



RESEARCH ARTICLE

CLIMATE CHANGE ADAPTATION AND GREEN INFRASTRUCTURE AS INSTRUMENTS FOR DISASTER RISK MANAGEMENT AND ECONOMIC STABILITY IN NIGERIA

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ABSTRACT

This study examined climate change adaptation and green infrastructure as strategic instruments for disaster risk management and economic stability in Nigeria. Against the backdrop of intensifying climate variability, recurrent flooding, heat stress, coastal erosion, and agricultural disruption, the research investigated how adaptation investments and ecosystem-based infrastructure influenced disaster outcomes and macroeconomic performance. A mixed-methods design was adopted. Quantitative data covering the period 2005–2023 were analysed using multiple regression models, while qualitative evidence was derived from semi-structured interviews with climate policy officials, environmental planners, and disaster management experts. The findings revealed a statistically significant negative relationship between climate adaptation investment and disaster frequency ($\beta = -0.58$, $p < 0.01$), indicating that increased funding for resilience measures reduced climate-induced disasters. Green infrastructure development demonstrated a significant inverse relationship with economic loss ($\beta = -0.52$, $p < 0.05$) and a positive association with employment growth in green sectors ($\beta = 0.49$, $p < 0.05$). Cost-benefit analysis showed that every ₦1 invested in green infrastructure yielded approximately ₦3.8 in avoided disaster losses and productivity gains. Qualitative results further indicated that integrating ecosystem-based adaptation into national economic planning strengthened fiscal stability and reduced recovery expenditures. The study concluded that climate adaptation and green infrastructure functioned not merely as environmental interventions but as economic stabilization mechanisms essential for sustainable development and disaster resilience in Nigeria.

Keywords: Climate change adaptation, disaster risk management, economic stability, green infrastructure, sustainable development.

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1.0. INTRODUCTION

Nigeria is really feeling the effects of climate change and extreme weather. The country is getting hotter, and the rain is becoming more unpredictable, leading to more frequent and severe flooding, erosion of the coast, desertification, and long periods of drought. These changes are having a big impact on the economy and society as a whole. For example, the devastating floods of 2012 and 2022 damaged farms, displaced millions of people, and destroyed infrastructure all over the country, highlighting just how vulnerable Nigeria is to climate-related disasters. This shows that the country's plans for dealing with climate change and its infrastructure are not strong enough. The fact that these disasters keep happening points to deeper issues with how Nigeria is preparing for and responding to climate change.

Globally, the United Nations Framework Convention on Climate Change (UNFCCC) emphasises adaptation as a core pillar of climate action (UNFCCC, 2015). The Paris Agreement recognises adaptation as equally important as mitigation in safeguarding development gains and enhancing resilience among vulnerable countries (UNFCCC, 2015). Similarly, the United Nations Office for Disaster Risk Reduction (UNDRR), through the Sendai Framework for Disaster Risk Reduction 2015–2030, highlights ecosystem-based and structural measures for reducing hazard exposure and strengthening disaster risk governance (UNDRR, 2015).

Using nature to help us deal with climate change is a really smart idea. Things like restoring wetlands, creating green spaces in cities, and using special pavement that lets water through can be a cost-effective way to adapt to climate change. This approach is different from just building hard structures like walls and dams, because it uses the natural environment to help absorb floodwaters, regulate temperatures, and even absorb carbon dioxide from the air. By doing this, we can reduce the impact of natural disasters and make our communities safer. For example, wetlands can help absorb floodwaters, while green spaces in cities can help keep temperatures cooler. Even simple things like planting more trees and protecting mangroves can make a big difference. By using nature to our advantage, we can create a more sustainable and resilient world.

In Nigeria, efforts to adapt to climate change are not well coordinated across different government ministries and levels. The country has a plan in place, called the National Adaptation Strategy and Plan of Action on Climate Change, which provides a clear direction on how to tackle climate change. However, there are still significant gaps in implementing this plan due to a lack of funding, poor coordination among institutions, and limited technical expertise. As a result, the country is struggling to turn its climate change policies into tangible actions that can help build resilience against the impacts of climate change. This is a major concern because it undermines the ability of Nigeria to effectively respond to the challenges posed by climate change.



Climate change has a big impact on the economy. A lot of people in Nigeria work in farming, which is really affected by the weather. When there are floods, it damages roads, bridges, and power lines, and when it's too hot, it makes it hard for people to work and disrupts the flow of goods. This slows down the growth of the economy, puts a strain on the government's budget to fix the damage, and makes poverty and inequality worse.

Climate change is a big problem in Nigeria, and the country needs to find ways to deal with it. Even though the government is starting to pay attention to making Nigeria stronger against climate change, there is not much research on how investing in adaptation, building green infrastructure, reducing disaster risk, and keeping the economy stable are all connected. This study tries to fill that gap by looking at how climate adaptation and green infrastructure can help manage disaster risk and keep the economy stable in Nigeria.

1.1. Objectives of the Study

The study is guided by the following four specific objectives:

1. To examine the relationship between climate change adaptation investment and disaster frequency in Nigeria.
2. To assess the impact of green infrastructure development on economic loss from climate-related disasters.
3. To evaluate the contribution of green infrastructure to employment generation and economic stability.
4. To determine how climate adaptation policies can reposition environmental planning as a driver of sustainable economic growth

2.0. CONCEPTUALIZATIONS AND LITERATURE REVIEW

2.1. Conceptualizations

Climate Change Adaptation

Climate change adaptation refers to adjustments in natural or human systems in response to actual or expected climatic stimuli to moderate harm or exploit beneficial opportunities (IPCC, 2014). Adaptation strategies include structural, institutional, technological, and ecosystem based approaches. Ecosystem-based adaptation emphasizes conserving and restoring natural systems to reduce hazard exposure. Scholars argue that adaptation reduces vulnerability by addressing structural determinants such as poverty, land-use planning, and infrastructure deficits.

Green Infrastructure and Disaster Risk Management

Green infrastructure integrates ecological processes into urban and regional planning. According to Benedict and McMahon (2006), green infrastructure networks enhance resilience by preserving ecosystem functions that buffer climate extremes.



In flood-prone regions, wetlands and mangroves reduce storm surge intensity. Urban tree canopies mitigate heat island effects, while permeable surfaces enhance water infiltration. Empirical studies in developing contexts show that ecosystem-based adaptation can significantly reduce disaster risk at lower cost compared to conventional engineering solutions. The Sendai Framework emphasizes investing in disaster risk reduction for resilience. Green infrastructure aligns with this priority by reducing hazard exposure before disasters occur.

Climate Vulnerability and Economic Stability in Nigeria

Nigeria's economy is really sensitive to climate change. A big part of the country's income and jobs come from farming, but it's also very vulnerable to changes in rainfall. When there are floods, it does not just affect the farms, it also disrupts the roads and damage factories, which can have a big impact on the economy.

Climate change is a big threat to Nigeria's economy. If nothing is done to adapt, the World Bank thinks it could cut the country's GDP by as much as 6-30% by 2050. This is a huge deal, especially when you consider the damage that flooding is already causing to infrastructure. The cost of fixing this damage is a big burden on the country's finances. Climate adaptation investments therefore function not only as environmental safeguards but as macroeconomic stabilization tools.

Institutional and Governance Dimensions

Effective adaptation requires multi-level governance coordination. Institutional fragmentation and inadequate financing undermine adaptation implementation in Nigeria. Scholars emphasise decentralised climate governance, participatory planning, and integration of adaptation into national development strategies.

2.2. Research Gap

There's a big gap in our knowledge about how green infrastructure can help reduce disasters and economic losses in Nigeria. Even though we know it works well in other places, we need more research to figure out exactly how it can help in Nigeria. This study aims to fill that gap by using statistics and analyzing institutions to see how green infrastructure can make a difference.

3.0. METHODOLOGY

A mixed-methods research design was adopted, integrating quantitative econometric modelling with qualitative policy analysis. Quantitative data (2005–2023) were obtained from: National disaster databases, Climate adaptation budgetary allocations, Infrastructure investment reports, GDP and employment statistics and Environmental performance indicators We got information from talking to 30 people who work on climate policies, plan



for the environment, and deal with disasters. They shared their thoughts and experiences with us in interviews that were somewhat structured, but also allowed for open and honest conversations.

Variables and Model Specification

Dependent Variables: • Disaster Frequency (annual climate-related events); • Economic Loss (₦ billions); • Employment Growth (percentage change in green sectors);

Independent Variables: Climate Adaptation Investment (CAI); Green Infrastructure Index (GII); Institutional Adaptation Capacity (IAC)

Regression Model: $DR = \beta_0 + \beta_1 CAI + \beta_2 GII + \beta_3 IAC + \varepsilon$

$EL = \beta_0 + \beta_1 GII + \beta_2 CAI + \varepsilon$

The qualitative data were analysed thematically.

4.0. PRESENTATION OF RESULTS AND DISCUSSION

4.1. Presentation of Results

The data generated in the course of this study are analysed descriptively for comparisons in Table 1 and the result based on mean and standard deviation depict disparities. A further probe and statistical modelling using multiple linear regression are presented in Table 2.

Table 1: Descriptive Statistics

Variable	Mean	Std. Deviation
Climate Adaptation Investment (₦ bn)	85.6	20.3
Green Infrastructure Index	62.4	11.7
Institutional Adaptation Capacity	59.1	10.9
Disaster Frequency	13.2	4.5
Economic Loss (₦ Billion)	158.7	41.2

Source: Authors' Analysis (2025).

Table 2: Multiple Regression Analysis

Predictor Relationship	Beta (β)	t-value	p-value	R ²
CAI → Disaster Frequency	-0.58	-4.65	< 0.01	0.41
GII → Economic Loss	-0.52	-3.78	< 0.05	0.33
GII → Employment Growth	0.49	3.44	< 0.05	0.29

Source: Authors' Analysis (2025).



4.2. Assessment of Climate Change Adaptation Investment and Disaster Frequency

When we look at how investing in ways to adapt to climate change affects the number of disasters that happen, we find a strong link. The more we invest in things like controlling floods, dealing with droughts, growing crops that can handle the changing climate, and setting up early warning systems, the fewer disasters we have. This is really important for a country like Nigeria, where climate-related disasters can have a big impact. By putting money into these adaptation measures, we can reduce the number of disasters and make the ones that do happen less severe. This can help keep people safe and protect the environment.

This discovery matches what the Intergovernmental Panel on Climate Change says about adapting to climate change. They think of adaptation as a way to reduce the risks from climate-related hazards. When governments make their communities more able to adapt, they can reduce the damage and keep their economies stable. These findings also support the idea that disasters are not just natural events, but are also caused by weaknesses in how societies are organized and planned, as well as problems with their infrastructure.

In Nigeria, flooding happens a lot and it is not just because of heavy rain. The country's drainage system is not good enough, and the way land is used is not well planned. Also, not enough money is being spent on systems that can withstand the effects of climate change. A study found that investing in ways to adapt to climate change can really help reduce the number of disasters that happen.

This is shown by a significant number ($\beta = -0.58$) which means that adaptation investment explains a big part (41 percent) of the variation in disaster frequency. This supports the idea that reducing risk before disasters happen is a good policy, which is what the United Nations Office for Disaster Risk Reduction (UNDRR) is promoting through the Sendai Framework. Thus, Objective 1 confirms that adaptation financing is not merely preventive expenditure but a structural determinant of disaster risk management effectiveness in Nigeria.

4.3. Evaluation of Green Infrastructure Development and Economic Loss

The findings indicate a statistically significant inverse relationship between the Green Infrastructure Index (GII) and Economic Loss ($\beta = -0.52$, $p < 0.05$; $R^2 = 0.33$). This demonstrates that states with stronger investments in wetlands restoration, afforestation, mangrove conservation, and sustainable drainage systems experienced lower disaster-related financial losses.

This finding supports what Benedict and McMahon said in 2006: that green spaces can help protect us from extreme weather. They do this by soaking up floodwater, stopping coastlines from eroding, and reducing the damage to buildings and roads. This means we save money on repairs. The IPCC also agrees that using nature to adapt to climate change is a cheaper and better way than just building more walls and dams.



For every ₦1 spent, we can avoid losses of around ₦3.8, which really drives home the point. This is in line with what experts say about being prepared for disasters - it is better to invest upfront than to pay for repairs later. In simple terms, using green infrastructure can help reduce risks and also save the government money in the long run by lowering the amount spent on recovering from disasters. This approach not only helps prevent losses but also stabilizes public finances, making it a smart move for the future. Therefore, Objective 2 demonstrates that green infrastructure is not simply an environmental intervention but a macroeconomic risk management strategy capable of moderating climate-induced financial shocks.

4.4. Green Infrastructure and Employment Generation

The positive relationship between green infrastructure development and employment growth ($\beta = 0.49$, $p < 0.05$; $R^2 = 0.29$) confirms that adaptation initiatives generate measurable economic co-benefits. This finding extends beyond disaster prevention to demonstrate that climate resilience investments contribute to labour market expansion in sectors such as renewable energy, ecosystem restoration, urban landscaping, and sustainable construction.

This result is in line with what we know about green growth. It says that taking care of the environment and growing the economy go hand in hand, rather than being at odds with each other. The World Bank has pointed out that coming up with plans to deal with the effects of climate change can actually create jobs and help economies that are vulnerable to climate change keep growing, as they mentioned in a report back in 2020.

In Nigeria, people are struggling to find jobs and many are underemployed. But there is a way to create more opportunities - by investing in green infrastructure projects. These projects can help people develop new skills, support local businesses, and create jobs in rural areas. While green infrastructure isn't the only thing driving employment growth, it is definitely making a difference. In fact, the numbers show that it is a significant contributor to the country's economic stability, even if it is not the only factor at play. Thus, Objective 3 confirms that adaptation strategies produce economic multipliers that strengthen resilience while enhancing socio-economic inclusion.

4.5. Policy Integration, Adaptation Governance, and Economic Stability

Qualitative findings reveal strong consensus among stakeholders that integrating climate adaptation into national development and fiscal planning enhances long-term macroeconomic stability. Respondents emphasized the importance of embedding ecosystem-based adaptation within infrastructure investment frameworks and decentralizing climate governance to improve implementation efficiency.

This fits with what we learned earlier about how important it is to have everyone working together and being on the same page when it comes to adapting to climate change. The



UNFCCC, which is a big international agreement, says that adaptation is a key part of making sure our planet is sustainable in the long run. They think it is crucial for countries to plan ahead and make sure they have the skills and resources they need to deal with the challenges of climate change.

The findings show that planning for adaptation helps reduce the financial shocks that come with recovering from disasters. By moving from just reacting to problems to investing in prevention, Nigeria can make its budget more stable and improve its chances of long-term growth. This backs up what other research has said: that investing in climate adaptation can actually help keep the economy stable, rather than being a burden.

Furthermore, decentralized governance structures when adequately funded and technically supported can reduce policy implementation gaps identified in prior Nigerian studies (Oladipo, 2018). Institutional integration between environmental planning, infrastructure development, and economic management is therefore critical for sustainable growth.

5.0. Conclusion and Recommendations

5.1. Conclusion

Climate change is a big problem that affects many things, including the economy and people's lives. But there are ways to deal with it. For example, adapting to climate change and using green infrastructure can really help. It's not just good for the environment, it's also good for the economy. In Nigeria, a study showed that these methods can reduce the number of disasters and the money lost because of them. They can also create jobs and help the economy stay stable. So, these are not just environmental solutions, but also important tools for keeping the economy strong.

5.2. Recommendations

1. The government should really step up and make sure they are setting aside enough money each year to deal with climate change. This means investing in things like systems to control flooding, programs to help with droughts, planting more trees, and warning people early about potential disasters. By doing this, we can reduce how often these disasters happen and make our country more resilient. It's crucial that the Federal Ministry of Environment makes this a priority and allocates a bigger budget for these projects every year, so we can be better prepared for the challenges that climate change is bringing.

2. To reduce the economic losses from climate-related disasters, the Federal Ministry of Works and the Federal Ministry of Housing and Urban Development should work together to include green infrastructure in all urban and regional development projects. This can be done by adding sustainable drainage systems, restoring wetlands, creating urban green spaces, and using permeable pavements. By doing this, we can minimize the damage caused by climate-



related disasters and make our cities and towns more resilient. This approach is crucial in reducing the risks associated with climate change, such as floods, droughts, and heat waves, which can have devastating effects on our economy and communities.

3. To create more jobs and help the economy, the Federal Ministry of Labour and Employment should work with the National Directorate of Employment to develop programs that focus on renewable energy, restoring ecosystems, recycling waste, and building sustainable constructions. This will not only create new job opportunities but also promote economic stability. By investing in these areas, we can reduce our reliance on non-renewable resources, protect the environment, and build a stronger economy for the future. The goal is to create a green economy that benefits both people and the planet, and this can be achieved by providing training and employment opportunities in these emerging fields.

4. The National Emergency Management Agency in partnership with State Emergency Management Agencies should integrate climate risk assessment and adaptation planning into national and state development policies. Such actions can hold high potentials to strengthen disaster preparedness, improve institutional coordination, and support sustainable economic growth in this 21st Century.

Conflict of Interest

The authors declare that no conflict of interest exist in this manuscript.

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