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The Role of Technical and Vocational Education and Training in Achieving Sustainable Development Goal 13 in Taraba State Polytechnic

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Abstract

Climate change presents significant threats to environmental sustainability, economic stability, and human development, particularly in developing nations such as Nigeria. Sustainable Development Goal 13 (SDG 13) emphasizes the need for urgent action to combat climate change and strengthen climate resilience. Technical and Vocational Education and Training (TVET) has emerged globally as a strategic tool for equipping individuals with practical competencies, green skills, and climate literacy required to address these environmental challenges. This study examines the role of TVET in achieving SDG 13 in Taraba State Polytechnic, Taraba State, Nigeria, with emphasis on the integration of climate-responsive skills, institutional capacity, and sustainability practices within the School of Environmental Studies. A mixed-methods research design was adopted, combining descriptive survey and documentary analysis. Using Krejcie and Morgan's (1970) sample size determination, 103 respondents comprising academic staff, administrative staff, technical staff, and students were selected through stratified random sampling, and 95 completed questionnaires were retrieved and analyzed. Quantitative data were processed using descriptive statistics, including mean, standard deviation, and frequency distributions. Additionally, relevant policy documents, scholarly publications, and national climate frameworks were reviewed to support data interpretation. Results reveal that TVET programs significantly promote environmental awareness among students and staff (mean = 4.64), indicating strong institutional efforts in climate sensitization. Respondents also affirmed TVET's potential to enhance green jobs and sustainable livelihoods (mean = 4.18) and highlighted broad public support for climate-responsive TVET initiatives (mean = 4.73). However, the study identifies moderate integration of climate change mitigation strategies into the curriculum (mean = 3.44) and limited policy support for sustainability inclusion (mean = 3.27). Funding inadequacies (mean = 2.96) emerged as a major barrier, consistent with national literature that links weak financing to poor TVET performance. The study concludes that while TVET at Taraba State Polytechnic demonstrates strong potential to contribute to SDG 13 through awareness creation and emerging green-skill initiatives, substantial reforms are required to enhance its climate-responsive capacity. Curriculum modernization, investment in renewable-energy and sustainability infrastructure, capacity building for instructors, strengthened policy alignment, and multi-stakeholder partnerships to position the polytechnic as a regional leader in climate action and green-skills development are recommended.

Keywords: Technical and Vocational Education and Training (TVET); Sustainable Development Goal 13; Climate Change; Green Skills; Environmental Sustainability.

1.0. Introduction

Climate change has become one of the most defining challenges of the 21st century, with social, economic, agricultural, and ecological impacts that are particularly severe in developing countries. The increasing frequency of extreme weather events such as floods, droughts, heatwaves, and land degradation threatens global development, undermines poverty reduction efforts, disrupts livelihoods, and places additional pressure on fragile economies. The United Nations established Sustainable Development Goal 13 (SDG 13), which urges nations to "take urgent action to combat climate change and its impacts" through strengthened climate resilience, improved adaptive capacities, and comprehensive climate education (United Nations, 2024). Education remains a fundamental driver of human and societal development, equipping individuals with the knowledge, competencies, and values necessary for meaningful participation in social and economic life (Izuagba *et al.*, 2017). Nigeria, like many developing nations, is experiencing the adverse effects of climate change at an accelerating rate (Sachs *et al.*, 2019). Declining agricultural productivity, desertification in the northern regions, recurrent flooding in states like Taraba, and biodiversity loss stand as evidence of the urgent need for climate-responsive development strategies. These challenges affect millions of households and place stress on educational, economic, and environmental systems. Addressing them requires not only public awareness and policy reforms, but also the development of a skilled labor force equipped with the knowledge and competencies to engage in climate mitigation, adaptation, and sustainable environmental management.

TVET is a component of the educational process that integrates general education, applied sciences, and practical skills relevant to various sectors of economic activity (UNESCO, 2020). TVET has been globally recognized as a critical mechanism for empowering individuals with practical skills, enhancing workforce productivity, and promoting innovation in key sectors such as agriculture, energy, industry, and technology. TVET is increasingly seen as a key driver of sustainable development, especially through the concept of "greening TVET," which involves integrating sustainability principles, environmental stewardship, and green technologies into vocational and technical programs. According to UNESCO (2023), greening TVET prepares learners for emerging green jobs, supports national low-carbon development, and enhances societal resilience to environmental challenges. For Nigeria, where youth unemployment remains high and where environmental degradation continues to threaten major sources of livelihood, particularly agriculture, TVET can serve as a transformative tool. It offers pathways for young people to acquire employable skills in renewable energy installation, waste management, climate-smart agriculture, sustainable construction, and environmental management, sectors that are increasingly in demand due to climate pressures. A study by the Organization for Economic Co-operation and Development (OECD), shows that countries with strong technical and vocational education systems tend to have higher productivity growth and lower levels of youth unemployment (OECD, 2020). Effective TVET systems are those that are flexible, demand-driven, and inclusive, with strong linkages to employers and industries (World Bank, 2019). In Africa, the recognition of TVET's role in sustainable development is growing, but implementation remains inconsistent. Many African Union (AU) initiatives, including the Continental Education Strategy for Africa (CESA 2016–2025), emphasise the need to revamp TVET systems to address youth unemployment and promote entrepreneurship. However, challenges such as weak institutional capacity,

poor funding, and low societal regard for vocational training persist (UNESCO, 2019). Targeted investments in TVET can lead to increased employment opportunities, reduced poverty, and enhanced economic inclusion as evident in Rwanda, Kenya and Ghana (AfDB, 2021, Ogur, 2023).

Nigeria recognizes the strategic importance of TVET in national development (Akanbi, 2017; Okorafor & Nnajiofo, 2017). The Nigerian TVET sector has evolved through colonial and post-independence initiatives with the establishments of technical institutions in Yaba and Kaduna (Bello & Muhammad, 2021). Less than 10% of secondary school graduates transition to vocational institutions, despite the growing need for skilled labour in sectors like construction, agriculture, and ICT (NBTE, 2020). In Taraba State, the need for climate-oriented skills is particularly urgent. The state's geographical position exposes it to environmental threats such as soil erosion, flooding, deforestation, and changing rainfall patterns. These issues affect agricultural productivity, infrastructure, and local communities. Taraba State Polytechnic, as one of the major institutions for technical and vocational education in the state, therefore has a critical role in developing a climate-conscious workforce capable of supporting adaptation and mitigation strategies across local industries. However, although TVET institutions have the potential to address climate challenges, many Nigerian polytechnics, including Taraba State Polytechnic, may not yet be fully aligned with the requirements of SDG 13. This misalignment could stem from outdated curricula, inadequate investment, limited awareness of sustainability issues, and insufficient institutional capacity (ICERT, 2022; Ogunyemi *et al.*, 2020). As a result, there is growing interest among policymakers, scholars, and educational planners to understand how TVET programs can be strengthened to better support climate action and sustainability goals (UNESCO, 2019). This study aims to examine the role of Technical and Vocational Education and Training in achieving Sustainable Development Goal 13 within Taraba State Polytechnic. It seeks to assess the extent to which TVET programs integrate environmental sustainability, the challenges that limit their effectiveness, and opportunities for aligning the institution's training programs with national and global climate action priorities.

2.0. Statement of the Problem

Despite the recognized importance of TVET in supporting sustainable development, several persistent challenges hinder its capacity to contribute meaningfully to climate action in Nigeria. Many TVET curricula remain outdated, focusing predominantly on traditional technical skills without incorporating green competencies such as renewable energy technologies, climate-smart agricultural methods, sustainable construction practices, or environmental conservation principles (ICERT, 2022; Ogunyemi, *et al.* 2020). As a result, graduates lack the necessary skills required to contribute effectively to climate adaptation and mitigation initiatives. A significant number of TVET institutions in Nigeria lack adequate infrastructure and training facilities that support practical learning in green technology fields. Taraba State Polytechnic face similar constraints, such as insufficient laboratory equipment, lack of modern solar energy installation tools, outdated agricultural equipment, and limited access to digital learning resources. Without the proper tools, instructors cannot deliver hands-on training aligned with emerging global climate standards. The capacity of instructors to teach climate-related content remains limited. Many educators may not have been exposed to recent developments in green technologies or climate-resilient practices. A lack of professional development opportunities, coupled with inadequate government

support, contributes to low institutional readiness for advancing SDG 13 through TVET. There is a weak alignment between TVET programs and national climate policies. Even though Nigeria has committed to reducing greenhouse emissions and improving climate resilience, TVET institutions are not systematically integrated into climate action strategies. This creates a disconnect between national objectives and institutional practices (United Nations, 2024). Societal perception of TVET in Nigeria remains relatively low. Many students prefer academic pathways, leaving TVET under-enrolled and under-funded. This limits its potential as a vehicle for green-skills development and climate change responsiveness. Taraba State, which faces significant environmental vulnerabilities, lacks a comprehensive climate-responsive TVET framework capable of addressing local environmental challenges. Without a deliberate integration of sustainability principles into teaching and learning practices, Taraba State Polytechnic risks producing graduates who are not adequately equipped to support climate resilience in their communities. These issues underscore the need to examine how TVET can effectively contribute to SDG 13, identify gaps within Taraba State Polytechnic's existing programs, and propose actionable strategies for enhancing climate action through technical and vocational education. This study focuses on the integration of climate change mitigation strategies within the Technical and Vocational Education and Training (TVET) system in Nigeria, particularly in School of Environmental Studies, Taraba State Polytechnic. The issues investigated are; how TVET can support climate goals in Taraba state, with particular focus on climate change mitigation in Nigeria, assess policy frameworks that support sustainability integration in TVET, and barriers to implementing climate-responsive TVET.

3. Materials and methods

A mixed-methods research design was adopted to generate comprehensive insights into the role of TVET in achieving SDG 13. A structured questionnaire measuring perceptions of TVET's effectiveness in climate action, policy support, green skills development, and implementation challenges. Documentary review of national climate policies, UNESCO and ILO, and scholarly publications on TVET and sustainability were consulted. Data were analyzed using descriptive statistics such as frequency, standard deviation and mean on SPSS version 27. The respondents are 142 staff and students of the School of Environmental Studies, Taraba State Polytechnic, Jalingo. Using the Krejcie and Morgan (1970) sample size determination, a sample of 103 respondents was selected through stratified random sampling to ensure representation across academic staff, administrative staff, technical staff, and students. A total of 95 questionnaires were successfully retrieved and analyzed covering over 90% of the respondents.

4. Results and Discussion

The demographic distribution (Table 1) shows that the majority of respondents were males (74.7%) and females constituted 24% of the respondents. The dominant age was 65.3% (aged 20–29), while ages 30-39 and 40 -60 constitutes 15.8% of the respondents and the least was ages 0-18 (3%) and suggests high potential for the adoption of emerging green skills. The socioeconomic characteristics (Table 2) revealed a dominant student population (74.7%), while lecturers (12.6%) accounted for the second in population and the least were admin staff (9.5%) and Technical Staff (3.2%).

Table 1. Demographic characteristics

	Frequency	Percent
Student	71	74.7
Lecturer	12	12.6
Admin Staff	9	9.5
Technical Staff	3	3.2
Total	95	100.0

Table 2. Socio-economic characteristics

S/N	Gender	No of respondents	Per(%)
1	Male	71	74.7
2	Female	24	25.3
	Total	95	100
	Age		
1	0- 18	3	3.2
2	20-29	62	65.3
3	30-39	15	15.8
4	40-60	15	15.8
	Total	95	100

Table 3 revealed varying feedback from students, lecturers, admin and technical staff of the polytechnic who were the respondents. TVET program is effective in promoting environmental awareness (4.64), and has the capacity of promoting green jobs and sustainable livelihood (4.18), and a strong support for climate responsiveness initiative towards TVET programmes (4.73). The inclusion of climate change mitigation strategies in TVET training's also attracted significant response (3.44), policies supporting sustainability integration showed significant response (3.27) while funding inadequacies revealed significant barriers to implementing climate responsive TVET (2.96). There is s strong agreement that TVET promotes environmental awareness, reflecting the institution's efforts in sensitizing learners to climate challenges. Similarly, respondents acknowledged that TVET enhances opportunities for green jobs, aligning with global trends where vocational training is central to sustainable workforce development. However, moderate responses regarding curriculum integration and policy support reveal gaps in the institutionalization of climate education. This suggests that although some climate-oriented content exists, systematic and comprehensive integration remains limited. Funding emerged as a major barrier, corroborating literature that links weak financing to poor TVET performance in Nigeria in addition to inadequate funding affects infrastructure, teacher training, and access to instructional materials which are necessary for climate-focused learning. Public awareness was strongly endorsed, indicating the need for community engagement to strengthen climate action initiatives.

Table 3. TVET Education and Vocational Training

	N	Mean	Std. Deviation
Effectiveness of TVET programs in promoting environmental awareness	95	4.6383	.48307
Inclusion of climate change mitigation strategies in TVET institutions training	95	3.4421	.75394
TVET promote green jobs and sustainable livelihoods	95	4.1789	.38534
Presence of policies supporting sustainability integration in TVET	95	3.2737	.77791
Lack of funding is barrier to implementing climate-responsive TVET	95	2.9667	.82721
Public awareness can support climate responsive TVET initiatives	95	4.7263	.44821
Valid N	95		

The role of Technical and Vocational Education and Training (TVET) in supporting Sustainable Development Goal 13 (SDG 13) is increasingly recognized as essential for countries facing climate vulnerabilities. TVET has long been viewed as an engine for economic growth and employment creation. However, contemporary discourse emphasizes TVET's broader developmental potential beyond job preparation. Modern TVET frameworks incorporate sustainability principles, green skills, and environmental intelligence to prepare individuals not only for the labor market but also for participation in climate-conscious development (UNESCO, 2023). The notion of "greening TVET" is grounded in environmental education theory and sustainable development frameworks. It integrates climate awareness, resource efficiency, low-carbon technology, and environmental stewardship into all aspects of vocational learning. For SDG 13, which emphasizes adaptive capacity, resilience, and climate education, TVET aligns closely with the need for a skilled, climate-aware population capable of supporting mitigation and adaptation measures (United Nations Nigeria, 2024). Across the world, countries are restructuring TVET systems to address climate challenges. In Europe, Asia, and South America, governments are: updating curricula to include renewable energy and sustainability, establishing partnerships with industries for green-skill training, creating green campuses with energy-efficient infrastructure, incorporating climate education across all technical disciplines. UNESCO (2023) notes that global demand for green jobs is increasing rapidly, especially in energy, agriculture, engineering, environmental management, construction, and waste recycling. Successful international examples show that aligning TVET with climate priorities significantly contributes to national resilience and low-carbon development.

Nigeria can adopt these approaches, particularly within polytechnics like Taraba State Polytechnic, by embedding sustainability in training programs. Nigeria faces severe climate risks including flooding, desertification, declining crop yields, and water scarcity. These environmental issues disproportionately affect states like Taraba, where agriculture and natural resources form the foundation of the local economy. Nigeria urgently needs a climate-ready workforce equipped with green skills to mitigate environmental damage, support renewable energy expansion, and enhance community resilience. Many Nigerian polytechnics still offer traditional programs with little reference to environmental sustainability or climate adaptation (ICERT, 2022). Without curriculum reform, students graduate lacking critical green skills. Most institutions lack the modern tools needed to teach solar installation, wind energy, climate-smart agriculture, or waste recycling. This technological gap seriously limits hands-on training. While Nigeria's green economy is growing, particularly solar power, agritech, and waste management, TVET programs often do not match industry needs. Many instructors have limited exposure to new sustainability trends or green technologies. Continuous training and professional development are lacking. In Nigeria, academic education is often valued above technical training. This reduces student interest in vocational programs that could significantly support climate action. Together, these challenges highlight why Nigeria has not fully harnessed TVET for climate mitigation and adaptation. Taraba State is particularly vulnerable to climate change due to its geographical and environmental characteristics. The state has experienced: increased flooding, soil erosion, deforestation, reduced agricultural productivity, and irregular rainfall patterns. A climate-responsive TVET system at Taraba State Polytechnic can help address these issues through specialized programs in: environmental management, renewable energy technology, climate-smart farming, disaster preparedness, and sustainable construction. However, evidence from broader Nigerian TVET research suggests that Taraba State Polytechnic may face similar challenges including: limited integration of climate content into training programs, most technical courses may not include sustainability modules, inadequate equipment and teaching resources, solar training kits, climate research tools, weather monitoring devices, and waste management facilities may be unavailable, low environmental awareness, students and lecturers may not fully understand the connection between technical skills and climate action, insufficient partnerships, collaboration with industries, NGOs, and environmental agencies may be limited, funding constraints, budget limitations restrict modernization of facilities and professional training, despite these challenges, Taraba State Polytechnic has significant potential to lead climate-action education in the region if strategic reforms are implemented.

This study highlights that Technical and Vocational Education and Training (TVET) is critical to achieving Sustainable Development Goal 13 (Climate Action), particularly in climate-vulnerable regions like Taraba State. TVET is uniquely positioned to equip individuals with technical and environmental competencies required to support climate mitigation and adaptation. However, despite its potential, TVET in Nigeria, and by extension Taraba State Polytechnic, faces several challenges including outdated curricula, inadequate funding, limited instructor capacity, insufficient equipment, weak policy alignment, and low awareness of climate issues. These challenges hinder the institution's ability to deliver climate-responsive training. Nevertheless, opportunities exist. With deliberate reforms such as integrating green skills into curricula, investing in renewable energy training facilities, strengthening partnerships with industry and government, and improving instructor competency, Taraba State

Polytechnic can become a regional leader in climate-oriented vocational education. By modernizing the TVET system, the institution can play a transformative role in producing climate-conscious graduates who can support sustainable development, reduce environmental risks, and improve community resilience in Taraba State.

This study demonstrates that TVET has a significant role to play in achieving Sustainable Development Goal 13, especially within the context of Taraba State Polytechnic. TVET can support climate mitigation and adaptation through training in renewable energy, climate-smart agriculture, environmental management, and other green skill areas. However, for TVET to fulfill this potential, systemic reforms are required, including curriculum modernization, improved funding, capacity building, and alignment with national climate action policies. Taraba State Polytechnic can become a regional center for green skills training if proper investments and reforms are implemented. Doing so will not only contribute to SDG 13 but also promote youth employment, sustainable development, and climate resilience in Taraba State and Nigeria at large.

Recommendations

To strengthen the role of TVET in advancing SDG 13 the following recommendations are proposed:

Curriculum Reform, integrate climate education, environmental management, and sustainability principles across all TVET programs, introduce new green courses such as solar energy technology, climate-smart agriculture, waste management, energy-efficient construction, and environmental auditing.

Instructor Training and Capacity Building, organize regular professional development workshops on green technologies and climate change education, partner with environmental agencies, renewable energy companies, and NGOs for capacity-building programs, investment in Modern Equipment and Infrastructure, establish renewable energy laboratories (solar, wind, biomass), create demonstration farms for climate-smart agriculture, equip workshops with energy-efficient and sustainability-focused tools, provide digital resources for climate research and simulation-based learning, strengthen partnerships and collaboration, collaborate with organizations such as NIMET, NEMA, REA, and private renewable-energy companies, develop internship and apprenticeship opportunities in green industries, engage in community-based climate adaptation projects, promote climate awareness and environmental literacy, introduce campus-wide climate awareness campaigns, encourage student participation in climate clubs and environmental societies, improve funding and policy alignment, seek support from government, donors, and development partners for green-TVET investments and align institutional policies with national climate frameworks and SDG priorities.

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