 0.05 = 0.4850).

(ii) Combustible renewable energy had a non-significant impact on gross domestic product GDP in West Africa (P > 0.05 = 0.1415).

5.2 Conclusion

This investigation reveals that elements pertaining to environmental sustainability, such as the per capita availability of renewable internal freshwater resources and combustible renewable energy, do not exert a significant influence on economic growth within the West African Monetary Zone (WAMZ). The absence of a significant relationship concerning freshwater resources suggests that mere access to water does not inherently catalyze GDP growth, likely attributable to inefficiencies in the utilization and management of water resources. Similarly, while there exists a positive correlation between combustible renewable energy and GDP, its overall effect remains constrained, indicating that the integration of renewable energy technologies has yet to substantially reshape economic growth trails.

5.3 Recommendation

(i) It is imperative that the governments within the West African Monetary Zone (WAMZ) prioritize the development of comprehensive water management systems, robust infrastructure, and strategic policies that optimize the utilization of freshwater resources across agricultural, industrial, and domestic sectors, thereby significantly augmenting their capacity to catalyze economic expansion.

(ii)Policymakers are urged to foster substantial investments in renewable energy technologies, advance energy efficiency measures, and implement incentives to stimulate private sector engagement, thereby enhancing the contribution of combustible renewable energy to the gross domestic product growth within the region.

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