GREEN FINANCE FOR AFRICA'S SUSTAINABLE DEVELOPMENT: TRENDS AND FUTURE OPPORTUNITIES

FUNSO DAVID DARE, PhD.
funso.dare@aaua.edu.ng
Department of Banking and Finance, Adekunle Ajasin University, Akungba-Akoko, Nigeria.

Abstract

This study is an explorative examination of the recent trends in green finance in Sub-Sahara Africa (SSA) for a period of ten years. We also attempt projections into future trends and opportunities in green finance in Africa. First, we explore the trend of green finance and selected environmental and economic indicators in Africa, the challenges faced by green finance and its future opportunities in the continent. Quantitatively, the paper also investigated whether green finance and the selected indicators have significant causal relationship. We used trend analysis and the Granger causality test to analyze the data for green bonds, carbon emission (CO2), agricultural sector output, per capital income, forest area and child mortality rate from 2012 to 2021 obtained from the World Bank Development Indicators. We found that trend-wise, despite the rise in green finance between 2020 and 2021, carbon emission (CO2) has been on the increase while forest area has also depleted. Child mortality rate has consistently been on the decline over the years. Agriculture sector output also rose since 2019. Apart from 2021, Africa's per capita income has been on a steady decline since 2014. Of all the selected environmental and economic variables, only agricultural sector output has a significant causal relationship with green finance. We also identified salient challenges that are faced by green finance investment in Africa, the way out, opportunities and potentials available for green investment as well as the future outlook of green finance for sustainable development in Africa. We recommend increased development of innovative financing mechanisms, building of more institutional capacity to support green finance, development of specialized green finance units by institutions and promote development of green infrastructure.

Keywords: *Green Finance, Trend Analysis, Causality*

1. INTRODUCTION

The subject of green finance in Africa has been gaining momentum in recent years as countries and financial institutions begin to recognize the importance of sustainable development and the need to address climate change. Green finance, which refers to the financing of environmentally sustainable projects, has gained increasing attention in recent years as the world faces the urgent challenge of climate change. African countries are particularly vulnerable to the impacts of climate change, such as droughts, floods, and rising sea levels, which threaten food security, infrastructure, and human lives. Therefore, green finance has the potential to play a critical role in supporting sustainable development and mitigating climate change in Africa. This paper provides an empirical review of the current status, challenges, and opportunities for green finance in Africa. As noted by Hsu et al (2019), green finance can promote sustainable economic growth by financing projects that create green jobs, reduce greenhouse gas emissions, and increase access to renewable energy.

Green finance can also promote social development by financing projects that provide access to clean water and sanitation, promote gender equality, and improve health outcomes. It can promote environmental protection by financing projects that preserve biodiversity, reduce pollution, and promote sustainable land use.

However, to realize the potential of green finance to support integrated growth in Africa, several challenges need to be addressed, including the lack of access to finance, inadequate regulatory frameworks, and a lack of awareness and education about green finance.

Although green finance holds significant potential for promoting sustainable development in the Africa, there are several key shortcomings that need to be addressed to fully realize its benefits (Zhang, 2020). These include poor access to finance, lack of collateral, inadequate financial infrastructure, and high transaction costs in many African countries. Furthermore, the absence of robust regulatory frameworks is a major bane of green finance in Africa. Clear policies, regulations, and standards are essential to guide the development of green finance and ensure the integrity of investments. Weak governance and regulatory gaps create uncertainty for investors, making it difficult to attract private capital for green projects. Added to these is the problem of the lack of technical capacity and expertise in green finance. Significantly, Sub-Sahara African financial institutions lack the knowledge and skills required to assess and manage environmental and social risks associated with green investments. This hampers their ability to identify viable projects, conduct proper due diligence, and effectively monitor investments.

According to Asongu and Nwanchukwu (2020), the shortage of well-structured and bankable green projects is a significant barrier to green finance in Sub-Sahara Africa. The development of a robust investable projects requires extensive planning, technical expertise, and coordination among various stakeholders. The authors also identified inadequate risk mitigation mechanisms as a problem facing green finance in the region. The authors asserted that the perceived risks associated with green investments in Africa, such as policy and regulatory risks, currency risks, and project-specific risks, can deter potential investors, hence, the absence of adequate risk mitigation mechanisms, such as guarantees, insurance, and blended finance instruments, further restricts the flow of capital into green projects.

There is also the challenge of inadequate awareness and knowledge sharing. Kessides et al (2019) stated that the limited awareness and understanding of green finance concepts among policymakers, financial institutions, and potential investors is a significant hurdle. Insufficient efforts to promote knowledge sharing, capacity building, and awareness campaigns hinder the adoption and implementation of green finance initiatives in the SSA. The author advocated for a multi-faceted approach involving policymakers, regulators, financial institutions, development organizations, and other stakeholders. Such approach will strengthen regulatory frameworks, build institutional capacity, develop financial products tailored to local needs, and promote knowledge sharing.

This paper explores the trends of green finance in Africa, its causality with some selected economic and environmental indicators and the potentials for future growth in green finance in the region. We identified three main objectives of the study as follows:

i. An exploration of the trends of green finance and selected economic and environmental indicators in Africa from 2012 to 2021.
ii. A determination of the causal relationship (or absence of it) between green finance and the selected economic and environmental indicators in Africa from 2012 to 2021.
iii. An examination of the possible future potentials and opportunities for green finance in sub-Sahara Africa.

The only null hypothesis tested in the study is that none of the selected indicators have a significant causal relationship with green finance during the study period.

2. LITERATURE REVIEW

Literature suggests that green finance has the potential to support integrated growth (Gupta & Sharma, 2020). This is hinged on the tenets and blueprint of the Sustainable Development Goals (SDGs). The United Nations' SDGs provide a comprehensive framework for sustainable development, emphasizing the interconnectedness of environmental, social, and economic aspects. Green finance aligns with several SDGs, including affordable and clean energy (SDG 7), sustainable cities and communities (SDG 11), and climate action (Bollen & van der Knoop, 2019). By directing financial resources towards green projects, green finance contributes to achieving these goals and promotes holistic socioeconomic development. As noted by Gibbs and O'Neil (2018), also, the concept of the financialization of nature posits that natural resources and ecosystem services have economic value and can be integrated into financial systems. Green finance therefore leverages this idea by assigning economic value to environmental benefits and creating financial mechanisms to support sustainable projects. By attributing economic worth to nature, green finance encourages investments in environmental preservation, thus fostering socioeconomic development.

The European Parliament defined Green bonds as "any type of bond instrument committed to financing environmental or climate projects that invest in any of these areas: renewable energy, energy efficiency, pollution prevention and control, biodiversity, clean transportation, sustainable water management, climate change adaptation, eco-efficient products, production technologies and processes" (Spinaci, 2021). According to Spinaci (2021), green bonds have grown in quantum over the years. The interconnection between green bonds and indicators of sustainable development is worth examining.

Ozili (2022) listed the theories relevant to green finance and sustainable development some of which include "priority theory. resource theory, peer emulation theory and others. According to Ozili (2022), while the priority theory states" that the rate at which economic agents make every effort to achieve sustainable finance goals in a country or region is a true reflection of the priority given to the sustainable finance agenda", the peer emulation theory posits that "hat economic

agents take similar actions, or adopt similar policies and strategies, of the peers they emulate in pursuit of sustainable finance goals". The author states that the resource theory maintains that that some countries have superior human-made resources which gives them a comparative advantage in achieving their sustainable finance goals and in transitioning to sustainable finance, compared to other countries."

2.1 Empirical Literature

Green finance in Africa is still at an early stage of development. Empirical evidence suggests that green finance has a positive impact on socioeconomic development. It promotes economic growth, stimulates job creation, and contributes to poverty reduction. Green finance is also aligned with the achievement of the SDGs. However, challenges remain, including the need for standardized measurement and reporting frameworks for green finance impacts. Further research and policy measures are necessary to maximize the positive effects of green finance on socioeconomic development (Wang and Huang, 2021).

Several empirical studies have found a positive association between green finance and economic growth. For instance, Berrone et al. (2020) examined the impact of green bonds on GDP growth in a sample of countries and found that an increase in green bond issuances positively influenced economic growth.

Similarly, Cucuzzella and Johnstone (2018) analyzed the impact of environmental finance on economic performance and found a positive relationship between the two variables. Green finance has been shown to stimulate green innovation, which, in turn, enhances productivity and economic growth. Empirical studies by Zeng et al. (2021) and Choong et al. (2019) highlight the positive impact of green finance on green innovation and productivity, contributing to sustainable economic development. Green finance plays a crucial role in job creation, particularly in green sectors such as renewable energy, waste management, and sustainable agriculture. Empirical evidence supports this notion. For example, a study by Zhang and Li (2020) analyzed the relationship between green finance and employment and found that an increase in green finance positively influenced employment growth in renewable energy industries. Similarly, Hsu et al. (2019) found that green investment promoted job creation in the clean energy sector.

Green microfinance, which provides financial services to low-income individuals and small enterprises engaged in green activities, has been found to contribute to poverty reduction. Empirical studies by Luo and Ma (2020) and Gichuki et al. (2019) highlight the positive impact of green microfinance on income generation and poverty alleviation in rural communities. Several studies have examined the relationship between green finance and the achievement of the Sustainable Development Goals (SDGs), which encompass a broad range of socioeconomic objectives. For instance, Kshetri and Dholakia (2021) explored the link between green finance and the SDGs and found that green finance positively contributed to multiple SDGs, including poverty reduction, gender equality, and sustainable cities.

According to a report by the African Development Bank (2021), the total investment in renewable energy in Africa was only $10.7 billion in 2018, which is a small fraction of the investment needed to meet the continent's energy needs. Green bonds, which are debt instruments issued to fund environmentally sustainable projects, have also been slow to take off in Africa. However, there are some positive developments, such as the establishment of green investment funds and the adoption of policies to promote renewable energy development. One notable trend in Africa is the increasing issuance especially from 2020 to 2021 of green bonds, financial instruments specifically designed to fund environmentally friendly projects. Countries such as South Africa, Kenya, and Nigeria have experienced successful green bond issuances, highlighting the growing commitment to financing sustainable development projects (AfDB, 2020).

African financial institutions are increasingly incorporating environmental risk assessments into their lending processes. Banks are providing loans for renewable energy projects and energy-efficient technologies, aligning their activities with environmental sustainability objectives (IISD, 2021). These sustainable lending practices encourage the adoption of clean technologies and contribute to reducing greenhouse gas emissions.

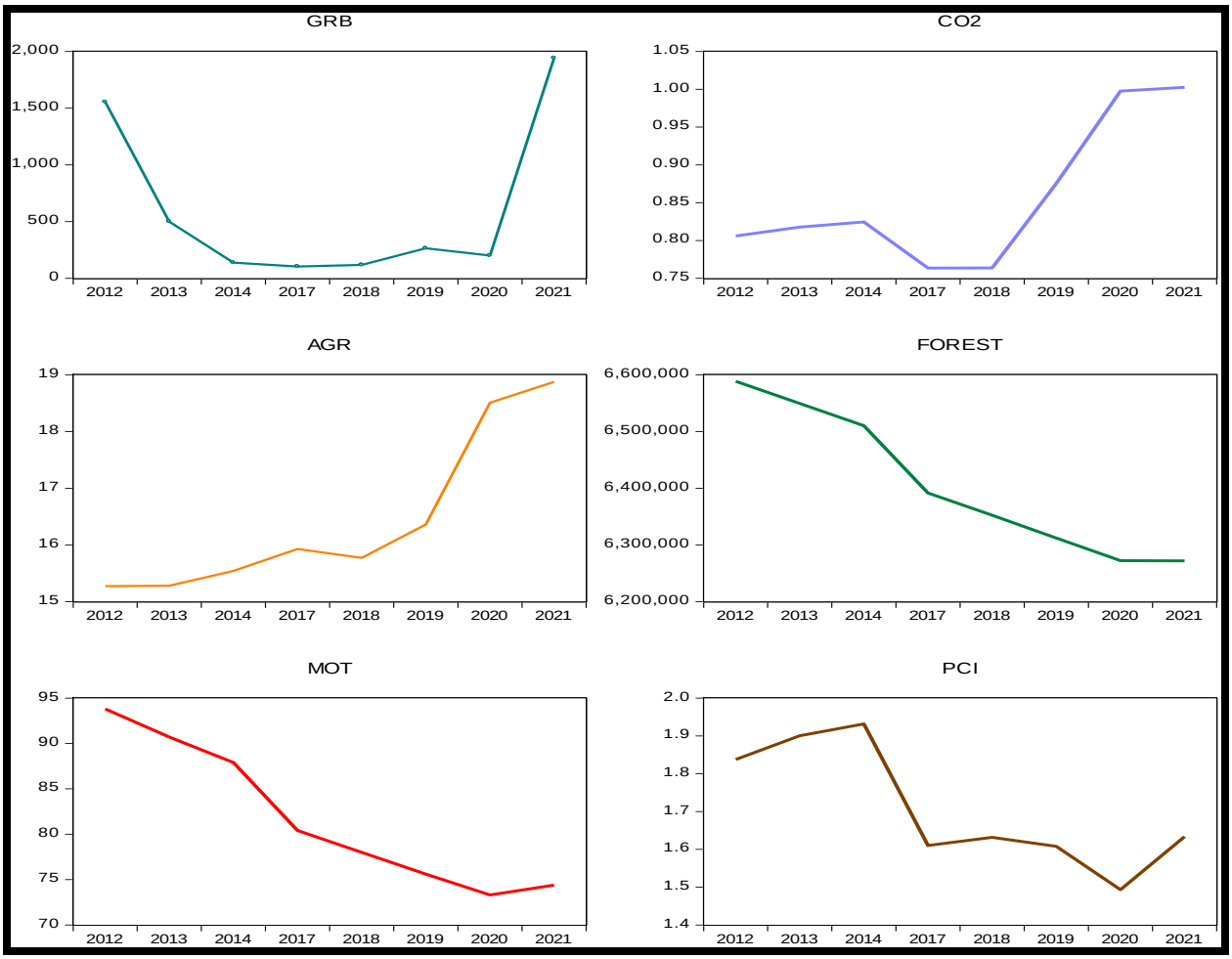

Figure 1: Trends of Green Bond and Selected Socio-economic Indicators.
Source: The World Bank (2022)

Sub-Saharan Africa has experienced significant trends in carbon dioxide (CO2) emissions over the years. While the region has historically had relatively low carbon emissions compared to other parts of the world, there has been a noticeable increase in recent decades due to economic growth, urbanization, and industrial development. This paper examines the trends in CO2 emissions in Sub-Saharan Africa and highlights relevant sources.

According to data from the World Bank, CO2 emissions in Sub-Saharan Africa have been steadily rising. From 1990 to 2014 and 2018 and beyond, CO2 emissions increased by approximately 130%, indicating a notable upward trend (World Bank, 2021). This increase can be attributed to multiple factors, including population growth, rapid urbanization, expanding industries, and a rise in energy consumption. Economic growth has been a key driver of rising CO2 emissions in Sub-Saharan Africa. As countries experience economic development and industrialization, the demand for energy and fossil fuel consumption tends to increase. This is particularly evident in sectors such as manufacturing, transportation, and power generation, which are significant contributors to

carbon emissions. The World Bank. (2021) reported that in order to address the challenges associated with rising carbon emissions, Sub-Saharan African countries have taken steps towards adopting renewable energy sources, implementing energy efficiency measures, and promoting sustainable development practices. Initiatives such as the Paris Agreement and regional

collaborations like the Africa Renewable Energy Initiative have provided frameworks for countries to work towards reducing their carbon footprints.

As shown on Figure 1, agricultural production in Sub-Saharan Africa has been increasing over the years to meet the growing demand for food due to population growth and changing dietary patterns. This expansion, however, has been accompanied by increasing CO2 emissions. According to the Food and Agriculture Organization (FAO), agricultural emissions in Sub-Saharan Africa increased by approximately 34% between 1990 and 2017 (FAO, 2021). Several factors contribute to agricultural emissions in the region. One significant source is the conversion of forests and grasslands to agricultural land. Deforestation and land-use change release significant amounts of CO2 into the atmosphere. The expansion of agricultural land through slash-and-burn practices, as well as the use of fire for land clearing, also contribute to emissions. In addition, the use of synthetic fertilizers, which are common in modern agricultural practices, can result in the release of greenhouse gases, including CO2. The decomposition of organic matter and manure in agricultural systems also generates emissions of CO2 and other greenhouse gases.

Moreover, Africa relies heavily on traditional and inefficient farming practices, such as open field burning of agricultural residues. These practices release substantial amounts of CO2 and other pollutants into the atmosphere. Efforts are being made to address agricultural emissions in Sub-Saharan Africa. The promotion of sustainable agriculture practices, such as agroforestry, conservation agriculture, and integrated soil fertility management, can help reduce emissions. These practices focus on maintaining soil health, optimizing nutrient management, and enhancing carbon sequestration in vegetation and soils. Furthermore, there is growing recognition of the potential of climate-smart agriculture (CSA) in mitigating agricultural emissions. CSA combines sustainable practices, climate adaptation, and productivity enhancement. It emphasizes the use of climate-resilient crop varieties, efficient water management, and improved livestock management, all of which can contribute to reducing agricultural emissions. Importantly, agricultural activities in Sub-Saharan Africa contribute to CO2 emissions due to factors such as land-use change, use of synthetic fertilizers, and inefficient farming practices. However, efforts are being made to promote sustainable agriculture and climate-smart practices to mitigate these emissions and enhance the resilience of agricultural systems.

3. METHODOLOGY

This study used trends analysis to analyze the behaviour of green finance and the selected environmental and economic variables during the study period. Furthermore Granger causality test modelling was used to ascertain whether there is any significant causality between green finance and sustainable environmental and economic development. The Granger causality model tests (with t- and F-statistic) whether one variable (*A*) can provide significant information on future

changes in the value of another variable (*Y*). Adapting a general Granger causality model to this relationship, we express the causality between the two sets of variables as:

$$Y_t = \sum_{i=1}^{k} a_i A_{t-i} + \sum_{j=1}^{k} b_j Y_{t-j} + u_{1,t} \quad \ldots\ldots\ldots\ldots\ldots\ldots \text{(i)}$$

$$A_t = \sum_{i=1}^{k} c_i Y_{t-i} + \sum_{j=1}^{k} d_j A_{t-j} + u_{2,t} \quad \ldots\ldots\ldots\ldots\ldots\ldots \text{(ii)}$$

Where *Y* and *A* are green finance and selected environmental and economic indicators respectively.

While *Y* (green finance) = GREENBOND, *A* (eco-environmental variables) = CO2, (carbon emission),
CMOTR (child mortality rate), FOREST (forest areas), PCINC (per capital income) and AGROUT (agricultural sector output). All these variables are taken as defined by the World Bank Global Indicators. a, b, c, and d are coefficients of changes in the associated variables

4. TRENDS OF GREEN FINANCE AND ECO-ENVIRONMENTAL AND CHALLENGES

4.1 Africa's Environmental Condition: The Need for Green Finance

A report by the Meteorological Organization WMO, (2022) specifically focused on Africa reveals that increasing temperatures, rising sea levels, changing precipitation patterns, and more extreme weather events pose significant threats to human health, food and water security, and socio-economic development on the continent. The "State of Climate in Africa 2021" report provides a comprehensive overview of current and future climate trends in Africa, underscoring the importance of accurate data for effective adaptation planning. The report highlights the escalating dangers of climate change for Africa's agriculture sector, which is vital for the continent's economy and livelihoods. Heatwaves, droughts, pests, diseases, and flood-related infrastructure damage can have severe implications for food security at regional, national, and individual levels. The report also emphasizes the health impacts of changing climate patterns, such as the spread of vector-borne diseases like malaria and dengue fever.

Earlier, a WMO (2020) report for Africa's climate for 2019 had highlighted that from an economic standpoint, Africa, particularly regions with hot climates, faces substantial challenges due to climate change. Low-income countries in these areas are particularly vulnerable to the adverse consequences. According to the report, the continent's overall Gross Domestic Product (GDP) is projected to decline between 2.25% and 12.12% under various scenarios of global temperature increase compared to pre-industrial levels. Notwithstanding, the WMO attest to the fact that Africa has been demonstrating a strong commitment to addressing climate change through various initiatives.

The Food and Agriculture Organization (FAO, 2021) reported that food problem is one major outcome of climate change in Africa, especially in areas prone to flooding and drought. For example, the organization reported that the number of undernourished individuals increased

averagely by 45.6% since 2012. Being the backbone of Africa's economy and main supporter of the livelihoods of the majority of the continent's population, agriculture is highly vulnerable to the impacts of climate variability and change in Africa. The Intergovernmental Panel on Climate Change (IPCC, 2022) projected that warming scenarios could have devastating effects on crop production and food security. According to the Panel, key risks to agriculture include reduced crop productivity due to heat and drought stress, increased pest and disease damage, and flood-related impacts on food system infrastructure. These risks have serious consequences for food security at regional, national, and individual household levels. By its projection, by the middle of the century, major cereal crops grown in Africa will face adverse impacts, albeit with variations among regions and crops. Under the worst-case climate change scenario, it is projected that mean crop yields will decrease by 13% in West and Central Africa, 11% in North Africa, and 8% in East and Southern Africa. Among the crops, millet and sorghum are expected to be the most resilient, with yield losses of only 5% and 8%, respectively, by 2050.

A second negative effect of it is felt in the health of the people. Temperature increases and changes in rainfall patterns caused by deforestation and climate change have significant implications for population health across Africa. Warmer temperatures and higher rainfall create more favorable conditions for

disease-carrying insects, increasing the transmission of vector-borne diseases like dengue fever, malaria, and yellow fever. Moreover, new diseases are emerging in regions where they were previously absent (Vermaak, 2020).

Economically, according to the International Monetary Fund (2021), the adverse consequences of climate change are concentrated in regions with hot climates, where a disproportionately large number of low- income countries are located. It is predicted that a significant decrease in Gross Domestic Product (GDP) in the five African subregions due to global temperature increase was imminent. The continent's overall GDP is expected to decrease by 2.25% to 12.12%. West, Central, and East Africa will experience a higher adverse impact compared to Southern and North Africa.

Climate change is recognized as a major challenge for Africa's development in the Agenda 2063, concluded in 2013. Since 2015, the Nationally Determined Contributions (NDCs) to the Paris Agreement have become the primary instrument guiding policy responses to climate change. Over 90% of African countries have ratified the Paris Agreement and are actively working on submitting their revised NDC. A significant portion of the global population living in poverty consists of women, and approximately half of all women worldwide are engaged in agriculture. In developing countries, this percentage rises to 60%, and in low-income countries facing food shortages, it reaches 70%. Consequently, reducing poverty through agricultural growth in Africa specifically benefits women. Additionally, there are instances where women may lack access to weather and climate services. It is crucial to ensure that all individuals, including women, have access to these services to enhance their personal resilience and capacity to adapt.

Zemp, et al (2019) noted that many to mitigate climate risks and extreme events, Africa has adopted a promising approach of reducing poverty through socioeconomic growth, particularly in

the agricultural sector. Techniques that promote value addition using clean and efficient energy sources, such as solar- powered micro-irrigation, have shown potential in increasing farm-level incomes, improving yields, reducing water usage, and offsetting carbon emissions. This is where green finance comes in. Urgent actions are required to address these in the area of investments in green projects and sustainable development initiatives.

4.2 Challenges

In Africa, stakeholders believe that adopting green finance is germane for achieving sustainable economic growth and addressing pressing environmental issues. However, the continent faces several challenges that impede the development and effective implementation of green finance initiatives. These challenges are described in Figure 1, although there may be others. Adamu and Eskeland (2021) noted that access to finance is a crucial challenge for green projects in the SSA but that limited access to capital and high borrowing costs hinder the financing of sustainable initiatives.

The African continent as a whole have financial institutions that face difficulties in providing long-term financing for green projects, as they often prioritize short-term and less risky investments. The authors submitted that lack of dedicated financial mechanisms and instruments for green finance further exacerbates the financial constraints. Hence, they advocated that enhancing access to finance for green projects, establishing green investment funds, and promoting public-private partnerships can help alleviate this challenge.

Anggraini et al., (2020) identified limited education and awareness as well as poor understanding of green finance concepts and mechanisms as one major challenge facing green finance in the SSA. According to the authors, many individuals, businesses, and policymakers are unfamiliar with the potential benefits and opportunities offered by green finance. This limits the demand for green finance products and inhibits the growth of green investments. Therefore, we opine that greater awareness campaigns, capacity building, and knowledge dissemination which are crucial for promoting green finance in the sub-continent be put in place.

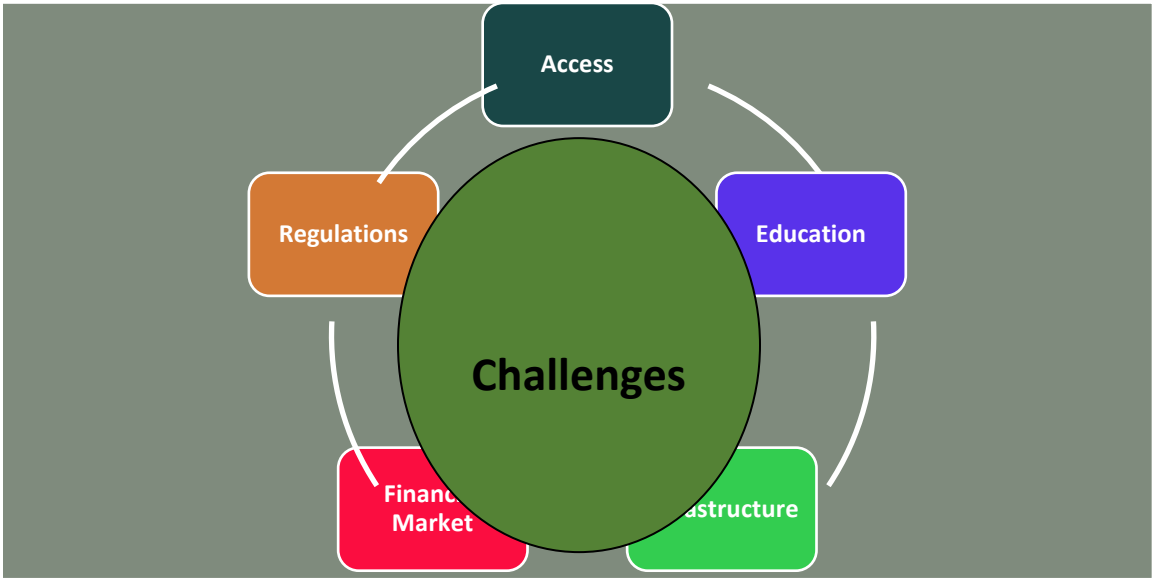

Figure 2: Challenges Facing SSA Countries in Green Finance.
Source: Author's (2023).

Another challenge as specified by Asongu & Nwachukwu, 2020) is absence of a sound regulatory framework and supportive policies that focus on green finance. Obviously, this regulatory and policy gaps hinder the growth of green finance. We observe that many SSA countries lack adequate legal framework, standardized definitions of green finance concepts and proper implementation of a few policies put in place on green finance. Hence a development of a comprehensive regulatory standard by each country on green finance is strongly advocated. Currently in the SSA countries there is lack of adequate infrastructure and underdeveloped financial markets which pose a significant challenge to green finance in the sub-continent. According to Kessides et al., (2019) real and financial sector infrastructures development is a critical component of sustainable projects, including renewable energy generation and eco-friendly transportation systems.

4.3 Causality Test

To ascertain whether past changes in green finance has caused present changes in the environmental and economic indicators selected, we used the Granger causality test. The result is presented in Table 1. The decision rule in Granger causality test is to compare calculated values and probabilities of the F-distribution each pair of dependent and independent variables with their critical values and the selected 0.05 level of significance. Two variables are causally related if the calculated F-statistics is greater than its critical value or of its probability is less than the 0.05 level of significance ($p,0.05$).

Table 1: Summary of Causality Test Results

Null Hypothesis:	**Obs**	**F-Statistic**	**Prob.**

CO2 does not Granger Cause GREENBOND	6	2.74887	0.3923
GREENBOND does not Granger Cause CO2		0.64078	0.6620
AGROUT does not Granger Cause GREENBOND	6	300.810	0.0407
GREENBOND does not Granger Cause AGROUT		1.68742	0.4781
FOREST does not Granger Cause GREENBOND	6	3.18708	0.3683
GREENBOND does not Granger Cause FOREST		5.84769	0.2807
CMOTR does not Granger Cause GREENBOND	6	2.95071	0.3807
GREENBOND does not Granger Cause CMOTR		17.7152	0.1657
PCINC does not Granger Cause GREENBOND	6	0.77166	0.6270
GREENBOND does not Granger Cause PCINC		14.8467	0.1805

Source: Author's Computation (2023)

CO2 and green finance do not have causal relationship as implied in the probabilities of their F-statistics (0.3923 >0.05 and 0.6620 >0.05). However, agriculture output granger caused green bond, but the latter did not granger cause agriculture output. This implies that previous changes in agricultural output have caused present changes in green bond issues than previous changes in the latter causes in itself (p = 0.0407<0.05), but previous changes in green bonds have not had the same effect on agricultural sector output. There is no significant causal relationship between forest area and green finance given their p values (0.3683>0.05 and 0.2807>0.05 respectively). This is obvious as it confirms the trend in the size of forest area that had decreased progressively throughout the studied period.

In the same vein, child mortality rate and green finance have no significant causal relationship given their p values (0.3807>0.05 and 0.1657>0.05 respectively) just like it is for per capita income and green finance (0.6270>0.05 and 0.1805>0.05 respectively. For CO2, forest area, child mortality rate and per capita income, the null hypothesis of no significant causality between them and green finance cannot be rejected. However, since agricultural sector output has causal relationship with green finance, the null hypothesis cannot be accepted for it. There is a unidirectional causality that runs from the former to the latter. That most of the selected variables (CO2 emission, forest area, child mortality and per capita income) do not have causal relationship with green finance calls for concern all stakeholders in the discuss of sustainable green finance in Africa.

4.3 Opportunities and Potentials

The UNEP (2018) has identified opportunities and potentials available for green investment in Africa. These opportunities and potentials are summarized in Figure 3.

One of them is investment in renewable energy. Africa has vast renewable energy resources, including solar, wind, and hydroelectric power.

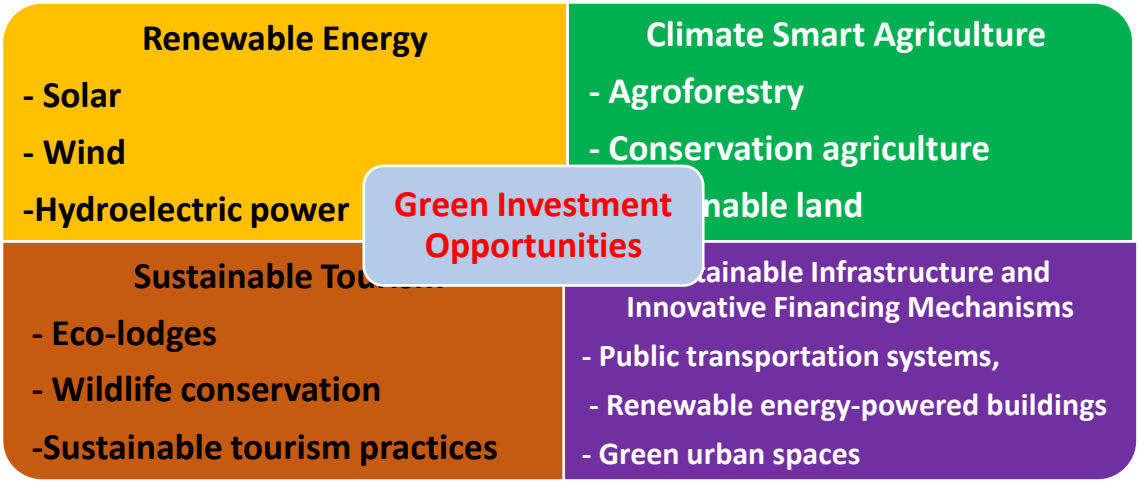

Figure 3: Opportunities and Potentials for Green Investment
Source: Author's Conception (2023).

Investing in renewable energy infrastructure projects presents significant opportunities for green finance to drive sustainable development on the continent. As noted by the UNEP (2018), renewable energy investments not only contribute to mitigating climate change but also improve energy access, create jobs, and foster economic growth. Second, there are opportunities for climate friendly agriculture. The UNEP (2020) averred that financing sustainable agriculture practices is essential for ensuring food security and reducing the environmental footprint of agricultural activities. Green finance can support initiatives such as organic farming, agroforestry, and sustainable land management practices. These practices promote biodiversity, enhance soil health, and reduce reliance on synthetic inputs, contributing to long-term sustainability.

Another opportunity lies in the potential increase in investment in sustainable infrastructure. The Africa continent needs significant investment in infrastructure to support economic growth and development. Green finance can be used to fund sustainable infrastructure projects such as public transportation systems, renewable energy-powered buildings, and green urban spaces. Also, there are opportunities for investment in innovative green financing. We expect to witness rising green bonds issue, green investment funds, and climate risk insurance. These instruments, among others, can help to mobilize private sector investment in green projects. Finally, the continent needs improved green finance to prevent the negative environmental impacts that tourism has on the African economy. Investment in sustainable tourism projects such as eco-lodges, wildlife conservation, and sustainable tourism practices can help solve this problem. The potential for green finance in Africa is significant but as we earlier pointed out, there are still significant challenges to be addressed, including the lack of access to finance, inadequate regulatory frameworks, and a lack of awareness and education about green finance. Addressing these challenges will be critical to unlocking the full potential of green finance in Africa.

5. NECESSARY STEPS TOWARDS POSITIVE OUTLOOK IN GREENING AFRICA

The future outlook for green finance in Africa is promising. However, the following factors issues should be well addressed to achieve positive outlook in green finance in the continent.

i. **Increasing Awareness and Commitment:** There is a growing awareness of the need for sustainable development and climate action in Africa, driven by factors such as the impacts of climate change, increasing urbanization, and the adoption of the United Nations Sustainable

   Development Goals (SDGs). African governments and financial institutions are increasingly committing to sustainable development and climate action, which is likely to drive demand for green finance.

ii. **Growing Investment:** There has been an increase in green investment in Africa in recent years. According to the International Finance Corporation (IFC, 2022), green investment in sub-Saharan Africa grew by 39% between 2017 and 2018. This trend is expected to continue as more investors seek opportunities in the growing green economy.

iii. **Favorable Policies and Regulations**: African governments are adopting policies and regulations that support the development of green finance. For example, several African countries have developed national climate change strategies, and some have adopted policies such as feed-in tariffs to promote renewable energy development. These policies create an enabling environment for green finance.

iv. **Innovations in Financing Mechanisms**: There are a growing number of innovative financing mechanisms for green finance in Africa, such as green bonds, green investment funds, and climate risk insurance. These mechanisms are helping to mobilize private sector investment in green projects and support the growth of the green economy.

v. **Support from International Partners:** International organizations such as the United Nations Development Programme (UNDP), the World Bank, and the African Development Bank are providing technical and financial support to African countries and financial institutions to develop green finance. This support is helping to build capacity and accelerate the development of green finance in Africa.

6. CONCLUSION AND RECOMMENDATIONS

This paper exploratively examined the trend of green finance and selected environmental and economic indicators in Africa, the challenges faced by green finance and its future opportunities in the continent. Quantitatively, the paper also investigated whether green finance and the selected indicators have significant causal relationship. We found that trend-wise, despite the rise in green finance between 2020 and 2021, carbon emission (CO2) has been on the increase while forest area has also depleted. Thankfully, child mortality rate has consistently been on the decline over the years. Agriculture sector output also rose since 2019 (a factor which might also have contributed to the rise in CO2). Apart from 2021, Africa's per capita income has been on a steady decline since 2014. Of all the selected environmental and economic variables, only agricultural sector output has a significant causal relationship with green finance. We also identified salient challenges that are faced by green finance investment in Africa, the way out, opportunities and potentials available for green investment as well as the future outlook of green finance for sustainable development in Africa. We recommend the increased development of innovative financing mechanisms, such as green bonds and green investment funds, to attract private sector investment in green projects. We

also advocate the building of more institutional capacity to support green finance, including the development of specialized green finance units within financial institutions and the establishment of green finance centers. There is also the need to promote the development of green infrastructure, such as renewable energy and sustainable transportation, to support sustainable economic growth. Africa should strengthen the role of civil society in promoting green finance and integrated growth, including the participation of local communities and non-governmental organizations in the development and implementation of green finance policies and projects.

REFERENCES

Adamu, A., & Eskeland, G. S. (2021). African green finance: Barriers and opportunities. *World Development, 140*, 105353. doi:10.1016/j.worlddev.2020.105353.

African Development Bank (AfDB). (2020). African Green Bonds Market Report 2020, https://www.afdb.org.

Anggraini, R., Shabrina, N. R., Asih, D. S. W., & Kurniawan, D. (2020). Green finance development in ASEAN countries: Challenges and recommendations. *Journal of Environmental Management, 271*, 111027. doi:10.1016/j.jenvman.2020.111027.

Asongu, S. A., & Nwachukwu, J. C. (2020). The impact of finance on energy consumption in Africa: Does green finance matter? *Energy Exploration & Exploitation, 38*(2), 232-252. doi:10.1177/0144598719838291.

Berrone, P., Fosfuri, A., & Gelabert, L. (2020). The impact of green bonds on firms' innovation and financial performance. *Journal of Business Ethics, 163*(2), 323-354. doi:10.1007/s10551-018-3935-y.

Bollen, J., & van der Knoop, P. (2019). Green bonds and their socio-economic impacts: An exploratory analysis. *Journal of Cleaner Production*, 208, 1526-1536: doi:10.1016/j.jclepro.2018.10.123.

Choong, C. K., Yusop, Z., Law, S. H., & Tan, H. B. (2019). Green finance, environmental performance, and economic growth: The moderation role of innovation. *Technological Forecasting and Social Change, 146*, 253-261. doi:10.1016/j.techfore.2018.10.002.

Cucuzzella, C., & Johnstone, N. (2018). *Environmental finance and investments.* In N. Johnstone (Ed.), A Research Agenda for Environmental Management (pp. 161-181). Edward Elgar Publishing. doi:10.4337/9781786438990.00015.

Food and Agricultural Organization & United Nations Water.(2021). Progress on level of water stress. global status and acceleration needs for SDG Indicator 6.4.2,. Rome. https://doi.org/10.4060/cb6241en.

Gibbs, D., & O'Neill, K. (2018). The financialization of nature: An introduction. *Environment and Planning E: Nature and Space, 1*(4), 466-484. doi:10.1177/2514848618814157.

Gichuki, C. N., Heshmati, A., & Majune, S. (2019). Green microfinance and poverty alleviation: A review. *Journal of Cleaner Production*, 231, 1206-1217. doi:10.1016/j.jclepro.2019.05.225.

Gupta, M., & Sharma, P. (2020). Green finance for sustainable development: A systematic review of the evidence. *Journal of Cleaner Production, 276*, 124236. doi:10.1016/j.jclepro.2020.124236.

Hsu, S. Y., Tsai, P. L., Lin, C. W., & Chen, P. C. (2019). Does green investment enhance job creation? *Renewable and Sustainable Energy Reviews, 112*, 637-646. doi:10.1016/j.rser.2019.06.002.

Intergovernmental Panel on Climate Change (IPCC, 2022) Sixth assessment report working Group I – The Physical Science Basis, *Regional Fact Sheet – Africa*; IPCC. https://www.ipcc.ch/report/ar6/wg1/downloads/factsheets/ IPCC_AR6_WGI_Regional_Fact_Sheet_Africa.pdf.

International Finance Corporation (2022). Emerging Market Green Bonds Report 2021 Riding the Green Wave, https:///www.ifc.org.

International Institute for Sustainable Development (IISD). (2021). Sustainable Banking and Finance in Africa, https:www/iisd.org/sustainable-banking-and-finance-in-africa/.

Kessides, I., Rainer, A., & Wilson, C. (2019). Green finance in Africa: Barriers and opportunities for scaling up private sector investment. World Bank Group, https://openknowledge.worldbank.org/handle/10986/31295

Kshetri, N., & Dholakia, U. M. (2021). Green finance and sustainable development goals: An exploratory study. *Journal of Cleaner Production, 297*, 126604. doi:10.1016/j.jclepro.2021.126604.

Luo, X., & Ma, Y. (2020). Green microfinance and rural poverty alleviation: Evidence from China. *Journal of Cleaner Production, 276*, 123633. doi:10.1016/j.jclepro.2020.123633.

Ozili, P. K. (2022). Theories of sustainable finance, *Managing Global Transitions*. *21* (1): 5–22.

Spinaci, S. (2021). Green and sustainable finance, European Parliamentary Research Service, European Parliament Briefing, PE 679.081 – February 2021.

The World Bank. (2021). CO2 emissions (metric tons per capita), https://www.wb.org/database/emissions/.

United Nations Environment Programme (UNEP). (2020). Nature-Based Solutions, https://www.unep.org/nature-based-solution/

Vermaak, C. (2020). "Climate change is an increasing threat to Africa", *United Nations News blog,* 27 October, 2020 [online]. Accessed June 5, 2023.

Wang, L., & Huang, Z. (2021). The green finance development and socio-economic effect: A review. *Technological Forecasting and Social Change, 172*, 121065. doi:10.1016/j.techfore.2021.121065.

World Meteorological Organization WMO, (2022), State of Africa climate in 2021 report, WMO-No. 1300: https://library.wmo.int/index.php?lvl=notice_display&id=22125.

World Meteorological Organization WMO, (2021. *State of the Climate in Africa 2020* (WMO-No. 1275). Geneva, 2021.

Zemp, M.; Huss, M.; Thibert, E. et al (2019). Global glacier mass changes and their contributions to sea-level rise from 1961 to 2016. *Nature* 2019, *568* (7752), 382–386. https://doi.org/10.1038/s41586-019-1071-0.

Zeng, S., Xu, X., Dong, J., & Tam, V. W. Y. (2021). Does green finance promote green innovation? Evidence from Chinese manufacturing industries. *Journal of Cleaner Production, 280*, 124394. doi:10.1016/j.jclepro.2020.124394.

Zhang, Y., & Li, X. (2020). Does green finance promote employment in renewable energy industry? An empirical analysis of the solar photovoltaic industry in China. *Technological Forecasting and Social Change, 155*, 120051. doi:10.1016/j.techfore.2020.120051.