

## Green Features: A Pathway to Climate Change Mitigation in Gombe State University (GSU), Nigeria

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### Abstract

The adoption of green features in the built environment has emerged as a promising pathway towards climate change mitigation. This article explored the role of green features in mitigating climate change concerns within the Nigerian context, with a focus on the case study of Gombe State University (GSU) as a case study. The study employed a multiple approach, including literature review, case study analysis, and content analysis of relevant documents, to investigate the implementation of sustainable sustainability initiatives at GSU. Key findings from the study revealed that GSU has made a significant stride towards climate change mitigation by successfully implemented various green initiatives, including afforestation, erosion control measures, renewable energy integration, and eco-friendly waste management. Specifically, the university has planted over 3,000 seedlings (including 500 date palms and other fruit and non-fruit trees) and established a mini-animal zoo park for animal conservation. These efforts have greatly demonstrated an improved eco-friendly and conducive learning atmosphere and mitigate the effect of climate change and in return reduced the carbon footprint and erosion control. The research concluded by demonstrating that green features can be a successful strategy for Nigerian universities to combat climate change and create sustainable campuses. Thus, recommending integration of green features into institutional policies, increased awareness campaigns within the educational sector, encouraging renewable energy adoption, implementing comprehensive waste management strategies, and further research on optimizing green features for the Nigerian context. By embracing these recommendations, Nigerian universities can serve as models for climate change mitigation and sustainable development, contributing to the country's efforts to achieve SDGs Goals 13.

*Keywords:* Climate Change, Nigeria, Sustainable Development Goals, Mitigation

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### 1.0 INTRODUCTION

Sustainable development aims to improve humanity's well-being while addressing environmental issues. In September 2015, leaders from 193 countries and the United Nations (UN) General Assembly adopted the resolution "2030 Agenda for Sustainable Development," which includes 17 Sustainable Development Goals (SDGs) and 169 related targets to ensure a sustainable future for economic, social, and environmental development (Aguene, 2021).

In Nigeria, this challenge is particularly acute, as the country faces rapid urbanization, resource depletion, and the growing impacts of climate change. Central to this agenda is the development of green buildings, which seek to resolve the contradiction between scarce resources and the significant resource demands created by non-green structures (Abdulsalam et al., 2023). The need to simultaneously enhance the quality of life in buildings while reducing harm to the environment led to the development of green building practices in sustainable real estate. These practices encompass several aspects such as innovative design, efficient operation, construction, and maintenance of structures (Abdulsalam et al., 2024). In addition to contributing 20% or more of the world's greenhouse gas emissions, these buildings also generate trash, pollute the environment, use water resources excessively, and deplete natural resources (Agenda, 2016). Consequently, there is greater awareness of green building as a strategy to combat these climate change concerns in the 21st century has risen due to the challenges faced by global climate change, pollution, and the depletion of unfavourable natural resources (Parashar and Parashar, 2012). However, life without properties can also be miserable and dangerous; therefore, it's vital to maintain an evolving equilibrium free of environmental dangers. A new design conception, operation, construction/renovation, and building maintenance method known as "green building" has emerged due to the combination of these difficult variables (Kane, 2017).

Public tertiary education institutions play a crucial role in society by promoting knowledge, skills, and values necessary for a sustainable future. However, many institutions struggle to put sustainability commitments into actual actions (Narayan, 2008). Chi-Nguyen, (2012)'s study revealed that building provides a framework for our daily lives related to every country's progress. In addition, the

building industry generates roughly 40%-70% of greenhouse gas emissions (Warren-Myers et al., 2020), making it a more substantial contributor to global greenhouse gas emissions, and contributing considerably to climate change (Hurlimann et al., 2019).

The global concern of Climate change challenges is critical, Nigeria is already feeling the consequences of climate change with increased flooding and erosion, drought, land degradation, extreme weather and loss of biodiversity (Haider, 2019). Climate change has subjected two-thirds of Nigeria to the risk of desertification (Olaniyi et al., 2013). Nigeria is placed among the top ten countries affected by climate change (Okon et al., 2021). In line with these challenges, GSU has made significant strides in addressing climate change and environmental sustainability.

However, this research investigates the “Green Features: A Pathway to Climate Change Mitigation” with reference to Gombe State University (GSU), Nigeria. The study aims to achieve its objective by investigating climate change in Nigeria, exploring the nature of green features implemented in GSU through literature review, case study, and content analysis. The study employed a qualitative research approach to thoroughly explore the focal subject matter. This involves utilizing secondary data obtained from a various scholarly resource (published journal articles, books, book chapters, and conference proceedings). Thus, the study provides recommendations and strategic ways to promote sustainable practices in our tertiary institutions in Nigeria.

This study will go a long way in contributing to general body of knowledge in the context of green building initiatives, climate change and SDGs Goal 13 (climate change action). In addition, it also showcases the level of green initiatives and awareness at GSU to which other tertiary institutions can leverage on the opportunities. The recommendations from the study will impact climate change stakeholders, government, the GSU management and other related professions in decision making and insights for policy and practices in green building and climate change especially in Northeast and Nigeria as a whole.

### 1.1 Issue

Global warming has increasingly gained worldwide recognition over the past decade. The negative effect poses on the environment by the development of Conventional properties instead of sustainable properties has inevitably contributed to a global appeal for a better approach. As a developing country with the regular growth of mass property due to the growing population of the country. Nigeria has suffered from adverse environmental impact of traditional development of conventional methods of building construction (non-green building); the sector is affected by the consumption of excessive energy, water, accumulated waste, environmental problems (air pollution, noise pollution); the consumption of natural and manufactured materials for which the construction industry is responsible (Kane, 2017). However, these lead to an increase in heat, drought and insect outbreaks that are in one way or the other linked to climate change action, thereby declining supplies of water, reduction in agricultural yields, health issues due to heat, flooding and erosion in coastal areas are of concern to the United Nation Assembly, which led to the adoption of 2030 Agenda by the United Nation Assembly in 2016.

As a result of the related context, it is against this precedent that the study seeks to strengthen its findings on the Implementation of Green building features as a way of curbing Climate Change Action (SDG Goal 13) in Gombe State University (GSU), Gombe, Nigeria.

## 2.0 LITERATURE REVIEW

### 2.1 Nigeria SDGs Overview

Nigeria as a country, has continued to demonstrate its commitment towards achieving Sustainable Development Goals (SDGs) which address major development challenges since its adoption in September 2015 as reported by United Nations. Nigeria's role in achieving the SDGs is crucial due to its population and impact on the African continent (Emah, 2023).

Nigeria's progress in the Sustainable Development Goals (SDGs) is attributed to government attention which leads the country's rise in the SDG index (Benjamin et al., 2024). Despite challenges like the COVID-19 pandemic affecting the SDG progress, the Federal Government of Nigeria has implemented policies outlined in the Nigeria Economic Recovery and Growth Plan, such as promoting sustainable management of natural resources, reducing gas flaring, and installing solar systems (Fada et al., 2022). In addition, Nigeria is striving to work towards the SDGs, despite facing security crises and social tensions, by addressing issues like poverty, environmental degradation, and social inequalities. Thus, aiming to end poverty, protect the planet, and ensure peace and prosperity for all its citizens by 2030 through the implementation of the 17 SDGs and associated targets (Oluwasuji, 2023).

Nigeria as a nation has embarked on the implementation of the Sustainable Development Goals (SDGs) after the 2030 Agenda was adopted by the United Nations Assembly in 2016 with the rapid establishment of institutional structures at the national and international level to support smooth implementation, as reported by (Government of Nigeria, 2020) the following strategies were implemented in Nigeria:

1. The Nigeria Government developed a National Transformation Strategy from the Millennium Development Goals (MDGs) to Sustainable Development Goals (SDGs) in 2016.
2. Nigeria SDGs-Indicators Baseline Report, 2017 (SDGs data mapping and publication)
3. Nigerian Economic Development and Growth Plan (ERGP), 2017 – 2020 (consolidation of social, environmental and economic attributes of SDGs into ERGP)
4. Nigeria, in 2019, developed Home and customization of the Integrated Strengthening Policy Model (SDGs)
5. Re-design of National Statistical System (NSS) indicators and requirements of the SDGs to be finalized by August 2020
6. Integrated National Financial Plan (INFF) SDGs were initiated and implemented.
7. Nigeria reviewed and conducted the second Volunteer Review (VNR) on the execution of the SDGs in Nigeria

## 2.2 Nigeria Overall Performance

**Table 1** Nigeria SDGs Scorecard

No.	Description	Score
1.	Overall Index score	49.3/100
2.	Regional Average score	53.1/100
3.	SDG Global Rank	160 (of 166)
4.	Spill over score	99.15/100

Table 1 captured the performance of all scorecards in Nigeria according to the SDGs report 2020 the national scorecard rated on full progress towards achieving all 17 SDGs. The points represent the Nigerian percentage of SDG achievement globally, regionally, target points and waste school. The table shows that the total Nigerian index is 49.3%, the regional average is 53.1%, and the spill over rate is 99.1% while calculating 160 out of 166 countries in the Global SDG. Thus, this means that national action can have positive or negative consequences for other countries in achieving their SDG goals. At the same time, the Spill Index assesses those spillovers on four levels: environmental, economic and financial, social and security. Achieving high scores means that the world is producing positive and negative results.

## 2.3 Climate Action in Nigeria

The pressing need to combat the challenges of climate action has prompted the actors in the field including multilateral organizations, institutions and countries to embark on research to address climate issues globally. Nigeria has made significant progress towards achieving SDG 13, particularly through policies focused on environmental sustainability. The Federal Government of Nigeria has implemented policies outlined in the Nigeria Economic Recovery and Growth Plan, such as promoting sustainable management of natural resources, reducing gas flaring, and installing solar systems (Fada et al., 2022). Sustainable Development Goal 13 (Climate Change Action) in Nigeria is on track (maintaining SDG success) with an average of 98% performance, according to the SDGs report. Since Nigeria became a member of the United Nations Framework Convention on Climate Change (UNFCCC) in 1994, it has played a significant role in international climate negotiating activities, in which the Kyoto Protocol in 2014 and the Paris Agreement in 2017 were ratified. In other developments, Nigeria sent the first National Communications in 2003, the Second National Communications in February 2014 to honour its reporting obligations, and more recently, under the Paris, Agreement drafted its National Determined Contributions (NDC) obligations in November 2015. (Federal Ministry of Environment, 2020). Goal 13 of the Sustainable Development Goals calls for action to combat climate action (change) and its adverse effects. All nations on every continent have been, in one way or another, affected by actions in climate. It undermines the country's economy and affects people, costing people, communities, and countries more expensive today and tomorrow. Climate change profoundly affects people through rising temperature, rising sea levels, and extreme weather events, exacerbating health disparities, and necessitating urgent collective action for mitigation (United Nations, 2019).

The results have resulted in an estimated annual economic loss of \$100b, not to mention the extent of geophysical disasters, around 91% caused by climatic action. It killed 1.3m and injured 4.4b people between 1998 and 2017. By 2020, was raise to \$ 100b a year to help less-developed countries across the world combat, adapt to changes in climate, and invest in lower carbon emission growth. Activities from human are driving climate change, which has resulted in greenhouse gas emissions continuing to rise. Without action, global temperatures will grow by the 21st century, exceeding 3 degrees Celsius, when parts of the world are expected to warm even higher (United Nations, 2019).

The establishment of the Anthony Nyong Climate Centre of Excellence (ANCCE) has further contributed to Nigeria's progress by building partnerships, capacity building, and initiating waste management projects, thus, despite challenges like the COVID-19 pandemic affecting progress, Nigeria has shown commitment to addressing climate change issues (Fada et al., 2022).

However, in Nigeria, higher institutions and research institutes must play the important role of providing knowledge base for designing, implementing, and monitoring the SDG 13. Their role will fuel National governance and policy making on climate as well as identify missing gaps in potentials for climate research and studies (Fada et al., 2022).

## 2.4 Goal 13 – Climate Change Facts and Figures

The following data about SDG 13 are reported by (*Goal 13 Climate Action \_ UNDP, n.d.*):

1. It is estimated that as of 2017, approximately 1.0 ° C of global warming above pre-industrial levels are man-made.
2. Sea levels have risen by 20cm (eight inches) since 1880 and are expected to increase by another 30-122 cm (1 -4 feet by 2100).
3. The Paris bond includes only one-third of the air-conditioning needed to keep the earth below 2 ° C.
4. By taking bold action, approximately US \$ 26 trillion in economic benefits by 2030 will be the first.
5. A sustainable energy sector focusing on it will create about 18 million jobs by 2030.

However, to achieve the stated action of climate change to mitigate its effects, the following climate objectives are reported (UNDP, 2016)

1. Increase persistence and resilience in all countries to climate-related dangers and environmental disasters.
2. Integration of change in climatic strategies into national policy, strategy, and planning
3. Investing in education, awareness, and individual and institutional capacity to reduce the action of climate, adaptability, impact, and provide early warning.

4. Implementing the commitment made by the developed parties to the United Nations Climate Change Conference to pool \$ 100 billion annually by 2020 on all resources to address the needs of developing countries in the context of meaningful mitigation and transparency to implement and make full use of the Green Fund its money very quickly

**Table 2** Challenges in Achieving SDG 13 in Nigeria

S/N	Source	Challenges
1.	Benjamin et al. (2024)	<ul style="list-style-type: none"> <li>Nigeria faces challenges due to the reliance on fossil fuels for energy needs, making the transition to renewable energy expensive and inaccessible to a significant portion of the population, leading to continued greenhouse gas emissions.</li> <li>Some Nigerians engage in unsustainable practices like deforestation and burning of bush for agricultural purposes and cooking with firewood, contributing to greenhouse gas emissions, driven by economic survival needs and limited access to eco-friendly energy sources</li> <li>The absence of strong political support and knowledge on climate-related concerns hinders the implementation of climate action plans in government policies and actions in some states, resulting in a lack of progress towards achieving SDG 13 in many Nigerian communities</li> <li>The country struggles with transitioning to renewable energy sources due to the high cost, leading to reliance on fossil fuels and contributing to environmental issues.</li> </ul>
3.	Oluwasuji (2023)	<ul style="list-style-type: none"> <li>The country has experienced numerous violent conflicts leading to loss of lives, displacement of people, and destruction of properties, creating a general atmosphere of social tension</li> <li>The increasing security challenges posed by Fulani herdsmen in different communities, including conflicts with landowners and the use of sophisticated weapons, contribute to the overall insecurity in the country</li> </ul>

**Table 3** Chronological Climate Action Milestones in Nigeria

S/N	Policy	Year	Description	Shortcomings to the Implementation of the Policies
1.	Nigerian Biofuel and Incentives	2007	<ul style="list-style-type: none"> <li>The policy is aimed at assisting in developing the biofuel economy to slowly decrease reliance on imported fuel, reduce Greenhouse gas emissions, and promote economic development. Substantive initiatives include the launch of biofuel compounds containing 10% ethanol and a variety of initiatives aimed at increasing market demand for biofuels and boosting their output (e.g., tax exemption). This policy involves the formation of the Biofuel Energy Commission and the Biofuel Research Agency, as well as the goal of producing 100 percent of the biofuels consumed in the country by 2020.</li> </ul>	<ul style="list-style-type: none"> <li>Lack of technology transfer provisions in the policy hinders the development of indigenous capabilities in the biofuel industry, similar to the challenges faced in the oil and gas sector due to dependency on foreign expertise.</li> <li>Slow progress in the construction of bioethanol factories and infrastructure development indicates a lack of effective implementation and government focus on biofuel initiatives, jeopardizing the policy's ability to transform Nigeria into a biofuel economy. (Ohimain, 2013)</li> </ul>
2.	Nigeria Vision 2020	2009	<ul style="list-style-type: none"> <li>Climate action harms development processes and the environment, according to Vision 2020. (I) improves economic benefits through sustainable environmental management; (ii) promotes ecological education; and (iii) enhances environmental management. The following are the goals of the concrete climate policy developed under Vision 2020:</li> <li>Increasing the portion of power generation mixes to 25% by 2013</li> <li>Raise wind power to 10MW by 2013</li> <li>Increasing solar energy to 10MW by 2013</li> <li>Increasing generation of biomass capacity to 1,000 MW</li> <li>Increasing forest coverage from 6% to 10%</li> <li>Reduction of losses and effects due to floods and droughts by 10% by 2013</li> </ul>	<ul style="list-style-type: none"> <li>Lack of consistent implementation of development plans and projects is a major shortcoming in achieving Nigeria's Vision 2020. Nigerian leaders need to focus and maintain continuity in executing these plans to ensure success.</li> <li>Insufficient private sector investment, transparency, good governance, and efforts to reduce crime and poverty rates among youths and the unemployed are also identified as factors that may inhibit the successful implementation of Nigeria's Vision 2020.</li> <li>Inadequate funding poses a significant challenge to the implementation of Vision 2020. Adequate financial resources are crucial for the successful execution of development plans, including investments in key sectors (Jibril &amp; Anas, 2013)</li> </ul>

4.	National Policy on Climate Change	2010	<ul style="list-style-type: none"> <li>• Within the framework of socio-economic development. Its primary goals are as follows:</li> <li>• Implement mitigation initiatives that promote low-carbon and long-term economic growth.</li> <li>• Increasing national capacity for climate change adaptation</li> <li>• Increasing national capacity for adaptation to climate change</li> <li>• Enhance climate change scientific research, innovations, and R&amp;D to a new level, allowing the country to play a more active role in international scientific and technological cooperation on climate change.</li> <li>• Increasing public awareness and engaging private sector companies in solving global challenges in the change of climate</li> <li>• It enhances National institutions and mechanisms (policy, legal, and economic) to create an appropriate and effective structure for climate change management.</li> </ul>	<ul style="list-style-type: none"> <li>• Limited emphasis on the involvement of local communities in decision-making processes, which could lead to challenges in implementing climate-resilient development initiatives.</li> <li>• Lack of clear strategies for monitoring and evaluating the progress of the policy implementation, making it difficult to assess its impact and effectiveness in addressing climate change challenges.</li> <li>• The policy may not adequately address the economic consequences of climate change, which could result in significant costs to the country's GDP if concrete adaptation actions are not taken.</li> </ul>
5.	National Renewable Energy and Energy Efficiency Policy (NREEEP)	2015	<ul style="list-style-type: none"> <li>• This document lays out the government's stance on improving renewable energy generation efficiency in the country.</li> </ul>	<ul style="list-style-type: none"> <li>• The NREEEP lacks effective legislation to support its implementation, hindering the rapid development of renewable energy in Nigeria</li> <li>• The lack of a renewable energy law contributes to low interest from investors, as there is no clear legislation outlining the roles and responsibilities of stakeholders in the renewable energy sector</li> <li>• There are gaps in follow-ups and management of the policy, as there is no unifying umbrella under which all the policies could be effectively managed and implemented.(Daudu &amp; Idehen, 2021)</li> </ul>
6.	National Gas Policy	2017	<ul style="list-style-type: none"> <li>• National Gas Policy aims to set goals and implement the institutional framework for the gas sector.</li> <li>• This document explicitly emphasizes the use of Liquefied Petroleum Gas (LPG) to combat climate change, reduce deforestation, and improve public health.</li> </ul>	<ul style="list-style-type: none"> <li>• The National Gas Policy 2017 faces challenges due to shortages in infrastructure, hindering the free flow of gas across states and restricting transmission channels to a single route.</li> <li>• The policy aims for efficient and transparent gas transportation agreements with flexibility for third-party access, but there may be challenges in fully implementing this aspect, which could impact the policy's effectiveness.</li> <li>• There may be challenges in ensuring full compliance with domestic gas obligations by stakeholders, which could hinder the policy's goal of commercializing gas to stimulate economic growth and enhance electricity generation.</li> <li>• To ensure the effective implementation of the National Gas Policy 2017, there is a need for a robust regulatory agenda in the Nigerian gas sector. (Timitimi, 2022)</li> </ul>
	Economic Recovery and Growth Plan	(2017-2020)	<ul style="list-style-type: none"> <li>• The Economic Recovery and Growth Program aims to promote sustainable economic development in Nigeria from 2017 to 2020. It is a documentary of various</li> </ul>	<ul style="list-style-type: none"> <li>• The Nigeria Economic Recovery and Growth Plan (ERGP) faces a significant challenge due to</li> </ul>

			<p>strategies that outlines detailed approaches, particularly in the areas of climate change, renewable energy production and utilization, energy efficiency, and land and desert destruction.</p>	<p>the absence of a legal framework supporting its establishment and execution.</p> <ul style="list-style-type: none"> <li>The general economic performance in Nigeria has been undermined by issues such as corruption and mismanagement of public finances. Addressing these challenges is crucial for the effective implementation of the ERGP and the overall economic development of the country.</li> <li>The implementation of Development Plans in Nigeria is often hindered by political risks. Changes in government have historically led to the neglect of these plans, impacting their success. This highlights the importance of stability in government for the successful implementation of national plans (Solomon and Fidelis, 2018)</li> </ul>
8.	The flare gas (prevention of waste and pollution) regulations	2018	<ul style="list-style-type: none"> <li>Flammable gas regulations establish a legal framework to follow the objectives of the State Government to reduce GHG emissions by burning and releasing natural gas.</li> <li>The main objectives of the regulations are <ol style="list-style-type: none"> <li>To reduce the environmental and social impact of natural gas explosions,</li> <li>To prevent the depletion of natural resources, and</li> <li>To create social and economic benefits through gas extraction.</li> </ol> </li> <li>This document presents several facts: <ol style="list-style-type: none"> <li>The legal basis for the implementation of the Nigerian Gas Flare Commercialization Program (NGFCP)</li> <li>A new gas-fired regime - "pollutant pays" goal and</li> <li>Obligations to producers and gas emissions reporting projects</li> </ol> </li> </ul>	<ul style="list-style-type: none"> <li>The fines received as gas-flaring penalties are supposed to be utilized for environmental remediation and relief of host communities. However, the effectiveness of this provision depends on how efficiently these funds are utilized, and if mismanagement occurs, it can undermine the intended benefits for affected communities. (Olujobi et al., 2022)</li> <li>Absence of Comprehensive Legislative Framework</li> <li>Without robust enforcement measures in place, such as penalties for failure to provide accurate data or incomplete data, the regulations may not be effectively enforced, allowing non-compliance to persist.</li> <li>The regulations may lack stringent penalties that are necessary to deter gas flaring effectively. This can lead to continued flaring activities without significant consequences</li> <li>The absence of transparent guidelines on how waivers and approvals for gas flaring are granted can create a culture where politically sensitive projects escape regulatory scrutiny, impacting the effectiveness of the regulations. (Babalola &amp; Olawuyi, 2022)</li> </ul>
	Nigeria Economic Sustainability Plan	2020	<ul style="list-style-type: none"> <li>Flammable gas regulations establish a legal framework to follow the objectives of the State Government to reduce GHG emissions by burning and releasing natural gas.</li> <li>The main objectives of the regulations are <ol style="list-style-type: none"> <li>To reduce the environmental and social impact of natural gas explosions,</li> <li>To prevent the depletion of natural resources, and</li> <li>To create social and economic benefits through</li> </ol> </li> </ul>	<ul style="list-style-type: none"> <li>There is often a wide gap between the formulated policy goals and their actual achievement due to ineffective implementation in various facets of public administration in Nigeria.</li> <li>Lack of continuity in economic policies by successive governments has been identified as a problem in Nigeria, contributing to the</li> </ul>



		<p>gas extraction.</p> <ul style="list-style-type: none"> <li>This document presents several facts:                     <ol style="list-style-type: none"> <li>The legal basis for the implementation of the Nigerian Gas Flare Commercialization Program (NGFCP)</li> <li>A new gas-fired regime - "pollutant pays" goal and</li> <li>Obligations to producers and gas emissions reporting projects</li> </ol> </li> </ul>	<p>country's economic challenges.</p> <ul style="list-style-type: none"> <li>Poor economic performance in Nigeria has also been attributed to a weak institutional framework, further hindering the effective implementation of economic sustainability plans.</li> <li>Limited financial resources or budgetary constraints could impede the full execution of the initiatives outlined in the Economic Sustainability Plan, affecting its overall impact and reach.</li> <li>Political instability or changes in government leadership may lead to disruptions in the implementation of the plan, affecting its continuity and long-term success.(Anam et al., 2023)</li> </ul>
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Sources: (Nigerian Biofuel Policy and Incentives - Climate Change Laws of the World, n.d; Nigeria Vision 2020 - Climate Change Laws of the World, n.d; National Policy on Climate Change, 2009; FAO.org , n.d; Economic Recovery and Growth Plan – the Statehouse, Abuja, n.d; Nigeria Economic Sustainability Plan (NESP) | Climate Policy Database, 2021; Obayomi, 2018)

### 2.5 Challenges in achieving SDGs Goals Implementation in Nigeria

The following present the hindering challenges/factors in achieving or implementing SDGs goals in Nigeria as reported by (Federal Republic of Nigeria, 2017)

- The general humanitarian crisis in the north-eastern region, Niger Delta militancy, and the herders/farmers' crisis also challenge the implementation of SDGs in Nigeria.
- Nigeria's reliance on the oil/gas sector, the decline in agricultural production/productivity, limited agriculture value addition, and the country's general economic recession caused by the Covid-19 pandemic and fluctuation in global oil prices are significant challenges to SDG implementation.
- The gap and deficit in technological advancement and infrastructure are significant impediments to achieving the SDGs.
- The need for more public institutions to produce SDG data for various initiatives and monitoring of SDG across the three levels of government.

**Table 4** Challenges in Implementing SDGs in Nigeria

S/N	SOURCE	CHALLENGES
1.	Benjamin et al. (2024)	<ul style="list-style-type: none"> <li>Some Nigerians engage in unsustainable practices like deforestation and greenhouse gas emissions due to economic survival needs and limited awareness of eco-friendly alternatives, hindering SDG adoption.</li> </ul>
2.	Fada et al. (2022)	<ul style="list-style-type: none"> <li>Nigeria faces challenges in achieving SDG implementation due to its vast development needs and economic constraints, including a deteriorating fiscal space and rising debt levels.</li> </ul>
3.	Oluwasuji, (2023)	<ul style="list-style-type: none"> <li>Nigeria faces significant challenges in terms of security crises such as insurgency, kidnapping, banditry, terrorism, Fulani herdsman menace and inter-communal clashes, which hinder the progress towards SDG attainment.</li> <li>Disparities in literacy levels between regions, with significantly lower literacy rates in certain areas, pose a challenge to achieving educational SDGs in Nigeria.</li> </ul>
4.	Ejiogu et al. (2024)	<ul style="list-style-type: none"> <li>Economic growth disparities between regions, particularly with declining human development in rural areas and the north, pose a challenge to achieving balanced development across the country.</li> <li>Poor federal-state coordination contributes to challenges in public service delivery and hinder progress towards SDG.</li> </ul>
5.	Aguene (2021)	<ul style="list-style-type: none"> <li>Nigeria faces challenges in achieving the Sustainable Development Goals (SDGs) due to poor health outcomes, such as high maternal mortality rates, which have shown some improvement but still need significant progress.</li> </ul>
6.	Emah (2023)	<ul style="list-style-type: none"> <li>Corruption among public officials has been a major challenge in the implementation of development programs, hindering progress towards sustainable development.</li> <li>Rising poverty levels in Nigeria have posed a significant obstacle to achieving the SDGs, impacting efforts to reduce poverty and improve overall well-being.</li> <li>Poor budgetary allocations to critical sectors have limited the effectiveness of programs aimed at achieving the SDGs, affecting the quality-of-service delivery and outcomes.</li> <li>Weak development policies and programs have impeded the successful implementation of sustainable development initiatives, leading to slow progress in meeting the SDG targets.</li> </ul>

### ■3.0 CASE STUDY: GOMBE STATE UNIVERSITY, (GSU), NIGERIA

Gombe State University, better known as (GSU) was created in 2004 as a tertiary non-profit institution in the Tudan-Wada area of Gombe. The University is accredited by the National Universities Commission of Nigeria (NUC) with a student enrolment range of 500-999 when it first takes off (Gombe State University \_ Standards and Review, n.d.).

#### 3.1 Gombe State University (GSU) Strategy on Climate Action (Goal 13)

The site of Gombe State University (GSU), before its establishment in 2004, was characterised with desert encroachment, gully erosion, and devastated infrastructures (unmaintained buildings and facilities).

The GSU management in 2004, when it took off, immediately swung into action in curbing the adverse effect of climatic change action on land and the environment of the university by planting no less than three thousand (3,000) seedlings (Over five hundred date-palm seedlings and Other varieties of fruit- and non-fruit-bearing trees to replace the uprooted trees), most of which are now matured and serve as gully erosion control and management, thereby making the University environment weather-friendly and very conducive for teaching, learning and research activities as well as checkmating the effect of global warming and erosion control (Dailytrust, 2016).

However, other measures of preserving nature are also seen in animal conservation by the Department of Zoology by establishing a mini-animal zoo park at the University. The zoo has been a notable attraction to the community and Gombe people.



**Figure 1** Dates trees innitiaves at GSU



**Figure 2** Cross section of green innitiaves at GSU

(Source: *Picture Gallery – Gombe State University*. (n.d.). <https://gsu.edu.ng/home/medium-gallery/>)





**Figure 3** Green initiatives at GSU main entrance gate



**Figure 4** Zoological park at GSU

(Source: *Picture Gallery – Gombe State University*. (n.d.). <https://gsu.edu.ng/home/medium-gallery/>)



**Figure 5** Ostriches at GSU zoological park



**Figure 6** Lion at GSU zoological park

(Source: *Picture Gallery – Gombe State University*. (n.d.). <https://gsu.edu.ng/home/medium-gallery/>)

**Table 5** SWOT Analysis of Gombe State University's Green Initiatives

STRENGTH	WEAKNESS
<p><b>Climate-Conscious Design</b></p> <ul style="list-style-type: none"> <li>GSU has demonstrated a strong awareness of climate change challenges and has implemented various physical green features to mitigate its impacts.</li> </ul> <p><b>Erosion Control and Land Conservation</b></p> <ul style="list-style-type: none"> <li>Effective measures have been taken to control erosion and conserve land, transforming the campus environmental stability</li> </ul> <p><b>Low Carbon Emissions</b></p> <ul style="list-style-type: none"> <li>GSU's green initiatives have contributed to reducing greenhouse gas emissions and improving air quality on campus. Thereby contributing to more environmentally friendly and weather-friendly campus environment, potentially enhancing the learning experience for students.</li> </ul>	<p><b>Resource Limitations</b></p> <ul style="list-style-type: none"> <li>A significant weakness lies in the challenges with the availability of water sources and the high cost of eco-friendly materials.</li> </ul> <p><b>Maintenance and Monitoring Gaps</b></p> <ul style="list-style-type: none"> <li>There appears to be a lack of a robust monitoring and evaluation system for maintenance, potentially impacting the long-term effectiveness of green features</li> </ul> <p><b>Energy and Material Constraints</b></p> <ul style="list-style-type: none"> <li>The university is hindered by limited access to sustainable energy sources and the high cost of eco-friendly materials which hinder broader implementation of green practices.</li> </ul>
OPPORTUNITY	THREAT
<p><b>Renewable Energy Prospects</b></p> <ul style="list-style-type: none"> <li>GSU has the opportunity to harness Nigeria's renewable energy potential by exploring options like solar or wind power generation. This could reduce reliance on traditional energy sources and enhance its sustainability operations.</li> </ul> <p><b>Enhanced Visibility</b></p> <ul style="list-style-type: none"> <li>Effective promotion of GSU's green initiatives (mini-animal zoo park) can attract tourists and visitors, establish the university as a leader in sustainable practices within Nigeria thus, enhancing community engagement and awareness.</li> </ul> <p><b>Environmental Resilience</b></p> <ul style="list-style-type: none"> <li>The successful implementation of green features has the potential to create a conducive learning environment and promotes resilient campus atmosphere.</li> </ul> <p><b>Waste Management Innovation</b></p> <ul style="list-style-type: none"> <li>Adopting best practices in waste management, such as waste-to-energy or waste-to-wealth programs, can further improve GSU's environmental impact.</li> </ul>	<p><b>Climate Change Impacts</b></p> <ul style="list-style-type: none"> <li>Climate change itself poses a threat to GSU's green spaces. Extreme weather events or changing weather patterns could damage existing green features or necessitate adaptation strategies.</li> </ul> <p><b>Political Will and Perceptions</b></p> <ul style="list-style-type: none"> <li>Shifts in political leadership and priorities could affect the continuity and support for GSU's green initiatives, posing a risk to their long-term sustainability.</li> </ul> <p><b>Population Growth</b></p> <ul style="list-style-type: none"> <li>Rapid population growth in the region may increase pressure on the university's resources and infrastructure, potentially undermining its green efforts.</li> </ul> <p><b>Funding Constraints</b></p> <ul style="list-style-type: none"> <li>Insufficient funding for green building initiatives remains a significant challenge and impede the effective implementation and expansion of green features and sustainability projects.</li> </ul>

Table 5 SWOT analysis highlights GSU's strengths and opportunities, while also acknowledging the weaknesses and threats that need to be managed. Addressing these areas will be great for GSU to enhance its sustainability efforts and continue contributing positively to climate change mitigation and environmental conservation. It's also presented a valuable tool for assessing the current state and future prospects, and it can guide decision-making and strategy development to maximize strengths, address weaknesses, seize opportunities, and mitigate threats. Gombe State University (GSU) has made some impressive achievement in implementing green features and sustainability practices on its campus. On its strength, GSU has demonstrated a proactive approach to climate change through its implementation of physical green features. They've implemented some cool green features like planting trees to control erosion and keeping the air cleaner. These initiatives can also create a more pleasant learning environment for students and successfully reduced carbon emissions, enhancing air quality on campus.

However, there are some weaknesses that need be address such as access to reliable water sources and energy seems to be an issue, and there are gaps in their maintenance and monitoring systems. The high costs of eco-friendly materials also pose a barrier. Nevertheless, GSU present several opportunities to capitalize on. The university can tap into Nigeria's potential for renewable energy like solar or wind power which can reduce dependence on non-renewable sources, and eco-education, the university could generate additional revenue and awareness and, as such promote sustainability. The university's green initiatives, including the mini-animal zoo park, have the potential to attract tourists and enhance community engagement. Consequently, there are some challenges (threats) that could impact its progress, this includes, changes in political priorities (which might lead to a decrease in support continuity for green initiatives). Population growth pressures could all undermine the university's green efforts if not properly managed. Ensuring sufficient funding and comprehensive planning will be crucial to maintaining and expanding GSU's sustainability initiatives over the long term. SWOT analysis provides a snapshot of the internal strengths and weaknesses of the subject (the area or initiative in focus) as well as the external opportunities and threats it faces. It's a valuable tool for assessing the current state and prospects, and it can guide decision-making and strategy development to maximize strengths, address weaknesses, seize opportunities, and mitigate threats.

### 3.2 Future Actions in Implementation of Green Building Features at Gombe State University (GSU)

The management of Gombe State University should also adopt the following green building principles beyond planting trees and landscaping:

1. The University should consider using renewable energy (solar power); this can be done by converting the rooftop of the walkways across the university to solar panels to generate green energy for university usage.
2. Consider the usage of effective eco-friendly waste management.
3. The university management should also consider water management (this can be done by harvesting and conserving water during rainfall which will be used for the plantation and other usage)
4. Erosion control channels should also be converted to canals and dams.
5. Use eco-friendly building materials where possible.
6. Road construction across the university should be built using concrete or interlocking instead of asphalt, as this absorbs less heat, lowering the temperature around the university.

Table 6 stated the steps that can be adopted by the management of the university for future actions. To further develop Gombe State University's (GSU) green building features, the institution should consider the following steps:

**Table 6** Suggested implementations to be adopted by the management of the university

No.	Green Building Features	Implementation
1.	Enhanced Green Infrastructure	<ul style="list-style-type: none"> <li>• Expanding Green Spaces: Augment the quantity of green spaces, such as parks and gardens, on the campus. This can encompass the establishment of rooftop gardens and vertical gardens on the exteriors of buildings to augment biodiversity and offer natural cooling.</li> <li>• Green Roofing Systems: Implement green roofing technologies on both existing and newly constructed structures. Green roofs have the ability to decrease heat absorption, control runoff, and offer insulation, resulting in a reduction in energy expenses.</li> </ul>
2.	Sustainable Energy Solutions	<ul style="list-style-type: none"> <li>• Renewable Energy Integration: Invest in renewable energy sources such as solar panels and wind turbines to decrease dependence on non-renewable energy sources, hence facilitating the integration of renewable energy. This has the potential to substantially reduce the university's carbon emissions and operational expenses.</li> <li>• Energy-Efficient Systems: Upgrade the current infrastructure by installing energy-efficient equipment such as LED lighting, energy-efficient HVAC systems, and motion-sensor lighting. This will help reduce energy consumption.</li> </ul>
3.	Water Conservation and Management	<ul style="list-style-type: none"> <li>• Rainwater Harvesting: By implementing rainwater harvesting system to collect and store rainwater for non-drinking purposes that can be used for watering plants, flushing toilets and cooling systems.</li> <li>• Water-Efficient Fixtures: Install water-efficient fixtures, such as low-flow toilets and faucets, to reduce water consumption across campus facilities.</li> </ul>
4.	Waste Management Initiatives	<ul style="list-style-type: none"> <li>• Comprehensive Recycling Programs Establish extensive recycling systems to manage waste properly. This includes sorting garbage at the source and ensuring effective recycling of items such as paper, plastic, glass, and metals.</li> <li>• Organic Waste Management: Set up composting facilities to handle organic waste from food services and landscape upkeep. The compost can be utilized to enhance the soil in the university's gardens and green spaces.</li> </ul>
5.	Sustainable Transportation	<ul style="list-style-type: none"> <li>• Eco-Friendly Transportation Options: Promote the use of bicycles and electric vehicles (EVs) by providing necessary infrastructure like bike lanes, bike racks, and EV charging stations.</li> <li>• Shuttle Services: Implement or enhance shuttle services using eco-friendly buses to reduce the carbon footprint associated with commuting.</li> </ul>
6.	Educational and Research Programs	<ul style="list-style-type: none"> <li>• Green Building Courses: Introduce academic courses and programs focused on green building technologies, sustainable development, and environmental science to educate students and staff about sustainability.</li> <li>• Research and Development: Encourage research on green building technologies and sustainability practices by providing grants and resources to faculty and students.</li> </ul>
7.	Community Engagement and Awareness	<ul style="list-style-type: none"> <li>• Awareness Campaigns: Conduct awareness campaigns to educate the university community about the importance of green building practices and how they can contribute.</li> <li>• Partnerships: Develop partnerships with government bodies, NGOs, and the private sector to share knowledge and resources for sustainable development.</li> </ul>
8.	Monitoring and Evaluation	<ul style="list-style-type: none"> <li>• Regular Audits: Conduct regular environmental audits to monitor the progress of green</li> </ul>



		<p>initiatives and identify areas for improvement.</p> <ul style="list-style-type: none"> <li>• Sustainability Reporting: Establish a system for reporting sustainability metrics and progress, ensuring transparency and accountability in achieving green building goals.</li> </ul>
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## ■5.0 CONCLUSION AND RECOMMENDATIONS

In conclusion, the adoption of green features and sustainable practices in the built environment holds great promise as a pathway to climate change mitigation in Nigeria. The urgent need to address the adverse impacts of conventional building practices on the environment, coupled with Nigeria's commitment to the Sustainable Development Goals (SDGs), has led to the exploration of innovative approaches to construction and development. Gombe State University (GSU) highlights the positive strides that can be made through conscious efforts to incorporate green building principles. From afforestation and erosion control to the utilization of renewable energy sources and eco-friendly materials, GSU exemplifies how institutions can contribute to climate change mitigation while providing conducive learning and research environments.

Nigeria's engagement with the SDGs, particularly Goal 13 on Climate Action, underscores the country's commitment to addressing the challenges posed by climate change. Policy initiatives, strategies, and regulations put in place over the years reflect a growing awareness of the need for sustainable development that considers environmental, economic, and social factors. Despite these positive steps, challenges persist, including the need for increased funding, technological advancements, and better data collection and monitoring mechanisms. The impact of humanitarian crises, economic fluctuations, and reliance on the oil and gas sector further complicate the path to achieving SDG targets. However, these challenges also highlight the interconnected nature of sustainable development and the importance of coordinated efforts across sectors.

In moving forward, Nigeria must continue to prioritize the adoption of green features and sustainable practices in its built environment. This requires a multi-faceted approach that involves collaboration between government bodies, educational institutions, private enterprises, and civil society. By embracing renewable energy, efficient waste management, and environmentally conscious construction methods, Nigeria can contribute significantly to global climate change mitigation efforts while securing a more sustainable and resilient future for its citizens. The journey towards climate change mitigation through green features is an ongoing endeavour that demands continued commitment, innovation, and collaboration at all levels of society.

However, the following present the general recommendations for promoting green features and climate change mitigation in Nigeria, particularly within the context of the built environment and educational institutions like Gombe State University:

1. Develop and implement comprehensive sustainability policies that integrate green building practices and climate change mitigation strategies into all levels of governance and decision-making processes.
2. Raise awareness about the importance of green features and sustainable practices among students, faculty, staff, and the broader community through educational campaigns, workshops, and seminars.
3. Establish incentives and regulations that encourage the adoption of green building standards and sustainable design principles in construction projects across the country.
4. Invest in research and development of innovative, locally appropriate green building materials and technologies to reduce the environmental impact of construction and enhance energy efficiency.
5. Encourage the integration of renewable energy sources, such as solar power, into building designs to reduce reliance on fossil fuels and lower carbon emissions.
6. Implement efficient waste management practices, including recycling and composting, to minimize waste generation and reduce the environmental impact of construction and operation.
7. Prioritize the development of green spaces, parks, and urban gardens within educational institutions and urban areas to enhance biodiversity, improve air quality, and provide recreational spaces.
8. Foster collaboration between government agencies, educational institutions, private sector, NGOs, and international organizations to share knowledge, resources, and expertise for sustainable development initiatives.

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