SUSTAINABLE FINANCE AND ECONOMIC GROWTH IN WEST AFRICAN MONETARY ZONE

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Abstract

*The study sought to evaluate the effect of sustainable finance on economic growth in west African monetary zone (2000 – 2024). Sustainable finance is proxied by renewable internal freshwater resources per capita (RIFWPER) and Carbon intensity of GDP while GDP per unit of energy used represents the economic growth. Nigeria and Ghana were purposively selected from countries in West African Monetary zone base on two countries with highest population growth rate among others. The data used for ex-post facto research design were secondarily sourced from world development indicators and published works of other scholars. Despite growing research on energy efficiency and sustainable development, few studies have examined GDP per unit of energy used (energy productivity) in the West African Monetary Zone (WAMZ)**. Most studies in Sub-Saharan Africa focus separately on carbon emissions, renewable energy, or economic growth, rather than their joint effect on energy productivity. A gap in understanding energy productivity in resource-dependent economies**,** where structural factors differ from advanced countries. While in developed economies higher energy productivity often reflects technological innovation and decarbonization, in WAMZ countries it may still rely on carbon-intensive production**.** Consequently, there is limited empirical evidence on whether energy efficiency improvements can occur in these economies without increasing carbon intensity. Several pre-tests were carried out such as panel unit root test, Pedroni co-integration test. Generalized Method of Moment (GMM) model was used to address endogeneity. The results*

revealed that: (i) internal freshwater resources per capita (RIFWPER) had a negative (-0.0096) effect on GDP per unit of energy used, while Carbon intensity of GDP had a positive effect (86.98) on GDP per unit of energy. the findings suggest that within the West African Monetary Zone, energy productivity (GDP per unit of energy used) is significantly influenced by environmental and structural factors. These results highlight the need for WAMZ economies to pursue structural transformation policies that promote cleaner technologies, renewable energy adoption, and true decoupling of economic growth from carbon emissions if sustainable energy productivity is to be achieved.

Key Words: Sustainable Finance, Generalized Method of Moment (GMM), Carbon intensity, Decabornization, Carbon Emission, Renewable Energy

INTRODUCTION

The evolution of sustainable finance has broadened the scope of capital markets to incorporate environmental, social, and governance (ESG) objectives into mainstream investment practices. Among sustainable financial instruments, green bonds and green, social, and sustainability (GSS) bonds have emerged as pivotal mechanisms for mobilizing long-term financing for climate mitigation, environmental protection, and socially inclusive development. These instruments are designed to attract both institutional and retail investors by aligning investment flows with internationally recognized sustainability goals, such as those encapsulated in the United Nations' Sustainable Development Goals (SDGs) and the Paris Agreement commitments (Muhammad *et al.*, 2022).These instruments are structured to finance projects that generate measurable environmental benefits such as renewable energy, climate adaptation, and biodiversity conservation while also supporting inclusive development objectives (Muhammad et al., 2022). The growing integration of Environmental, Social, and Governance (ESG) considerations into financial markets reflects a broader transformation in investment philosophy, whereby sustainability risks and opportunities are increasingly embedded into capital allocation decisions.

In Africa, and particularly within West Africa, the development of sustainable bond markets represents both a financial innovation and a strategic development imperative. Historically, West African capital markets have been constrained by shallow liquidity, limited institutional investor participation, and insufficient regulatory frameworks to support innovative financial instruments

(FSD Africa, 2023). However, recent years have witnessed notable progress within the West African Economic and Monetary Union (WAEMU) and the wider Economic Community of West African States (ECOWAS), where green and GSS bond issuances have begun to expand. These developments signal an emerging alignment between regional financial integration efforts and global sustainable finance standards.

A significant milestone in African sustainable finance was the issuance of a €750 million sustainability bond by the Banque Ouest Africaine de Développement (BOAD) in 2021. This transaction marked the first large-scale sustainability bond issued by an African multilateral development bank and demonstrated the feasibility of mobilizing international capital markets for climate-aligned development in West Africa (Duquenne & Lejeune, 2021). The proceeds were earmarked for environmentally sustainable infrastructure and socially impactful projects, thereby establishing a model for future issuances in the region.

Building on this momentum, the ECOWAS Bank for Investment and Development (EBID) issued its first Green, Social, and Sustainability (GSS) bond valued at FCFA 70 billion in 2024. The bond, which was oversubscribed within days, reflected growing investor confidence in ESG-aligned instruments within the WAEMU regional financial market (ECOWAS Bank for Investment and Development [EBID], 2024). Importantly, this issuance was structured under a formal ESG financing framework, reinforcing transparency, accountability, and alignment with international green bond principles.

The expansion of sustainable bond markets in West Africa has been supported by institutional and regulatory reforms aimed at integrating ESG standards into financial governance. The WAEMU Green Bond Scoping Report highlighted the necessity of establishing robust eligibility criteria, reporting standards, and supportive regulatory infrastructure to ensure credibility and investor trust (FSD Africa, 2023). Furthermore, regional regulatory authorities have introduced guidelines and taxonomies defining eligible green and sustainable activities, thereby harmonizing regional capital market practices with international norms. Such measures are essential for mitigating green washing risks and enhancing market integrity.

Scholarly research further underscores the importance of institutional quality and governance structures in scaling sustainable finance in emerging economies. Boafo et al. (2025) argue that strong regulatory oversight, policy coherence, and investor incentives significantly influence the effectiveness of green financial instruments in promoting sustainable economic growth. In the West African context, the integration of ESG frameworks within WAEMU and ECOWAS institutions therefore represents not merely a financial innovation but also a structural reform aimed at embedding sustainability within regional economic governance.

1.2 Statement of the Problem

The West African Monetary Zone (WAMZ) aims to promote monetary stability and economic integration among its member countries. However, the region continues to face challenges such as inflation instability, exchange rate volatility, fiscal imbalances, and weak policy coordination. These issues make it difficult to achieve the goal of a stable common currency and sustainable economic growth within the zone. These include limited awareness among investors and businesses, inadequate data on ESG performance, high perceived costs of green projects, and weak regulatory enforcement. Furthermore, there is a gap in technical expertise and capacity building among financial institutions to effectively assess ESG risks and opportunities. The economic environment presents both opportunities and imperatives for sustainable finance. With a young population, growing entrepreneurial ecosystem, and strong domestic financial market, sustainable finance can mobilize private capital to drive inclusive growth, job creation, and environmental protection**.** For instance, funding renewable energy projects in rural communities can simultaneously expand electricity access, create employment, and reduce reliance on fossil fuels.

1.3 Objective of the Study

The main objective of the study is to evaluate the effect of sustainable finance on economic growth in West African monetary zone (2000 – 2024). The specific objectives are to:

(i) Assess the impact of renewable internal freshwater resources per capita (RIFWPER) on the economic growth in West African monetary zone.

(ii) Evaluate the impact of carbon intensity of GDP per unit of energy on the economic growth in West African monetary zone

1.4 Research Questions

(i) Does renewable internal freshwater resources per capita (RIFWPER) impact economic growth in the West African Monetary Zone (WAMZ)?

(ii) How do carbon intensity of GDP per unit of energy influence economic growth in the West African Monetary Zone (WAMZ)?

1.5 Research Hypotheses

(i) Renewable internal freshwater resources per capita (RIFWPER) have no positive effect on economic growth in the West African Monetary Zone (WAMZ).

(ii) Carbon intensity of GDP per unit of energy has no positive effect on economic growth in the West African Monetary Zone (WAMZ).

1.6 Scope of the Study

The study sought to evaluate the effect of sustainable finance on economic growth in West African monetary zone (2000 – 2024).The base year 2000 was characterized by the establishment of WAMZ in West African region which caused the monetary policy convergence efforts to be more realistic, influencing financial sector stability. Nigeria and Ghana are selected as the focal countries due to their dominant economic size representing the WAMZ.

2.0 REVIEW OF RELATED LITERATURE

2.1 Conceptual Review

2.1.1 Renewable internal freshwater resources per capita

Renewable Internal Freshwater Resources per capita (RIFWPER) refers to the total volume of internally generated renewable surface and groundwater resources available within a country divided by its population, commonly measured in cubic meters per person per year. From a neoclassical growth perspective, natural resources such as water are treated as productive inputs that enhance agricultural productivity, industrial output, and long-run economic growth, consistent with the resource-based growth framework (Solow, 1956; World Bank, 2023). In contrast, water scarcity theorists argue that declining per capita freshwater availability constrains food security, public health, and structural transformation, particularly in developing regions where water stress thresholds are increasingly binding (Falkenmark, 1989; UN-Water, 2023). Institutional scholars further contend that water abundance alone does not guarantee economic gains, as governance quality, regulatory frameworks, and property rights determine efficient allocation and sustainable management (Ostrom, 1990; OECD, 2022). From an ecological economics standpoint, RIFWPER is also viewed as a sustainability indicator, emphasizing the need to balance economic expansion with environmental limits and intergenerational equity in the face of climate change and rising population pressures (Daly, 1996; IPCC, 2023).

2.1.2 Carbon Intensity of GDP per unit of Energy

Carbon intensity of GDP per unit of energy refers to the amount of carbon dioxide (CO_2) emissions generated relative to economic output and energy consumption, reflecting how efficiently an economy converts energy into productive activity with minimal environmental impact. From the environmental economics perspective, lower carbon intensity indicates improved energy efficiency and technological progress, consistent with endogenous growth theory where innovation reduces emission intensity (Romer, 1990; IEA, 2023). The

Environmental Kuznets Curve (EKC) hypothesis suggests that as economies grow, carbon intensity may initially rise but eventually decline due to structural transformation and cleaner technologies (Grossman & Krueger, 1995; World Bank, 2023). Energy economists argue that improvements in GDP per unit of energy (energy productivity) signal decoupling of economic growth from carbon emissions, thereby promoting sustainable growth (OECD, 2022). However, ecological economists caution that reductions in carbon intensity may be offset by scale effects if overall energy consumption expands rapidly, limiting environmental gains (IPCC, 2023).

2.1.3 Economic Growth

Economic growth refers to the sustained increase in a country's real output of goods and services over time, commonly measured by growth in real Gross Domestic Product (GDP). In the neoclassical framework, pioneered by Robert Solow, growth is driven by capital accumulation, labor expansion, and exogenous technological progress. Endogenous growth theorists such as Paul Romer argue that innovation, human capital development, and knowledge spillovers are central determinants of long-run growth. Structural economists further contend that economic growth involves transformation from low-productivity agriculture to higher-productivity industrial and service sectors (Lewis, 1954; Kuznets, 1971). However, contemporary sustainability debates, influenced by ecological economists like Herman Daly, emphasize that growth must be balanced with environmental constraints and inclusive development to ensure long-term welfare gains.

2.2 Conceptual Framework

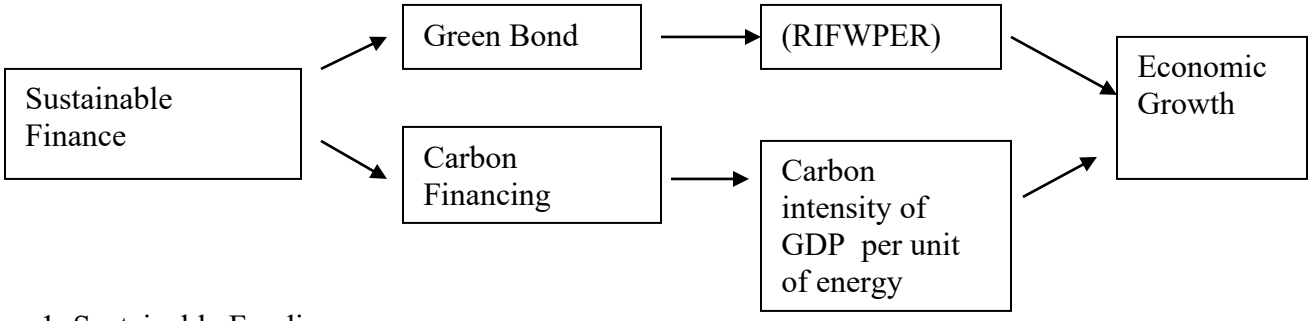

Figure 1; Sustainable Funding

The conceptual framework illustrates the pathway through which sustainable finance influences economic growth in the West African Monetary Zone (WAMZ). At the core, sustainable finance acts as the primary driver, providing the capital needed for environmentally and socially responsible investments. This is operationalized through instruments such as green bonds and carbon financing, which mobilize funds specifically for projects that reduce environmental degradation and promote low-carbon development. These financing instruments are expected to influence key mediating factors, including Renewable Internal Freshwater Resources per Capita (RIFWPER) and carbon intensity of GDP. For instance, funds raised through green bonds may be invested in water conservation infrastructure, irrigation systems, or hydropower projects, improving per capita freshwater availability (RIFWPER). Similarly, carbon financing incentivizes projects that reduce carbon emissions per unit of GDP, lowering the carbon intensity of economic activities and promoting energy efficiency. Ultimately, these environmental and energy efficiency improvements are expected to enhance economic growth, as measured by increases in GDP, productivity, and sustainable development indicators. The framework highlights a causal chain: sustainable finance → environmental and energy efficiency improvements (RIFWPER and carbon intensity) → economic growth. It also implies that the effectiveness of sustainable finance depends on how well these environmental and energy outcomes are achieved, suggesting that RIFWPER and carbon intensity act as critical mediators linking finance to growth.

2.3 Theoretical Review

This study is anchored on the Ecological Modernization Theory (EMT), which posits that economic growth and environmental protection can be mutually reinforcing through technological innovation, sustainable policies, and green investment (Mol & Spaargaren, 2000). In the context of the West African Monetary Zone, EMT emphasizes the role of sustainable finance instruments, such as green bonds and carbon financing, in promoting low-carbon and resource-efficient economic activities. Specifically, in Nigeria and Ghana, where rapid urbanization, industrial expansion, and water stress challenge sustainable development, EMT suggests that strategic investment in renewable water infrastructure and low-carbon energy can enhance economic growth while mitigating environmental degradation. Thus, the theory provides a conceptual lens to understand how RIFWPER improvements and reductions in carbon

intensity of GDP, funded through sustainable finance, can support inclusive and environmentally responsible growth in the region.

2.4 Empirical Review

This study by Ceviz, A. Y. (2025)examined the dynamic relationship between green financial development and sustainable economic growth in Pakistan using annual data from 2000–2022 and the Autoregressive Distributed Lag (ARDL) bounds testing approach. It included variables such as green credit, green insurance, green securities, green investment, and FDI, with urban population and technology as controls. Results showed that green credit and green securities significantly promoted sustainable growth**,** while green investment and technology had adverse effects, though green insurance had short-term positive impacts. Granger causality tests indicated a unidirectional causal link from green credit to sustainable growth. The study recommended that policymakers optimize green financial instruments and strengthen institutional frameworks to enhance sustainable development outcomes.

This multi-country study by Jalal, W., & Ullah, M. (2025) , covering India, the United Arab Emirates, and Oman used Structural Equation Modeling (SEM) based on questionnaires from financial industry participants to assess the impact of sustainable finance on FDI, economic development, financial stability, and economic stability. Variables included sustainable finance indicators and mediators like financial market stability and economic stability. The findings revealed a positive relationship between sustainable finance and economic development, with financial market stability significantly mediating the sustainable finance growth relationship. It also found that financial stability improved the influence of sustainable finance on FDI. The authors recommended strengthening financial and economic stability to maximize the benefits of sustainable finance for growth and investment.

Focusing on Indian states from 2010–2021 by Liang, Z., & Nasruddin, E. (2024) ,this study used panel regression and two-step Generalized Method of Moments (GMM) to test how green finance and financial technology influence sustainable economic growth. Independent variables were green finance indicators, fintech adoption, and economic efficiency components, while the dependent variable was a composite measure of sustainable economic growth. The results

indicated that green finance significantly contributed to high-quality economic growth by improving environmental quality and economic effectiveness, and fintech enhanced the positive effect of green finance on environmental outcomes. It recommended promoting fintech alongside green finance to strengthen the sustainability trajectory of economic growth.

In this study of 30 Chinese provinces from 2003 to 2022 as carried out by Sifa, M. A., & Rikantasari, S. (2026). , researchers employed dynamic panel GMM, fixed and random effects, and panel co-integration analysis to investigate how green finance influences economic growth in natural resource markets. Variables included public and private green finance investments, GDP growth, and control measures such as resource fiscal policies. The study found a statistically significant positive correlation between green finance and economic growth**,** with private investment particularly effective and long run impacts stronger than short run effects. It recommended integrating public–private participation and coordinated policies for green finance to harmonize environmental goals with economic performance.

This empirical research by Tang, X., Wang, Q., Noor, S., Nazir, R., Nasrullah, M. J., Hussain, P. H., & Larik, S. A. (2024) , examined the influence of green finance on sustainable economic growth in Indonesia**,** using panel data regression across 2010–2024**.** Independent variables included green loans, green bond issuance, and renewable energy investment, with sustainable economic growth measured by Green GDP and Sustainable Development Index. The preliminary results suggested that increases in green finance positively and significantly impacted sustainable economic growth, both directly and indirectly through improvements in energy productivity and carbon efficiency. The study recommended that Turkish policymakers and financial institutions strengthen green finance mechanisms to drive low carbon development.

2.5 The Knowledge gap

Despite the growing literature on energy efficiency, carbon emissions, and sustainable development, limited empirical studies have specifically examined GDP per unit of energy used (energy productivity) within the context of the West African Monetary Zone (WAMZ)**.** Most existing studies on Sub-Saharan Africa focus either on carbon emissions, renewable energy consumption, or economic growth independently, rather than analyzing how environmental

resource variables and carbon intensity jointly influence energy productivity. Another important gap lies in the structural interpretation of energy productivity in resource-dependent economies. In many advanced economies, improvements in GDP per unit of energy are associated with technological innovation and decarbonization. However, the results suggest that in WAMZ countries, increases in energy productivity may still be linked to carbon-intensive production structures. This raises an unresolved question in the literature: Can energy efficiency improvements in developing, fossil-fuel-dependent economies occur without increasing carbon intensity? Empirical evidence addressing this issue for WAMZ countries is scarce.

3.0 METHODOLOGY

3.1 Research Design

The study adopted "ex-post facto" research design. According to Onwumere (2005), ex-post facto research design aims at determining, establishing or measuring the relationship between one variable or the impact of one variable on another, in which the variables involved are not manipulated by the researcher. Therefore, the adoption is based on the fact that the research is aimed at establishing the effect of sustainable finance on economic growth in West African monetary zone (2000 – 2024), which relied on historic data as the event under investigation had already taken place and the data cannot be manipulated or influenced by the researcher.

3.2 Nature and Sources of Data

The nature of this data includes renewable internal freshwater resources per capita ,carbon intensity of GDP per unit of energy and economic growth. A secondary source of data was obtained from the world development indicators and scholarly publications. Secondary data was utilized because the nature of such research requires existing data, not raw or primary data that has not been utilized. The choice of secondary data was made as it is faster, reduces time wastages in data gathering, it is non-reactive, often available for re-analysis

3.3 Population of the Study and Sample size

The population of the study is made up of the six countries in West African Monetary Zone (WAMZ) ,namely Gambia ,Ghana , Guinea, Liberia, Nigeria and Sierra Leone. Nigeria and Ghana were purposively selected from countries in West African Monetary zone base on two countries with highest population growth rate among others. This implied 33% of the member countries were represented in the study.

3.4 Specification of Model

The study specify the empirical works by Tang, X., Wang, Q., Noor, S., Nazir, R., Nasrullah, M. J., Hussain, P. H., & Larik, S. A. (2024) that examined the influence of green finance on sustainable economic growth in Indonesia**,** using panel data regression across 2010–2024**.** Independent variables included green loans, green bond issuance, and renewable energy investment, with sustainable economic growth measured by Green GDP and Sustainable Development Index. We substituted the model by replacing the renewable energy investment with renewable fresh water per caipta, economic growth and add carbon intensity of GDP per unit of energy in WAMZ using GMM.

The GMM model for the study is expressed as :

$GDPit=\alpha+\beta1RIFWPERit+\beta2CGDPE+\beta2INFL+\mu i+\epsilon it$

GDPit = Economic growth (dependent variable) for country i at time t

RIFWPER it = Renewable internal freshwater resources per capita

CGDPE it = Carbon intensity of GDP

INFLit = Vector of control variables (inflation,)

μi = Unobserved country-specific effects (fixed effects)

ϵit = Error term

3.5 Techniques of Data Analysis

We carried out some necessary preliminary tests to ensure that data validity and reliability is maintained .The unit root test, and test of hypotheses using GMM model and post estimation test using Ramsey reset test to ensure that parameters were neither over estimated or under parametized .

4.0 DATA PRESENTATION AND ANALYSIS

The study carried out panel unit root test to ensure that all the parameters for estimation are stable over the period of the study as displayed in table 4.1

4.1.1 Preliminary Test

Table 4.1 Panel Unit Root Test Summary

Levin,Lin & Chu t*	Statistic	Prob	Cross Sect.	Obs	Order of Diff
gdppueu	-2.03684	0.0208	2	40	1(1)
Lnrifwper	0.94482	0.8276	2	40	1(1)
C_i_ of gdp	-3.43710	0.0003	2	46	1(0)

Source: Researchers computation

Table 4.1 presents the results of the Levin, Lin and Chu (LLC) panel unit root test conducted to examine the stationary properties of the variables included in the model. The LLC test is a common panel unit root test that assumes a common unit root process across cross-sections. The null hypothesis of the test states that each individual series contains a unit root (that is, the variable is non-stationary), while the alternative hypothesis states that the series is stationary.The results show that for gdppueu**,** the Levin, Lin and Chu t-statistic is -2.03684 with a probability value of 0.0208. Since the probability value is less than the 5 percent level of significance, the null hypothesis of a unit root is rejected. This indicates that the variable becomes stationary after first differencing. Therefore, gdppueu is integrated of order one, I(1). Lnrifwper**,** the LLC t-statistic is 0.94482 with a probability value of 0.8276. The probability value is greater than 0.05, implying that the null hypothesis of a unit root cannot be rejected at conventional levels of significance. This suggests that the variable is non-stationary at level. However, based on the reported order of differencing, the variable becomes stationary after first differencing. Thus, Lnrifwper is also integrated of order one, I(1). In the case of C_i_ of gdp**,** the LLC t-statistic is -3.43710 with a probability value of 0.0003. The probability value is highly significant at the 1 percent level, leading to the rejection of the null hypothesis of a unit root. This indicates that the variable is stationary at level without requiring differencing. Therefore, C_i_ of gdp is integrated of order zero, I(0).

4.1.2 Test of Hypotheses

Table 4.2 Panel Generalized Method of Moment

Variables	coefficients	t-statistic	Prob.	R^2	DW	Prob(J-stat)	Coint Q01
gdppueu							ECM
rifwper	-0.009610	-4.277259	0.0001	0.36	2.45	0.000068	-0.522299
C_i_ of gdp	86.98520	10.27694	0.0000				0.0000

Table 4.2 presents the results of the Panel Generalized Method of Moments (GMM) estimation. The GMM technique is employed to address potential econometric issues such as endogeneity, omitted variable bias, and serial correlation. It is particularly suitable for panel data analysis where lagged dependent variables and endogenous regressors may be present. The table reports the estimated coefficients, t-statistics, probability values, coefficient of determination (R^2), Durbin–Watson statistic (DW), the probability of the J-statistic for instrument validity, and the error correction term (ECM), which captures the speed of adjustment toward long-run equilibrium.

The results show that rifwper has a coefficient of -0.009610 with a t-statistic of -4.277259 and a probability value of 0.0001. The negative sign of the coefficient indicates an inverse relationship between rifwper and gdppueu. Specifically, a one-unit increase in rifwper leads to a decrease of approximately 0.0096 units in gdppueu, holding other factors constant. The probability value is less than 1 percent, indicating that the relationship is statistically significant at conventional levels. This suggests that rifwper exerts a significant negative effect on economic performance as proxied by gdppueu. For C_i_ of gdp**,** the coefficient is 86.98520 with a t-statistic of 10.27694 and a probability value of 0.0000. The positive coefficient indicates a direct relationship between capital investment (as measured by C_i_ of gdp) and gdppueu. The result implies that an increase in capital investment significantly enhances economic performance. The very high t-statistic and the probability value of 0.0000 indicate strong statistical significance at the 1 percent level.

The R^2 value of 0.36 indicates that approximately 36 percent of the variation in gdppueu is explained by the explanatory variables included in the model. While not extremely high, this level of explanatory power is reasonable in macroeconomic panel estimations. The Durbin–Watson statistic of 2.45 suggests the absence of serious autocorrelation in the residuals, as the value is close to 2. This implies that serial correlation does not pose a major problem in the

estimated model. The probability of the J-statistic is 0.000068. The J-statistic tests the validity of the instruments used in the GMM estimation. Since the probability value is very small, it suggests that the instruments may not be perfectly valid at conventional significance levels, implying potential concerns regarding over-identifying restrictions. This may require further robustness checks.

Finally, the error correction term (ECM) coefficient is -0.522299 and is statistically significant with a probability value of 0.0000. The negative and significant ECM confirms the existence of a long-run equilibrium relationship among the variables, indicating co-integration. The magnitude of -0.522299 implies that approximately 52.2 percent of short-run disequilibrium is corrected within one period. This suggests a relatively moderate speed of adjustment toward long-run equilibrium following a shock. The Panel GMM results indicate that rifwper has a significant negative impact on economic performance, while Carbon intensity of GDP (C_i_ of gdp) has a significant positive effect. The presence of a negative and statistically significant error correction term further confirms the existence of a stable long-run relationship among the variables.

4.3 Discussion of Results

Objective One : The finding that rifwper has a significant negative impact on economic performance can be aligned with several established economic theories. First, from a neoclassical growth perspective, particularly the Solow–Swan model, long-run economic growth is driven by capital accumulation, labor, and technological progress. Any factor such as rifwper that reduces productive efficiency, distorts resource allocation, or discourages investment would negatively affect output growth. A negative coefficient therefore supports the theoretical argument that inefficiencies or structural distortions hinder capital deepening and productivity improvements.

Additionally, institutional economics, particularly the framework developed by Douglass North, argues that weak institutions, policy instability, or structural rigidities increase transaction costs and discourage productive investment. A statistically significant negative relationship between rifwper and economic performance suggests that institutional or policy-related inefficiencies may be undermining economic outcomes, consistent with this theory.

Objective Two : The finding that carbon intensity of GDP (C_i_ of gdp) has a significant positive effect on economic performance can be aligned with several strands of economic theory, particularly within the context of developing and industrializing economies. Similarly, structural transformation theory suggests that as economies shift from agrarian systems to manufacturing-based production, energy consumption rises substantially. During this phase, carbon-intensive activities often dominate because cleaner technologies may not yet be widely adopted. The positive coefficient therefore aligns with the idea that economic expansion, particularly in industrial sectors, tends to raise carbon intensity in the short to medium term.

Endogenous growth theory further implies that if technological progress is energy-dependent and largely fossil-fuel driven, increases in energy use (and thus carbon intensity) can temporarily stimulate output. Until cleaner innovation becomes dominant, economic expansion may be positively correlated with carbon-emitting production activities.

5.0 FINDINGS , CONCLUSION AND RECOMMENDATION

5.1 Findings

The of the study are as follows :

(i) Renewable internal freshwater resources per capita (RIFWPER) had no positive effect on economic growth in the West African Monetary Zone (WAMZ).

(ii) Carbon intensity of GDP per unit of energy had a positive effect on economic growth in the West African Monetary Zone (WAMZ).

5.2 Conclusion

The study finds evidence of a long-run relationship among the variables, as confirmed by the significant and negative error correction term in the Panel GMM results. While Renewable internal freshwater resources per capita (rifwper) exerts a significant negative effect on economic performance, carbon intensity of GDP has a significant positive impact, suggesting that current growth dynamics remain energy- and carbon-dependent. The findings imply that improving structural efficiency and transitioning toward cleaner, sustainable growth strategies are essential for achieving stable and long-term economic performance

5.3 Recommendation

(i) Since renewable internal freshwater resources per capita had no positive effect on economic growth in the West African Monetary Zone (WAMZ), policymakers should focus on improving the management, accessibility, and productive utilization of water resources rather than relying on their mere availability.

(ii) Given that carbon intensity of GDP per unit of energy had a positive effect on economic growth in WAMZ, it suggests that economic expansion in the region is currently energy- and carbon-driven. While this may support short-term growth, policymakers should gradually transition toward cleaner and more energy-efficient technologies to ensure long-term sustainability

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