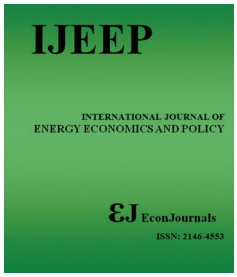

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Does Globalization Cause Environmental Degradation in Developing Economies? Evidence from Cote d'Ivoire Using Ecological Footprint

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ABSTRACT

This research examines the effects of globalization on environmental degradation in Cote d'Ivoire using data from 1970 to 2018. Previous studies in this area mostly focused on carbon emissions as indicator for environmental degradation. However, this study uses ecological footprint to cover different aspects of environmental degradation. Using the autoregressive distributed lag approach, the results disclose that globalization worsens the environmental quality by increasing ecological footprint. Furthermore, the results demonstrate a positive and monotonic relationship between economic growth and ecological footprint. The decomposition of globalization into different dimensions reveals that economic, social and political globalization contribute to environmental degradation. On the basis of the findings, some recommendations are suggested to tackle environmental degradation.

Keywords: Globalization, Environmental Degradation, Ecological Footprint, Cote D'ivoire
JEL Classifications: C32, F64, O13, Q56

1. INTRODUCTION

Globalization is hailed for removing barriers on goods and capital as well as for achieving economic prosperity. It helps a country participate in international exchange and connect with the world economy. It is widely believed that globalization plays an essential role in the development of nations. On the other hand, globalization is criticized to have detrimental effects on the environment. Globalization exerts both positive and negative externalities on the environment. For instance, globalization through trade and foreign direct investment can promote the development of pollution-intensive industries within developing countries where environmental standards are loose. Atmospheric pollution, destruction of ecosystems, exhaustion of natural resources and biodiversity, deforestation, and desertification are among some problems associated with globalization. Following this view, globalization is a source of environmental degradation causing global warming and climate change. Conversely, globalization can work in favor of environmental sustainability as well. It can provide cleaner production technology transfers to developing countries and enables them to achieve sustainable economic growth (Erdogan et al., 2021).

The evidence on the impact of globalization on the environmental is conflicting. A number of studies established that globalization has an improving effect on the environment (Shahbaz et al., 2016; Shahbaz et al., 2017; Zafar et al., 2019; Zaidi et al., 2019; Adjei et al., 2022; Aladejare, 2022; Farooq et al., 2022). On the other hand, other studies reported globalization escalating environmental degradation (Shahbaz et al., 2015; Twerefou et al., 2017; Sabir and Gorus, 2019; Langnel and Amegavi, 2020; Bataka, 2021). Others failed to discover a significant relationship between globalization and environmental degradation (Haseeb et al., 2018; Salahuddin et al., 2019a). So, there is no conclusive evidence about the impact of globalization on the environment. Consequently, the discourse on the nexus between globalization and environmental degradation

is still subject to further verification. The reason for mixed evidence is attributable to different proxies for globalization and environmental quality, as well as econometric technique utilized. While researchers have been drawn to the relationship between globalization and environmental degradation in many regions, no study has examined the case of Cote d'Ivoire. As a result, this study addresses this vacuum and adds the experience of Cote d'Ivoire to the existing ecological economics literature. It aims to examine whether globalization contributes to improve or worsen the environmental quality in Cote d'Ivoire. Unlike previous studies that have predominantly relied on carbon dioxide emissions, we use ecological footprint to proxy environmental degradation.

According to Dogan et al. (2020), ecological footprint is the adequate indicator to track environmental degradation. Furthermore, instead of trade and foreign direct investment which are traditionally used as measures of globalization, we employ the KOF globalization index which covers the economic, social and political aspects of globalization. These dimensions allow us to comprehensively examine the broader influence of globalization on the environmental degradation. Thus, we can look at the specific effect associated with different components of globalization. Like many sub-Saharan African countries, Cote d'Ivoire has tried to increase its connection with the rest of the world in quest of expediting economic growth and reducing poverty rate. Consequently, the country has recorded impressive economic growth rate but it has resulted in increased environmental degradation. For instance, between 1990 and 2019 Cote d'Ivoire's per capita carbon dioxide emissions grew by 85.3%. Ecological footprint also rose by 132.5% over the period 1990-2018. At the same time, globalization index increased from 38.87 points in 1990 to 53.4 points in 2018, representing a grow rate of 37.4%. The rising trend in globalization index along with the persistently surging trends in the environmental degradation indicators suggests that Cote d'Ivoire's globalization policy is not environmentally friendly. Globalization seems to be deteriorating the environment, which will have various consequences on the economy and human welfare. Environmental degradation is mainly the result of agricultural and economic activities which cause significant depletion of natural resources. It has been demonstrated that African countries will suffer the most from global warming as they are heavily reliant on climate-vulnerable sectors such as forestry, agriculture, water, non-renewable energy, fisheries, and tourism (Kifle, 2008).

Recent simulations also recognize the severe effects of climate change on African countries, and estimated that they lose between 5% and 15% of gross domestic product per capita as a consequence of climate change (African Development Bank, 2019). Côte d'Ivoire suffers from the detrimental effects of global warming through loss of biodiversity, forest fires, advancing dry zone and sea on the continent, coastal erosion, and floods. The forest which contributes to carbon sequestration is unfortunately disappearing at an annual rate of between 3 and 4%. From 16 million hectares of forest at the beginning of the 20th century, the forest cover dropped to about 7.8 million hectares in 1990 and reached 3.4 million hectares in 2015. The loss of forest is due to uncontrolled exploitation of forests for timber and wood energy, extensive agriculture, and accelerated urbanization. It is clear that the continuation of this trend will have serious consequences in the long-term at ecological, economic, social and political levels.

To show its willingness to combat climate change, Cote d'Ivoire has adhered to the commitments of intergovernmental conferences on the climate such as the 2030 Agenda for Sustainable Development adopted in September 2015, the Paris climate change conference of the parties to the United Nations framework Convention on Climate Change (COP15) in December 2015, the Bonn climate change conference (COP23) in November 2017, and recently the Sharm El-Sheikh climate change conference (COP27) in November 2022. To address the alarming destruction of its forest cover, Côte d'Ivoire has committed to restoring at least 20% of the national territory by 2030. To achieve this goal, the country has adopted various instruments such as the international Reduction mechanism Emissions of greenhouse gases from Deforestation and Degradation of forests, in short REDD+, the National Policy on Forest Preservation, Rehabilitation and Expansion (PPREF), and the new Forest Code of 2019.

In order for Cote d'Ivoire to achieve sustainable growth, it is necessary to identify factors that worsen environmental degradation and design policies which may help improve the situation. To this end, this study empirically examines the environmental impacts of economic growth and globalization in Cote d'Ivoire by taking annual data from 1970 to 2018. The study addresses the following research questions: Does economic growth cause environmental degradation? Is globalization deteriorating the environmental quality in Cote d'Ivoire? Which dimension of globalization affects the environmental quality in Cote d'Ivoire? To the best of our knowledge, this study is the first to investigate the link between economic growth, globalization and environmental degradation in Cote d'Ivoire. From the econometric perspective, the study relies on the ARDL bounds testing approach to cointegration designed by Pesaran et al. (2001) to depict the relationship between globalization and ecological footprint, controlling for economic growth.

The remainder of the paper proceeds as follows. Section 2 reviews the literature on the globalization and environment nexus. Section 3 provides detailed information on data and the econometric methodology employed for the empirical examination of the relationship between globalization and environmental degradation. Section 4 presents and discusses the empirical findings of the study. Finally, section 5 concludes the study and provides some recommendations.

2. LITERATURE REVIEW

The environmental externalities of globalization is a highly debated topic in environmental literature. The theoretical relationship between globalization and the environment is traditionally analyzed within two opposite views. The first view advocates that foreign trade and investment that increase with globalization provide platforms for shifting polluted industries from developed to developing countries with weak environmental standards (Copeland and Taylor, 2004). Conversely, the second

view claims that globalization provides an avenue for developing countries to reap the new technology from the developed countries, which will enable them to improve environmental quality (Birdsall and Wheeler, 1993). Now, the literature recognizes three channels through which globalization can impact on environmental quality, *i.e*. scale, composition, and technique effect (Grossman and Krueger, 1991). The scale effect occurs when aggregate output increases due to globalization. This expansion stimulates energy use and ecological resource utilization and hence escalates environmental degradation. The composition effect is associated with change in economic structure. The technique effect denotes various mechanisms by which globalization allows adoption of new technology that help improving the environmental quality (Grossman and Krueger 1995; Antweiler et al., 2001; Liddle, 2001; Rauf et al., 2018; Solarin and Ozturk, 2015; Zhang et al., 2023).

Several existing studies have examined the environmental impacts of globalization using both country-specific and cross-country analyses. The empirical literature in this regard documents mixed results. A large number of studies find that globalization improves the environmental quality. In contrast, many others report that globalization accelerates environmental degradation. For instance, Shahbaz et al. (2015) examine the effect of globalization on CO_2 emission levels in India over the period 1970-2012, using the ARDL approach. The results show that globalization, energy consumption, financial development and economic growth aggravate the environmental degradation by increasing carbon emissions. Shahbaz et al. (2016) examine the role globalization plays in carbon emissions for 19 African countries over the period of 1971–2012. Results from the ARDL approach unveil that globalization mitigates carbon emissions at the panel level, and in eight countries (i.e., Angola, Cameroon, Congo Republic, Egypt, Kenya, Libya, Tunisia and Zambia) but increases carbon emissions in five countries (i.e., Ghana, Morocco, South Africa, Sudan and Tanzania). Rudolph and Figge (2017) gauge the role of globalization in shaping the ecological footprints of 146 countries over the 1981–2009 period. The results of their study disclose that economic globalization influences the ecological footprints of consumption, production, imports and exports. Social globalization is negatively associated with the ecological footprints of consumption and production, while increasing the ecological footprints of imports and exports. Political globalization has no significant effect on ecological footprint. The overall globalization is found to increase the ecological footprints of imports and exports. Shahbaz et al. (2017) find evidence of globalization reducing CO_2 emissions in China.

Twerefou et al. (2017) find globalization worsening environmental degradation in 36 Sub-Saharan African countries over the period 1990-2013. Haseeb et al. (2018) make use of the dynamic seemingly unrelated regression technique and conclude that globalization has no effect on carbon dioxide emissions for BRICS economies. Lv and Xu (2018) investigate the impact of economic globalization on CO_2 emissions in 15 emerging countries over the period 1970–2012. The results reveal that economic globalization improve environmental quality, whereas income and energy intensity worsen it through increase in carbon dioxide emissions. Shahbaz et al. (2018a) examine the evidence from Japan over the period 1970-2014 using asymmetric threshold ARDL model. The results show that positive and negative shocks in globalization escalate carbon emissions. Shahbaz et al. (2018b) study the effect of globalization on CO_2 emissions for 25 developed economies in Asia, North America, Western Europe and Oceania during the period of 1970–2014. They employ Common Correlated Effect Mean Group (CCEMG) and Augmented Mean Group (AMG) estimators. The results show that globalization increases carbon emissions. Ahmed et al. (2019) study the impact of globalization on the ecological footprint of Malaysia over the period 1971-2014 by using the ARDL approach. The findings conclude that globalization does not impact the ecological footprint, but it significantly increases the ecological carbon footprint.

In the case of Pakistan, Khan and Ullah (2019) and Khan et al. (2019) conclude that economic, social and political globalization contribute to aggravate carbon dioxide emissions. Phong (2019) focus on selected ASEAN-5 countries (i.e., Myanmar, Malaysia, Philippines, Singapore and Thailand) over the 1971-2014 period using the fixed and random effects regression models. The results divulge that globalization triggers CO_2 emissions, and the significant impact comes from economic globalization. However, social and political globalization insignificantly affect CO_2 emissions. Sabir and Gorus (2019) investigate the effect of economic globalization on the ecological footprint of the South Asian countries over the period 1975–2017. Using panel autoregressive distributional lag model, they conclude that FDI, trade openness, and globalization index cause the environmental degradation by increasing ecological footprint. Salahuddin et al. (2019a) report that globalization has no significant effect on carbon emission levels for a panel of 44 SSA countries over the period 1984-2016. Salahuddin et al. (2019b) apply the ARDL model to the case of South Africa over the period 1980-2017. They find globalization increasing carbon emissions in the long-run.

Shahbaz et al. (2019) probe the nexus between globalization and CO_2 emissions for 87 countries. The results reveal an inverted U-shaped nexus for 18% of the countries, implying that globalization will mitigates carbon emissions for these countries in the future. On the other hand, a U-shaped link was found for 8% of the countries. The remaining countries do not have a U- or an inverted U-shaped relationship between globalization and CO_2 emissions. Zafar et al. (2019) study effects of globalization on carbon emissions in OECD countries over the period 1990-2014. Using the Continuously Updated Fully Modified Ordinary Least Square (CUP-FM) and Continuously Updated Bias-Corrected (CUP-BC) estimators, the outcomes of the study divulge the improving role of globalization on environmental quality by mitigating carbon emissions. The results also support the EKC hypothesis. Zaidi et al. (2019) study the case of Asia Pacific Economic Cooperation (APEC) countries from 1990 to 2016 by employing CUP-BC and CUP-FM methods. They find that globalization significantly improves air quality. Bilgili et al. (2020) investigate the impact of globalization on the ecological footprint of Turkey during the period 1970-2014 by using Markov regime switching models. Results suggest that financial globalization, politic globalization, trade globalization, and interpersonal globalization reduce ecological footprint. However, economic

and social globalization work against environmental sustainability by increasing ecological footprint. Destek (2020) evaluates the impact of globalization on environmental pollution in Central and Eastern European Countries (CEECs) from 1995 to 2015. Using the second-generation panel data techniques to deal with possible cross-sectional dependence, the findings show that overall globalization, economic globalization, and social globalization increase carbon dioxide emissions while political globalization reduces them.

Langnel and Amegavi (2020) examine the impact of globalization and electricity consumption on the ecological footprint for Ghana from 1971 to 2016. Applying the ARDL approach, the results divulge that globalization and electricity consumption significantly increase the ecological footprint. Considering the different components of globalization, the results probe that economic and social globalization trigger the ecological footprint while political globalization improves the environmental sustainability by reducing ecological footprint. Liu et al. (2020) analyze the impact of globalization on CO_2 emissions for the G7 countries between 1970 and 2015. Using panel fixed effects model, they find an inverted U-sharped nexus, suggesting that globalization initially causes environmental degradation by increasing carbon emissions, and later on, further globalization mitigate pollution. Mehmood and Tariq (2020) gauge the impact of globalization on carbon dioxide emissions n South Asian countries over the period of 1972–2013. The results document a U-shape nexus in Nepal, Afghanistan, Bangladesh, and Sri Lanka, and an inverted U-shape nexus in Pakistan and Bhutan. Wang et al. (2020) focus on G7 countries for the period of 1996–2017 using CS-ARDL approach. Their findings disclose that economic globalization increase carbon emissions.

More recently, Adebayo and Kirikkaleli (2021) apply wavelet to model CO_2 emissions in Japan for the period from 1990 to 2015. The results reveal that globalization, economic growth, and technological innovation contribute to increase CO_2 emissions while renewable energy consumption mitigates them. Ahmad et al. (2021) analyze the environmental effects of financial globalization, urbanization, and economic growth of the G7 countries for the period 1980 to 2016. Controlling for cross-sectional dependence, the findings of the study unfold that financial globalization reduces the ecological footprints, while urbanization worsens environmental degradation by triggering the ecological footprints. Besides, the nexus between economic growth and ecological footprints follows the EKC. Bataka (2021) depict the effect of globalization on environmental pollution in a panel of 38 Sub-Saharan African countries for the period from 1980 to 2017. The study reveals that globalization worsens environmental pollution in SSA by increasing carbon dioxide emissions. In a study of 23 SSA countries from 1960 to 2016, Erdogan et al. (2021) adopt the CUP-FM and CUP-BC approaches and conclude that globalization and human capital improve environmental quality by reducing ecological footprint. Khan et al. (2021) investigate the nexus among globalization, economic growth, energy consumption and carbon dioxide emissions in South Asian countries during the period 1972-2017. The results from Fully Modified Ordinary Least Square (FMOLS) approach reveal that globalization, economic growth, energy consumption are to blame for environmental damage. Leal and Marques (2021) scrutinize the effect of globalization on the environment for 23 African countries from 1999 to 2017. Relying on the ARDL model, they report that economic globalization *de facto* increases environmental degradation, suggesting the relocation of polluting industries to African countries. Furthermore, economic and political globalization *de jure* are found to improve environmental quality.

Majeed et al. (2021) examine the drivers of the environmental quality of the Gulf Cooperation Council (GCC) economies from 1990 to 2018. They apply the cross-sectional autoregressive distributed lags (CS-ARDL) estimator that accounts for cross-sectional dependence and heterogeneity. The findings disclose that economic globalization and renewable energy consumption mitigate carbon emissions. Mehmood (2021) examine the effect of globalization on CO_2 emissions in Singapore during 1970–2014. The results from the ARDL analysis show that social globalization and economic globalization curb carbon dioxide emissions in the long-run, while political globalization worsens air pollution. Nathaniel et al. (2021) focus on the link between natural resources, globalization, urbanization, and environmental degradation in Latin American and Caribbean countries from 1990 to 2017. They utilize the AMG and CCEMG estimators to account for cross-sectional dependence and heterogeneity. The results reveal that globalization and urbanization increase CO_2 emissions. Nurgazina et al. (2021) investigate carbon emissions in Malaysia over the period 1978-2018. The results of ARDL modelling reveal that globalization, energy consumption, trade openness, and urbanization deteriorate the environmental quality by increasing carbon dioxide emissions. Yameogo (2021) analyzes the effect of globalization and urbanization on deforestation in Burkina Faso over the period 1980-2017. The study employs the ARDL approach and discloses that globalization and urbanization have positive and significant effect on deforestation, thus indicating a deterioration in environmental quality. Yameogo et al. (2021) apply the GMM estimator to ascertain the environmental effects of economic globalization in Sub-Saharan Africa for the period 2002-2017. The results suggest that economic globalization and economic growth negatively affect environmental quality. Yang et al. (2021) scrutinize the impact of globalization on the ecological footprint of the Gulf Cooperation Council (GCC) countries. They find evidence of globalization and energy consumption deteriorating environmental quality in the GCC countries. Yuping et al. (2021) investigate the effects of renewable energy consumption, non-renewable energy consumption, globalization, and economic growth on the CO_2 emissions in Argentina from 1970 to 2018. The application of the ARDL approach concludes that renewable energy consumption and globalization mitigate CO_2 emissions while non-renewable energy consumption triggers them, both in the short and long-run. Besides, the EKC hypothesis was confirmed.

Acheampong (2022) adopt nonlinear ARDL modeling to depict the effect of globalization on carbon emissions in Ghana. The results from symmetric ARDL model disclose that economic, social and political globalization increase carbon emissions. The

asymmetric results show that positive and negative changes in political globalization worsen air quality in the long-run, while positive and negative changes in social globalization improve it. Moreover, both positive and negative changes to economic globalization are neutral to CO_2 emissions. Adjei et al. (2022) gauge the impact of globalization on carbon dioxide emissions for the ten largest economies in Africa, over the period 1990-2018. Applying FMOLS, DOLS, and Fixed Effect models, they find that economic growth increases CO_2 emissions, whereas financial development, globalization, population, and renewable energy consumption reduce them. Aladejare (2022) analyze the effect of globalization on the environmental degradation in the 5 richest African economies (*i.e*., Algeria, Egypt, Morocco, Nigeria, and South Africa) from 1990 to 2019. The study uses three measures of environmental degradation, namely CO_2 emissions, CH4 emissions and ecological footprint. Results from the feasible generalized least squares and AMG estimators suggest that globalization mitigates environmental degradation. Besides, urbanization also enhances the environmental quality whereas economic growth has no substantial effect on environmental degradation. Alvarado et al. (2022) examine the impact of globalization on the ecological footprint of 95 countries during the period 1990–2018. The study employs the AMG, CCEMG, and DCCE methods to deal with cross-sectional dependence and heterogeneity. The results demonstrate that globalization has limited causal relationship with ecological footprint.

Farooq et al. (2022) study the link between globalization and the environment for a global panel of 180 countries over the period 1980–2016. The empirical results disclose overall globalization improving environmental quality. Results from quantile regression show the favorable effect of globalization mainly for countries with existing low levels of carbon emissions. The decomposition of globalization into different components reveals that economic globalization is detrimental to environmental sustainability whereas political globalization improves environmental quality. Gaies et al. (2022) probe the impact of economic globalization on carbon dioxide emissions for 17 MENA countries over the period 1980–2018. The results from the ARDL approach reveal that economic globalization escalates CO_2 emissions, the effect being much stronger for trade globalization than for financial globalization. Jahanger et al. (2022) check the determinants of the ecological footprint figures in 73 developing countries over the period from 1990 to 2016. They employ second-generation panel regression methods to account for heterogeneity across countries. The findings of the study spotlight that globalization decreases the ecological footprint of African and Latin American countries. Primbetova et al. (2022) examine the effect of globalization on the carbon emission figures of Kazakhstan adopting the ARDL approach. According to the outcomes, economic, political, and social globalization are responsible for environmental degradation by increasing carbon emissions in the country. In addition, income and energy consumption aggravate environmental degradation. Talpur et al. (2022) gauge the impact of globalization on CO_2 emissions in five South Asian developing economies for the period 1990 to 2014. Using FMOLS and DOLS, they conclude that globalization and economic growth aggravate pollution whereas renewable energy consumption mitigates it. Aladejare (2023) studies the experience of 29 African countries from 1970 to 2019. The study confirms that globalization improves environmental quality while income growth and urbanization are found to be environmentally degrading.

It is clear from this review of the relevant literature that most existing studies focused on carbon dioxide emissions as proxy of environmental quality. Besides, none of the preceding studies have analyzed the impact of globalization on the environment in the context of Cote d'Ivoire. Therefore, this current study attempts to bridge these gaps in the literature by scrutinizing the impact of globalization on the ecological footprint of Cote d'Ivoire between 1970 and 2018. The following section outlines the methodology of the study.

3. MODELS, METHODOLOGY AND DATA

3.1. Models

The objective of this research is to provide evidence in regard to the roles of renewable energy consumption, financial sector development and globalization in degrading environment in Cote d'Ivoire. Based on the literature review discussed above, the empirical model to be estimated is specified as follows:

Model 1: $$EQ_t = \beta_0 + \beta_1 GDP_t + \beta_2 GLO_t + \mu_t \quad (1)$$

where EQ symbolizes ecological footprint as a proxy for environmental quality, GLO stands for globalization, GDP stands for real GDP per capita, and μ_t is an error term.

As regards the expected signs, economic growth is hypothesized to trigger the consumption of energy, foods, water and other natural resources, which in turn harms the environment. Therefore, the sign of the parameter β_1 is expected to be positive. As discusses above, the sign of globalization is ambiguous. Globalization may induce expansion in economic output due to foreign trade and investments, and hence, worsens environmental degradation. On the other hand, globalization may bring new technology or production methods that will mitigate the environmental degradation. In the case of Cote d'Ivoire, an open developing country, we hypothesize the coefficient on globalization to be positive.

We consider the three dimensions of globalization and then estimate the associated model:

Model 2:

$$EQ_t = \varphi_0 + \varphi_1 GDP_t + \varphi_2 GLOE_t + \varphi_2 GLOS_t + \varphi_2 GLOP_t + e_t \quad (2)$$

where GLOE, GLOS, and GLOP signify economic, social, and political globalization index, respectively. Here again we hypothesize all the coefficients to be positive.

3.2. Econometric Methodology

Time-series econometric techniques were employed to scrutinize the relationship between finance and investment. Firstly, it is essential to determine the order of integration of the variables by mean of the PP unit root test of Phillips and Perron (1988) and the KPSS test of Kwiatkowski et al. (1992) are applied. In a second

step, we test whether there exists a cointegrating relationship among the variables. Cointegration means that despite being individually non-stationary a linear combination of the variables is stationary.

To ascertain the presence of a long-term relationship among the variables, the research employs the autoregressive distributed lag (ARDL) bounds test proposed by Pesaran et al. (2001). This approach was found to be advantageous over other cointegration testing methods. The ARDL approach could be used on data set which is a mixture of I(0) and I(1) variables provided there are no I(2) variables. Moreover, it allows the variables in the model to have different lags. Technically, the ARDL approach consists of estimating the following Unrestricted Error Correction Model (ECM):

$$\Delta EQ_t = \varphi_0 + \varphi_1 EQ_{t-1} + \varphi_2 GDP_{t-1} + \varphi_3 GLO_{t-1} + \sum_{i=1}^{m} \gamma_{1i} \Delta EQ_{t-i} + \sum_{i=0}^{n} \gamma_{2i} \Delta GDP_{t-i} + \sum_{i=0}^{p} \gamma_{3i} \Delta GLO_{t-i} + e_t \quad (3)$$

where Δ is the difference operator defined as $\Delta Z_t = Z_t - Z_{t-1}$. The appropriate lag structure *(m, n, p)* was selected using the AIC criterion following the recommendations of Lutkepohl (1991) and Liew (2004). The first part of the equation with the coefficients ϕ_1, ϕ_2, and ϕ_3 represents the long-run relationship of the model whereas the parameters γ_{1i}, γ_{2i}, and γ_{3i} represent the short-run dynamics. The null hypothesis of no long-run relationship is H_0: $\phi_1=\phi_2=\phi_3=0$. This hypothesis is tested through an *F*-test. Under the null hypothesis, however, the distribution of the F-statistic is non-standard. Pesaran et al. (2001) have provided critical values that account for integrating properties of the variables. The lower bound value assumes that all explanatory variables are I(0), while the upper bound value assumes that they are I(1). According to Pesaran et al. (2001), if the computed F-statistic is greater than the upper bound value, then the null hypothesis of no long-run relationship is rejected. Conversely, if the computed F-statistic falls below the lower bound value, then the null hypothesis is not rejected. On the other hand, if the computed F-statistic lies between the lower and upper bound values, then the result is inconclusive. When all the variables follow I(1) processes, the decision is taken based on the upper bound value. When all the variables are I(0) processes, the decision is taken based on the lower bound value.

To ascertain the goodness of fit of the ARDL model, we conduct diagnostic and stability tests. The diagnostic tests examine the serial correlation, normality, and heteroskedasticity associated with the model. The structural stability of the model is scrutinized using the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMSQ). Once the null of no cointegration is rejected, the estimated long-run coefficients are obtained as the negative value of the coefficients for the lagged explanatory variables divided by the coefficient for the lagged dependent variable (EQ_{t-1}).

To complement the analysis of the relationship between ecological footprint, economic growth and globalization, we further examine the direction of causality between the variables using the Granger causality test. In the presence of a long-run relationship, Granger causality test requires the inclusion of a lagged error-correction term within a vector error-correction model (VECM). Accordingly, Granger causality analysis involves estimating the following model:

$$\Delta EQ_t = \alpha_0 + \sum_{i=1}^{m} \alpha_{1i} \Delta EQ_{t-i} + \sum_{i=1}^{m} \alpha_{2i} \Delta GDP_{t-i} + \sum_{i=1}^{m} \alpha_{3i} \Delta GLO_{t-i} + \lambda_1 ECT_{t-1} + u_{1t} \quad (4)$$

$$\Delta GDP_t = \theta_0 + \sum_{i=1}^{m} \theta_{1i} \Delta EQ_{t-i} + \sum_{i=1}^{m} \theta_{2i} \Delta GDP_{t-i} + \sum_{i=1}^{m} \theta_{3i} \Delta GLO_{t-i} + \lambda_2 ECT_{t-1} + u_{2t} \quad (5)$$

$$\Delta GLO_t = \phi_0 + \sum_{i=1}^{m} \phi_{1i} \Delta EQ_{t-i} + \sum_{i=1}^{m} \phi_{2i} \Delta GDP_{t-i} + \sum_{i=1}^{m} \phi_{3i} \Delta GLO_{t-i} + \lambda_3 ECT_{t-1} + u_{3t} \quad (6)$$

In both equations, ECT_{t-1} stands for the lagged residuals obtained from the long-run relationship. Coefficients on ECT_{t-1} capture the speed of adjustment of the variables in response to a deviation from their long-run relationship. The significance of ECT_{t-1} indicates the existence of long-run causality between the variables while the significance of the differenced explanatory variables suggests short-run causality.

3.3. Data Description

The study uses annual time series data covering the period from 1970 to 2018. The choice of this time period was based on the availability of data. The dependent variable is ecological footprint used as a proxy for environmental degradation following current studies (Dogan et al., 2020; Saud et al., 2020; Ahmed et al., 2021; Erdogan et al., 2021). Ecological footprint quantifies the natural resources humans consume through production and consumption of goods and services. These resources include cropland, forest products, carbon space, built-up land, fishing grounds, and grazing land (Aladejare, 2022). It is a broader proxy for environmental damage as compared with CO_2 emissions which previous studies overwhelmingly employed. Further justification for the ecological footprint indicator stems from agricultural and mining activities which induce loss of biodiversity, pollution of surface water, groundwater, and soil erosion. The explanatory variable of interest is KOF globalization index. We use the version developed by Gygli et al. (2019) which is the revised version of the original index introduced by Dreher (2006). The KOF globalization index varies on a scale from 0 to 100. The greater value of the index means higher level of globalization. Owing to the multidimensional nature of globalization, the KOF globalization index was decomposed into three dimensions, that are economic (GLOE), social (GLOS) and political (GLOP) globalization. Economic globalization reflects flows of goods, capital and services. Trade, foreign direct investment, portfolio investment, foreign income payments as well as trade restrictions are all part of economic

globalization (Gygli et al., 2019). Social globalization captures the spread of information and culture as well as people interactions. Political globalization entails membership in international organizations and treaties as well as the number of embassies. KOF globalization index appears appropriate for examining the environmental effects of globalization instead of trade openness and foreign direct investment because it encompasses all aspects of globalization (Shahbaz et al., 2018b). Besides, we use real GDP per capita as control variable to avoid the misspecification of the empirical model. The description, unit of measurement and sources of the variables are shown in Table 1. For the econometric analysis, ecological footprint and real GDP were converted into natural logarithm form. Therefore, variations in the logarithm of ecological footprint and real GDP reflect growth rates while variations in globalization index are expressed in points.

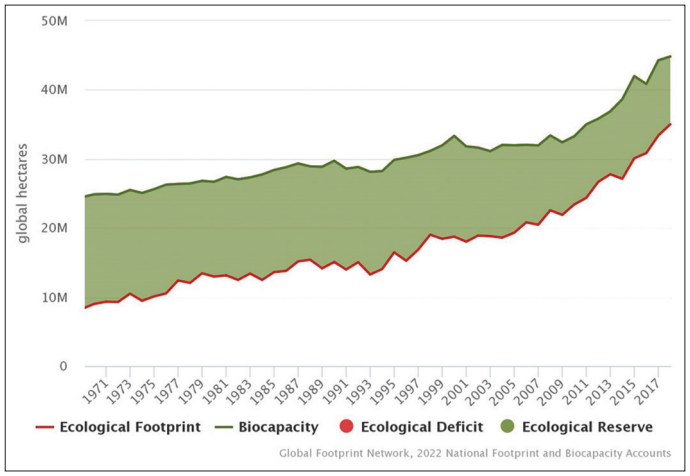
The ecological footprint and biocapacity of Cote d'Ivoire are plotted in Figure 1. As can be seen, Cote d'Ivoire is facing the challenges of growing ecological footprint. Even through the country is a net biocapacity exporter, its ecological reserve is reducing over time. Efforts should be made to widen the difference between biocapacity and ecological footprint in order to keep a sustainable lifestyle over the long term.

Figure 2 shows the trends of different components of ecological footprint. As depicted by this figure, the structure of ecological footprint has changed between 1970 and 2018. The contribution of fishing grounds has dropped from 39.3% in 1970 to 15.4% in 2018, whereas that of cropland has increased from 28.3% to 41.1%, becoming the major component of ecological footprint in Cote d'Ivoire. Carbon footprint and fishing grounds account for 18.3% and 9.7% of total ecological footprint, respectively. These figures provide rational of using ecological footprint as a broader indicator of environmental degradation instead of carbon emissions.

Figure 3 depicts the trends of the globalization index and its components. Globalization shows an upward trend over the sample period. Social and political globalization follow similar trend. Conversely, economic globalization has declined between 2012 and 2015. This decline is in relation with the economic conditions of the country during this period.

Table 2 presents the descriptive statistics and the correlation matrix between the variables. The descriptive statistics in panel A illustrate the mean, minimum, maximum and standard deviation of the data. It can be seen that ecological footprint rate averages 0.257 over the period 1970-2018, and varies from −0.002 to 0.583. Likewise, real income per capita has a mean value of 2.664 along with its minimum value and maximum value of 2.180 and 3.597, respectively. During the study period, the KOF globalization index has a mean value of 3.845, and runs between 3.660 and 3.977. The economic globalization index mean is 49.08, and its minimum and maximum values are 23.080 and 61.07, respectively. The mean values of the political and social globalization indices are 56.21 and 53.36, respectively. The Jarque-Bera test statistic was employed to test whether the variables under study follow a normal distribution. The test reveals that all the variables, except social globalization, are normally distributed as the P-values are greater than the 5% level.

Figure 1: Ecological footprint and biocapacity in Cote d'Ivoire (1970-2018)



Source: Global footprint network

Figure 2: Components of ecological footprint in Cote d'Ivoire, 1970-2018

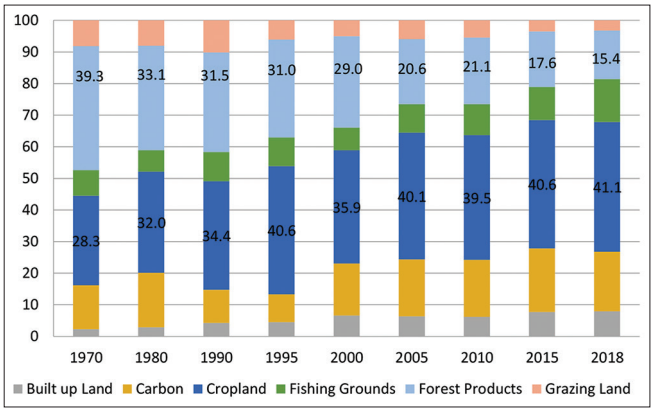


Table 1: Variables of the study and description

Variable	Description	Units	Sources
EFP	Ecological footprint	Global hectare per person	Global Footprint Network
GDP	Economic growth	GDP per capita (constant 2015 US $)	WDI
GLO	Globalization index	Index from 0 to 100	Swiss Economic Institute
GLOS	Social globalization	Index from 0 to 100	Swiss Economic Institute
GLOE	Economic globalization	Index from 0 to 100	Swiss Economic Institute
GLOP	Political globalization	Index from 0 to 100	Swiss Economic Institute

Global Footprint Network. Available from: https://www.footprintnetwork.org/. [Last accessed on 2023 January 06]. WDI World Bank; 2022. Available from: http://datacatalog.worldbank.org/ [Last accessed on 2023 January 06]. KOF Globalization Index is. Available from: https://kof.ethz.ch/en/. [Last accessed on 2023 January 06]. GLOS: Social globalization index, GLOP: Political globalization index, GLOE: Economic globalization index, EFP: Ecological foot print, WDI: World development indicators

Table 2: Summary of descriptive statistics and correlation matrix

Variables	EFP	GDP	GLO	GLOE	GLOS	GLOP
Panel A: Descriptive statistics						
Mean	0.257	7.617	43.412	43.815	26.530	59.432
Median	0.228	7.566	40.521	43.294	22.007	56.310
Maximum	0.583	8.058	53.406	49.886	44.983	72.690
Minimum	−0.002	7.351	33.372	37.944	19.452	40.334
SD	0.173	0.207	6.059	3.212	8.253	9.086
Jarque-Bera	3.623	3.679	4.090	2.298	9.970	2.866
P	0.163	0.158	0.129	0.316	0.006	0.238
n	49	49	49	49	49	49
Panel B: Correlation matrix						
EFP	1.000	0.926*	−0.570*	−0.622*	−0.344*	−0.613*
GDP		1.000	−0.635*	−0.635*	−0.443*	−0.651*
GLO			1.000	0.581*	0.914*	0.977*
GLOE				1.000	0.265**	0.569*
GLOS					1.000	0.841*
GLOP						1.000

*, **Significance at 5% and 10% levels of, respectively. EFP: Log of ecological footprint as global hectare per person, GDP: Log of real GDP per capita, GLO: KOF Globalization index, GLOE: Economic globalization index, GLOS: Social globalization index, GLOP: Political globalization index

The correlation matrix unveils that real GDP per capita (GDP) has a positive relationship with ecological footprint (EFP) whereas globalization and its components have a negative relationship with ecological footprint. This suggests that globalization and economic growth play a role in shaping the environmental sustainability in the context of Cote d'Ivoire.

There is evidence of multicolinearity among the explanatory variables. In particular, the correlation between social and political globalization is greater than 0.80, indicating that the multicolinearity problem is an issue in this study (Field, 2005). We use variance inflation factor (VIF) and tolerance value to ascertain the relationship among the explanatory variables as suggested by Daoud (2017) and Shrestha (2020). The values of VIF and tolerance reported in Table 3 reveal that the model 1 consisting of real GDP per capita and globalization as regressors is free from multicolinearity. However, when further decomposition of globalization is done (model 2), there is a strong correlation of political globalization with the rest of the variables.

4. RESULTS AND DISCUSSION

Before moving on to regression, it is important to check the order of integration of the variables. This study applies the unit root tests designed by Phillips and Perron (1988) and Kwiatkowski et al. (1992). The results portrayed in Table 4 indicate that all the variables have unit root in their level but are stationary at the first difference.

The next step of our empirical analysis is to test for the existence of long-run relationship among the variables. The appropriate lag order of variables included in the ARDL model was determined using the Akaike Information Criterion (AIC). Results from the bounds test are depicted in Table 5. The estimated value of the F-statistic (F = 8.808) is greater than the upper bounds critical value (4.61) at 5% level of significance. Results for model 2 reports an estimated F-statistic of 10.402 greater than the upper bounds critical value, confirming the existence of a long-run relationship between the variables. Thus, we can conclude that economic growth and globalization have a long-run relationship

Table 3: Collinearity test results

Variables	VIF (1)	Tolerance	VIF (2)	Tolerance
GDP	1.679	0.596	2.126	0.470
GLO	1.679	0.596	-	-
GLOE			2.206	0.453
GLOS			4.476	0.223
GLOP			6.716	0.149

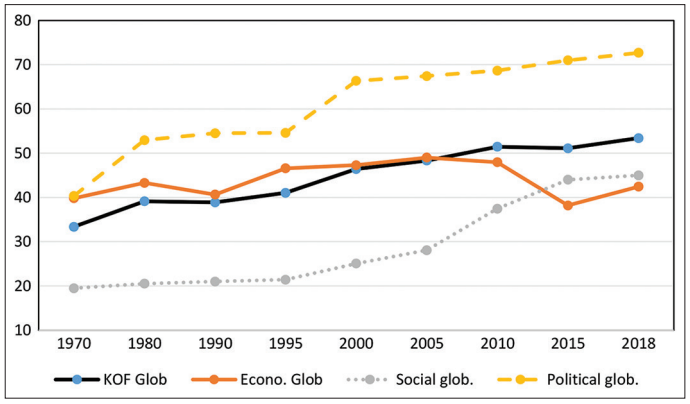
The general rule is Tol >0.2 and VIF<5. GDPL: Log of real GDP per capita, GLO: KOF Globalization index, GLOE: Economic globalization index, GLOS: Social globalization index, GLOP: Political globalization index

Table 4: Results of unit root tests

Series	Level		First difference		Decision
	PP	KPSS	PP	KPSS	
EFP	−1.322	0.216*	−11.163*	0.126	I (1)
GDP	−0.541	0.168*	−4.487*	0.132	I (1)
GLO	−1.974	0.125	−6.410*	0.065	I (1)
GLOE	−2.341	0.105	−8.603*	0.177*	I (1)
GLOS	−0.059	0.233*	−10.824*	0.500*	I (1)
GLOP	−2.865	0.062	−6.594*	0.063	I (1)

*The rejection of the null hypothesis at 5% level. The tests were carried out with the presence of intercept and trend terms in unit root estimating equation. 5% critical values are−3.506 and 0.146 for PP and KPSS tests, respectively. EFP: Log of ecological footprint as global hectare per person, GDP: Log of real GDP per capita, GLO: KOF globalization index, GLOE: Economic globalization index, GLOS: Social globalization index, GLOP: Political globalization index

Figure 3: Globalization index and its components in Cote d'Ivoire, 1970-2018



with ecological footprint. The diagnostic tests show that error terms of estimated models are normally distributed, and free from correlation and heteroskedasticity.

After confirmation of the long-run relationship among the variables, we proceed to estimate the long-run coefficients associated with real income and globalization using the ARDL approach. As a robustness check, we employ the Fully Modified OLS (FMOLS) and the Dynamic OLS (DOLS) estimators proposed by Phillips and Hansen (1990) and Stock and Watson (1993), respectively. These techniques account for the possible endogeneity of the variables and perform better in small samples. The results are portrayed in Table 6. As the upper part of the table reports, the coefficients associated with real GDP per capita are quite close to each other in terms of their magnitude and sign. As expected, economic growth is positively associated with environmental degradation by increasing ecological footprint. Keeping other things constant, a 1% increase in real income leads to about 0.67% rise in ecological footprint. This empirical evidence is consistent with many previous studies. It demonstrates that economic expansion is the main cause of environmental degradation through excessive exploitation of natural resources.

The evidence with regard to the aggregate measure of globalization indicates a positive and significant coefficient in the three estimations, confirming that globalization causes environmental degradation. Other things remain the same, a one point increase in the overall globalization index causes around 2.2% rise in ecological footprint. This finding is in tandem with previous studies (Farhani and Ozturk, 2015; Shahbaz et al., 2015; Ertugrul et al., 2016; Shahbaz et al., 2017a; Twerefou et al., 2017; Salahudin et al., 2019b). However, the outcome is contradictory with Amuakwa-Mensah and Adom (2017), Shahbaz et al. (2016) and Erdogan et al. (2021) who found that globalization works in favor of environmental sustainability by reducing ecological footprint in SSA countries.

In terms of the influence of the different dimensions of globalization, the results reported in the lower part of Table 6 divulge that economic and social globalization have positive and significant long-term impact on ecological footprint. Conversely, political globalization has a positive coefficient but statistically insignificant. The non-significance of the coefficient on political globalization may be due to multicolinearity among the variables as indicated above. We re-estimate model 2 with different combinations of globalization variables. The results are presented in Table 7. As shown, cointegration exists when political globalization enters the model with real GDP and social globalization. In this case, political globalization bears a positive and significant coefficient. Thus, a one point rise in political globalization increases ecological footprint by about 1.2%. The economic dimension of globalization raises ecological footprint by nearly 1.3% for each one point increase. This outcome signifies that reducing trade and investment barriers produces the scale effect by expanding economic growth, which in turn aggravates the environmental degradation. The social aspect of globalization also has a positive and significant effect on ecological footprint. A one point increase in social globalization causes around 1.9% rise in ecological footprint. We can observe that the effect of social globalization is higher than those of economic and political globalization. This finding provides evidence of the role of the spread of knowledge and innovative ideas among countries in shaping environmental sustainability. Social globalization makes people more aware of the importance of the environment for human life.

Table 8 reports the results of causality tests. The results show that both real GDP per capita and globalization cause environmental

Table 5: Bounds test for cointegration

Model	Order	F-statistics	Normality	Correlation	Heteroskedasticity
EFP=f (GDP, GLO)	ARDL (1,0,4)	8.808*	1.554 (0.459)	2.517 (0.773)	7.977 (0.435)
EFP=f (GDP, GLOE, GLOS, FLOP)	ARDL (1,4,5,5,5)	10.402*	1.803 (0.405)	1.809 (0.164)	27.291 (0.161)
		5% critical values		10% critical values	
		I (0)	I (1)	I (0)	I (1)
	k=2	3.88	4.61	3.38	4.02
	k=4	3.05	3.97	2.68	3.53

*The rejection of the null hypothesis at 5% level of significance. The selected model was based on AIC with maximum lag was set to 5 and includes constant and trend as deterministic regressors. EFP: Log of ecological footprint as global hectare per person, GDP: Log of real GDP per capita, GLO: KOF globalization index, GLOE: Economic globalization index, GLOS: Social globalization index, GLOP: Political globalization index, AIC: Akaike information criterion

Table 6: Estimated long-run coefficients

Variables	ARDL	DOLS	FMOLS
Model 1: EFP=f (GDP, GLO)			
Real GDP	0.670* (12.497)	0.673* (6.961)	0.681* (8.283)
Globalization	0.022* (4.611)	0.015* (2.950)	0.015* (2.368)
R^2_adj	0.911	0.941	0.867
Model 2: EFP=f (GDP, GLOE, GLOS, GLOP)			
Real GDP	0.418* (5.907)	0.493* (4.756)	0.355* (4.930)
Economic globalization	0.009* (2.737)	0.001 (0.222)	−0.002 (−0.923)
Social globalization	0.018* (8.017)	0.018* (5.496)	0.018* (7.553)
Political globalization	0.002 (0.857)	−0.004 (-0.932)	0.004** (1.772)
R^2_adj	0.950	0.931	0.912

*,**Statistical significance at the 5% and 10% level, respectively. Models estimated include constant and trend as deterministic regressors. Coefficients for intercept and trend are not reported for simplicity. The dependent variable is the log of ecological footprint as global hectare per person. GDP: Log of real GDP per capita, GLO: KOF globalization index, GLOE: Economic globalization index, GLOS: Social globalization index, GLOP: Political globalization index, GDP: Ecological footprint

Table 7: Estimation of model 2 with different combinations of globalization

Variables	1	2	3	4
Real GDP	0.460* (7.318)	0.921* (7.321)	0.275* (2.874)	-
Economic globalization	0.013* (5.559)	0.025* (2.026)	-	−0.006* (−2.494)
Social globalization	0.017* (8.017)	-	0.019* (5.748)	0.028* (13.777)
Political globalization	-	−0.003 (−0.347)	0.012* (3.982)	0.011* (4.661)
Bounds test				
F-statistic	14.066*	3.577	14.011*	3.080
5% upper bounds critical value	4.230	4.230	4.230	4.230

*,**Statistical significance at the 5% and 10% level, respectively. Models estimated include constant and trend as deterministic regressors. Coefficients for intercept and trend are not reported for simplicity. The dependent variable is the log of EFP as global hectare per person. GDP: Log of real GDP per capita, EFP: Ecological footprint

Table 8: Granger-causality test results

Dependent variable	Explanatory variables			
	ΔEFP	ΔGDP	ΔGLO	ECT_{-1}
ΔEFP	-	7.144* (0.028)	4.280 (0.117)	−0.607* (−2.938)
ΔGDP	3.062 (0.216)	-	1.030 (0.597)	0.286 (1.630)
ΔGLO	4.729** (0.094)	3.363 (0.186)	-	−1.695 (−0.434)

*,**Statistical significance at the 5% and 10% levels, respectively statistics forΔEFP, ΔGDP andΔGLO are χ^2 with *P*-values in parentheses. Statistics for ECT_{t-1} are coefficients of adjustment, with *t*-statistics in brackets. The optimal lag length was 2 according to the AIC. EFP: Ecological foot print, GDP: Log of real GDP per capita, AIC: Akaike information criterion

degradation in the long-run. In the short-run, only real GDP per capita causes environmental degradation. Thus, the outcome confirms that economic growth is the major factor of environmental degradation in Cote d'Ivoire.

5. CONCLUSION

This research has explored the environmental impact of globalization in Cote d'Ivoire by using comprehensive measures for globalization and environmental degradation. More precisely, the study uses KOF globalization index and ecological footprint as indicators of globalization and environmental degradation, respectively. Previous studies mostly focused on carbon emissions which is an aspect of the environmental degradation. The study applies the autoregressive distributed lag model to test the long-run relationship between the variables as well as to estimate long-run effects. Using annual data spanning from 1970 to 2018, results disclose that there is a long-run connection between economic growth, globalization and ecological footprint. The core findings of the study reveal that globalization worsens the environmental degradation by increasing the ecological footprint of the country. The decomposition of globalization into different dimensions further reveals that economic, social and political globalization contribute to environmental degradation and the largest magnitude of impact comes from social globalization. Besides, the results demonstrate a positive and monotonic relationship between real GDP and ecological footprint. This means that economic growth contributes to environmental degradation in Cote d'Ivoire. The causality results divulge a one-way causal relationship running from economic growth to ecological footprint in the short and long-run, confirming the role of economic growth in the destruction of the environment. Overall, the findings of this research provide evidence that economic expansion and globalization are deteriorating the environmental quality in Cote d'Ivoire.

In terms of policy implications, government should adopt well-designed environmental policies to minimize the damages caused by globalization and tackle the concerns of environmental degradation and climate change. With the increased social globalization, awareness of environmental issues should grow in the future. We further suggest the use of renewable and cleaner energy sources along with enhanced green technologies and innovation in research and development so that the country can chart a sustainable environmentally-friendly economic growth path. In this regard, efforts should emphasize the use of solar and biomass which are potentially abundant in the country. Furthermore, the government should implement initiatives encompassing conservation and restoration of forests as well as biodiversity conservation. The control of existing classified forests and national parks and reserves by the Forest Development Corporation (SODEFOR) and the Ivorian Parks and Reserves Office (OIPR) must be reinforced within a strengthened forest governance framework. Efforts should be done to increase significantly human resources and means for intervention of these entities. Obviously, all these initiatives will require large budgets that are beyond the current financial capacity of the country. A national found can be put in place on the basis of environmental taxes on vehicles, industrial activities, and forest products. This fund will finance and support the climate change and environmental related projects and programs. The government could rely on private-public partnerships for financing the implementation of these programs as well. On the other hand, incentives can be provided to firms undertaking technological innovations and complying with the environmental standards. Additionally, supporting policies should take place to overcome the barriers that impede renewable energy adoption in Cote d'Ivoire. Ultimately, the country should reinforce its environmental protection policies. Adopting these policies, Cote d'Ivoire will enjoy the benefits of globalization in the form of long-term economic sustainable development.

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