Leveraging the Role of Information Professionals in Climate Action: Enhancing Ch_4, Co_2, and N_2O Mitigation in Nigeria through Researcher-Community Partnerships

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Abstract

This study reviewed literature on leveraging the role of information professionals in climate action for mitigating methane (CH_4), carbon dioxide (CO_2), and nitrous oxide (N_2O) emissions in Nigeria through researcher–community partnerships, focusing on three thematic areas: Nigerian communities' understanding of agricultural and anthropogenic sources of greenhouse gases and their impacts on climate change and livelihoods; research-based mitigation strategies and the role of information professionals in translating and supporting their community-level adoption; and the use of resilience theory to strengthen researcher–community partnerships for improved communication, knowledge sharing, and climate resilience. Guided by the PRISMA framework, literature was sourced from databases including Scopus, TERAS, and ProQuest, yielding 85 studies, of which 28 were included: 23 empirical and review studies published between 2019 and 2025 and 5 foundational theoretical works published between 1989 and 2005. The synthesized evidence indicates that emissions from cultivated land and other anthropogenic activities in Nigeria are high, posing serious risks to climate stability, food security, and socio-economic livelihoods, particularly among smallholder farmers, women, and youth. Although climate-smart agriculture practices such as improved rice management, sustainable land use, agroforestry, and efficient fertilizer application have demonstrated mitigation potential, their uptake remains limited due to information deficits, weak extension services, and institutional challenges. The study concludes that information professionals, especially university and public librarians, are critical knowledge intermediaries who can organize, validate, and translate climate research into accessible, localized, and actionable information, thereby enhancing climate literacy to bridge persistent research-to-practice gaps. It further agreed that trust-based, participatory researcher–community partnerships that integrate scientific and indigenous knowledge, guided by resilience theory, can strengthen absorptive, adaptive, and transformative capacities of Nigerian communities. The study recommends formally recognizing university libraries as climate knowledge hubs, strengthening partnerships between university and public libraries with extension agencies to support community-level climate literacy and CSA adoption, and establishing community-based climate knowledge centres within public libraries to enable inclusive, sustainable, and long-term climate resilience in Nigeria.

Keywords: Information Professionals, Climate Action, CH_4, CO_2, N_2O, Mitigation Researcher-Community Partnerships

Introduction

Climate change is a characteristic issue of the 21st century across the world, and is mainly caused by the build-up of greenhouse gases (GHGs), including carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) in the air. Although these gases vary in their origins, lifetime in the atmosphere and warming potentials, together they are causing the temperatures to rise, extreme weather conditions, and ecosystem disturbances in the world, as well as socio-economic strains. As a typical developing nation, Nigeria has its own share of climate pressure, since an increase in population rate, urbanization, energy demand, and agricultural expansion are increasing the emissions caused by various sectors such as energy production, waste management, land-use change, and livestock, and thus effective mitigation is a national priority (Yona et al., 2025). According to national inventories and assessments, prepared by the Intergovernmental Panel on Climate Change in 2025 and submissions made by Nigeria to the United Nations Framework Convention on Climate Change, the agricultural emissions in Nigeria are dominated by methane (50-60%), principally through livestock enteric fermentation and rice cultivation, nitrous oxide (30-40%), principally through poor use agricultural soils, improper fertilizer use, and poor manure management, with carbon dioxide emissions playing a minor role (20-35%), mainly through high tillage, deforestation. Even though CO_2 contributes approximately 75% of the overall global greenhouse gas emissions across all sectors, in Nigeria, the agricultural sector is dominated by CH_4 and N_2O and hence, mitigation of such anthropogenic activities is highly necessary to overcome the adverse effects of climate change

Such greenhouse gases have a long atmospheric lifetime of approximately 12- 114 years. For example, 12 years for methane, while nitrous oxide is 114 years, which are becoming prevalent is produced primarily through enteric fermentation, poor manure management, to emit CH_4, agricultural soil as a result of excess or improper utilization of fertilizers and soil infertility to emit N_2O (Abubakar et al., 2022). Farming and rural communities also tend to be oblivious of the fact that these normal activities have a direct impact on extreme weather conditions like droughts, floods and heat waves that consequently affect agricultural productivity, disrupt economic systems and living standards by reducing yields, raising food prices and increasing poverty.

Notably, the answers to these predicaments were found in the very communities that are involved in the emissions. The emission of methane by ruminant livestock can also be minimized through better feeding methods such as feeding the rumen with the seaweed Asparagopsis taxiformis which has been shown 95% to reduce methane emission as well as in proper handling of the manure and storage (Adefare et al., 2024; World Bank, 2025). Low-tillage or conservation agriculture, more afforestation and reforestation, and vigorous efforts to reduce deforestation and bush burning reduce the carbon dioxide emissions. The reduction of nitrous oxide emission can be achieved by use of more efficient fertilizers, application of the appropriate type and quantity and at the correct time, and elimination of soil degradation through proper land management activities. Although scientists in various fields are tirelessly trying to solve these problems that the world is facing, one of the greatest challenges facing the African countries and Nigeria especially is the poor communication and translation of scientific discoveries into practical and community activities (Abubakar et al., 2022; World Bank, 2025). This gap should be closed with the help of efficient information services, local education and implementation of inclusive policies to promote the transfer of knowledge to real climate solutions to guard livelihood and improve the quality of life.

Therefore, the information professionals such as librarians, data experts, knowledge managers, and community information facilitators, are best placed to fill these gaps. They can curate,

contextualize and disseminate climate research; facilitate communication gaps between scientists, research findings and non-technical groups; promote community-based monitoring and reporting; and improve the networks between universities, civil society, local government and citizens. Within the framework of mitigation of methane, CO_2 and N_2O, these collaborations can enable communities to learn more about the sources of emissions through their anthropogenic activities, leading to flooding, drought, high level of heatwaves and excess in cancer disease and they engage in mitigation planning, and co-create locally relevant solutions, as well as enhance the impact of research and strategic policies. Consequently, this paper will discuss how the researcher-community partnerships facilitated and complemented by information practitioners can facilitate effective climate action in Nigeria by making climate knowledge accessible, actionable and responsive to local demands and by making the mitigation response to methane, CO_2 and N_2O both scientifically informed and community-informed.

Statement of the Problem

Climate change is one of the most destructive world problems, as it systematically interferes with the ecosystem, worsens the quality of life, and increases the rate of disappearance of agricultural efficiency and economic sustainability, further aggravating food insecurity on the global level. According to the evidence of the literature such as (Arora & Mishra, 2022; Yeboah, 2024; Goni et al., 2025) showed that unless an immediate intervention is carried out, the conditions will be far worse in the year 2050 compared to the present estimations under existing vulnerability conditions (UV1 and UV2) which is mainly because the anthropogenic activities will not be controlled and regulated in the present scenario, including unsustainable agriculture, deforestation, the use of fossil fuels, and unsatisfactory waste disposal. Nigeria is a country where limited awareness of how day-to-day livelihood practices contributes to greenhouse gas emissions, mostly methane (CH_4), carbon dioxide (CO_2), and nitrous oxide (N_2O), which cause extreme weather conditions and reduce resilience (Abubakar et al., 2022; World Bank, 2025). Despite the already existing substantial amounts of researches and the methods of mitigating climate change, such as climate-smart agriculture and emission-cutting technology, a crucial gap still exists in the form of the translation of this knowledge into a practical community-level response. This pressure is compounded by poor information flow, stakeholder involvement and integration of local knowledge systems. Hence, using the resilience theory that highlights adaptive capacity, learning, and system change, this paper evaluates the need to adopt the leveraging of information professionals by forming researcher-community partnerships as a way of promoting awareness, adoption, and implementation of effective mitigation strategies to control CH_4, CO_2 and N_2O emission in Nigeria to facilitate community resilience and protect livelihoods.

Research Objectives

The study reviewed the following thematic areas in relation to leveraging information professionals in climate action: enhancing methane, CO_2, and N_2O mitigation in Nigeria through researcher-community partnerships that include:

1. To identify and review Nigerian communities' understanding of agricultural and anthropogenic sources of methane (CH_4), carbon dioxide (CO_2), and nitrous oxide (N_2O), as well as their impacts on climate change and livelihoods.
2. To identify and evaluate existing research-based mitigation strategies for CH_4, CO_2, and N_2O and examine how information professionals can facilitate their translation and adoption at the community level.

3. To analyze how researcher–community partnerships, guided by resilience theory, can enhance communication, knowledge sharing, and community resilience to climate change impacts in Nigeria.

Methodology

This study employs a systematic literature review method guided by the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework to explore the pivotal role of information professionals, particularly librarians and extension workers in leveraging researcher–community partnerships and in long run community people for mitigating methane (CH_4), carbon dioxide (CO_2), and nitrous oxide (N_2O) emissions in Nigeria. Literature was rigorously sourced from databases such as Scopus, TERAS, and ProQuest, initially yielding 85 studies, with 28 selected after screening: 23 empirical and review articles published between 2019 and 2025, plus five foundational theoretical works from 1989–2005. The analysis centers on three thematic areas Nigerian communities' understanding of agricultural and anthropogenic greenhouse gas sources and their livelihood impacts; research-based mitigation strategies (e.g., improved rice management, agroforestry, and efficient fertilizers) where information professionals translate evidence into community-adoptable formats amid challenges like information deficits and weak extension services; and resilience theory to fortify partnerships for enhanced communication, knowledge sharing, and climate resilience.

Literature Review/Result

Carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) are major causes of climate change in the Nigerian populations, most of which are a result of agricultural and anthropogenic efforts. The carbon dioxide emissions occur primarily due to the burning of fossil fuels, flaring of gases, deforestation, urbanization, and transportation, especially in the Niger Delta and large cities (IPCC, 2025, Onnoghen et al., 2024a). These operations decrease the carbon sink and increase the variation in temperatures and cause variations in rainfall patterns, heat stress, and declining agricultural productivity, which pose a threat to the farming-based economy and rural lives of Nigeria (World Bank, 2018; Onnoghen et al., 2024b). The main sources of methane emissions are the livestock production, flooded rice lands, improper waste management, and oil and gas leakage, and such rice-growving states as Kebbi, Niger, and Taraba are the hotspots (Bashir et al., 2025; Kehinde et al., 2024). In spite of its short atmospheric lifetime, high warming potential of methane amplifies the climate contribution by many folds and the absence of climate-smart agricultural approaches limits the mitigation efforts (Abubakar et al., 2022; Goni et al., 2024; IPCC, 2025).

Although in smaller quantities, the emissions of nitrous oxide have long-term climate risks because of their high potential to global warming and are primarily caused by the ineffective utilization of nitrogen-based fertilisers and poor agricultural management processes among smallholder farmers (Kehinde et al., 2024; IPCC, 2025). All three (CO_2, CH_4, and N_2O) have a severe impact on flooding, drought, and heat waves, which deteriorates food security, poverty, and socio-economic vulnerability, especially among women and youth who depend on agriculture (Arora & Mishra, 2022; Yeboah, 2024; Adefare et al., 2024). Despite the opportunities of climate-smart agriculture to reduce emissions and increase resilience, the adoption of the practice is still uneven because of the infrastructural, informational, and institutional barriers (Awoniyi et al., 2023; Zhao et al., 2023). Increased access to climate information, inclusive green entrepreneurship, and climate literacy (facilitated by knowledge institutions including libraries) are important to reduce greenhouse gas emissions and enhance adaptive capacity among the Nigerian communities (Hauke, 2019; Usang et al., 2024; Onnoghen et al., 2024a).

Current studies have determined some of the mitigation options of CH_4, CO_2, and N_2O emissions, especially through climate-smart agriculture (CSA) methods like better rice management (alternate wetting and drying to reduce CH_4), agroforestry and cover crops (optimize the use of carbon and minimize emission of CO_2) and precision fertilization with nitrogen (cut N_2O). Worldwide field experiments (one of which has been assessed by the Intergovernmental Panel on Climate Change) indicate that disseminating specific, practical information to farmers can substantially decrease nitrous oxide (N_2O) emissions. The most significant information to disseminate consists of: (1) optimized use of fertilizers (the so-called 4R strategy- right rate, right time, right source, right place) that can reduce N_2O by approximately 10-30%; (2) the use of nitrification inhibitors or more efficient fertilizers, which can reduce emissions by 30%; (3) precision farming and soil testing that can reduce emissions by 15-35%; and (4) better manure management and cover crops, which can decrease emissions by 10-40%. This indicates that, with appropriate guidance and training for farmers on such practices, agricultural N_2O emissions can be significantly reduced without necessarily reducing crop yields.

A PRISMA-based systematic review and searching databases such as Scopus and Web of Science through the Federal university of Technology (FUTB) library website, including CSA adoption studies, to generate evidence that information professionals, such as librarians, are essential to facilitate translation at the community level through curating open-access collections of these strategies and providing targeted literacy training and collaborating with extension services to bridge the awareness gap among smallholder farmers (Usang et al., 2024; Abubakar et al., 2022; Ajwang et al., 2024). The role is compatible with the green library projects focusing on sustainable development by sharing knowledge (Hauke, 2019), as well as dealing with Nigerian-specific challenges, including low levels of digital access and training needs (Onnoghen et al., 2024; Awoniyi et al., 2023; Bashir et al., 2025). In the reviewed literature, the mitigation of CH_4 is associated with better practices in rice cultivation, manure management, and climate-sensitive livestock systems, whereas CO_2 reduction is related to sustainable consumption, green entrepreneurship, adoption of renewable energy, and responsible land-use practices (Arora & Mishra, 2022, 2023; Kehinde et al., 2024; Zhao et al., 2023; IPCC, 2025). Optimized fertilizer use, soil management, and precision agriculture are among the key methods of mitigation of N_2O, which is demonstrated by the adoption of CSA studies among the smallholder farmers in Nigeria, Kenya, Uganda, and Ethiopia (Aturihihi et al., 2022; Ajwang et al., 2024; Goni et al., 2024, 2025; Yona et al., 2025). The information professionals, especially librarians and knowledge intermediaries, in this mitigation landscape have a highly significant translational role in terms of curating and providing evidence-based climate information, promoting climate literacy, and mediating community-level uptake via participatory learning, digital platforms, and the local knowledge hub (Hauke, 2019; Usang et al., 2024). Green libraries and information centres act as a reliable platform to share practical mitigation knowledge, connect the evidence of global climate (IPCC, 2025; World Bank, 2025) with the local realities, as well as empower farmers, women agripreneurs, and entrepreneurs by providing specific education and access to climate information services (Abubakar et al., 2022; Adefare et al., 2024; Bizo et al., 2024). Altogether, the PRISMA-informed evidence highlights the role of information professionals in ensuring effective mitigation of CO_2, CH_4, and N_2O at a community level based not only on technological solutions but also the strategic role of the information professional in translating the research into accessible, actionable, and culturally relevant knowledge that would support sustainable development and climate resilience (Onnoghen et al., 2024a, 2024b; Hauke, 2019).

Theoretical Framework

The study is guided by resilience theory to enhance communication, knowledge sharing, and community resilience to the adverse effect of the climate change in Nigeria. The resilience theory came into being during the 1970s and 1980s after researchers started focusing less on risk and pathology and more on the strengths that enable individuals to cope with adversity and adapt rather successfully. Some of the first pioneering studies by Norman Garmezy were done on children at high risk of psychopathology and revealed some protective factors, including supportive relationships, and individual competencies, which mitigated the impact of stress (Garmezy, 1974). Likewise, the longitudinal research of children in Kauai that was conducted by Emmy Werner illustrated that quite a number of children who were exposed to a great level of both social and environmental risks still attained good life outcomes because of the running personal, family, and community reserve (Werner, 1989). Combined, these early studies formed the fundamental assumption of the resilience theory, that positive adaptation is due to dynamic processes and protective mechanisms, and not only the lack of risk and subsequently the foundation of ecological and strength-based models of resilience. According to the resiliency theory, positive development is a dynamic process that is influenced by associations, and contextual support instead of an inborn attribute, and this viewpoint explores how the buildup of positive conditions across ecological levels, including individuals, family, and community, to cope with the tension of social circumstances and avoid the development of violent or devastating results. The conceptualization of resilience into a set of adaptive processes was done by Fergus and Zimmerman (2005), and the studies by Ostaszewski and Zimmerman (2006) and Stoddard et al. (2012) showed that multiple, reinforcing assets are more protective than single factors. These studies emphasize the importance of a strength-based and replicable framework that informs research and practice and addresses how youth and communities can use the resources at their disposal to overcome adversity and realize healthy development despite being at risk.

This framework directly informs the research on Leveraging Information Professionals in Climate Action in Nigeria, where the researcher-community partnerships can be evaluated as the promotional resilience factors contributing to better communication, trust, and shared capacity to combat the methane, CO_2, and N_2O emissions. Based on the resiliency theory, information professionals can also be viewed as bridges and intermediaries between climate research and knowledge that is available to audiences, encourage community action, and minimize conflict due to misinformation or resources strain.

Conclusions

On the whole, the analyzed literature shows that the emissions of CO_2, CH_4, and N_2O, which include the cultivated land and other anthropogenic sources, are high and have serious and compounding risks to the climate, food security, and socio-economic stability of Nigeria, especially among the smallholders, women, and young people. Although the climate-smart agriculture approach has shown viable results with regard to reducing emissions through better management of rice, sustainable land use, agroforestry, and efficient use of fertilizers, the adoption has been hampered by information deficits, ineffective extension services, and institutions. Using the PRISMA framework and the synthesized evidence shows that information professionals especially librarians and knowledge professionals can play a huge role in the translational aspect during sorting of viable information about climate, encouraging climate literacy, and providing research-practice interface at the communal level. Exploratory researcher-community partnerships, which entail incorporation of scientific evidence with local knowledge, trust-based

communication, and participatory learning guided by the resilience theory can enhance absorptive, adaptive, and transformative capacities of Nigerian communities. Therefore, mitigation of greenhouse gas emissions in Nigeria relying only on technological and agricultural developments cannot be effective; instead, inclusive knowledge systems and robust information infrastructures are needed to co-produce, access, and implement climate solutions to sustainable development and long-term resilience.

Recommendations

The study offered the following recommendations:

1. There is a need of university library to be officially considered as primary climate change investigation facilities that attentively collect, compile, and authenticate findings on greenhouse gas mitigation and climate-intelligent cultivation (CSA). By means of PRISMA-mediated systematic reviews and institutional repositories and the open-access platforms, the university libraries can transform the global climate science (e.g., IPCC reports) and local research into the policy-relevant and usable knowledge products by the communities. These hubs are supposed to be proactive by advising and mentoring information professionals in the public libraries through the provision of standardized toolkits, training modules and evidence summaries based on the agro ecological zones of Nigeria. This enhances the absorptive power of communities by making sure that the right, timely, and localized contextual climate information is always present.
2. There is need to establish of structured partnerships between the public libraries and the university libraries that would facilitate the creation of a research to practice pipeline. The university libraries would be the most active in generation and synthesis of evidence and the public libraries would be more of the points of implementation to the community by ensuring that the research outputs are translated to climate literacy programs, local language instructions and CSA manuals that are easy for the farmers to understand. Librarians ought to be trained as intermediaries of knowledge since they are able to give their guidance to the farmers, women agripreneurs and youth on ways of mitigating CO_2, CH_4, and N_2O. The collaboration can benefit adaptive capacity by sealing gaps in information, raising awareness of CSA, and boosting adoption by trusted and accessible institutions
3. Community-based climate knowledge centres should be established within or alongside public libraries to serve as collaborative spaces for librarians, agricultural extension workers, researchers, and local communities. These centres should support participatory learning, co-production of knowledge, and continuous feedback mechanisms, integrating scientific climate information with indigenous knowledge. By hosting workshops, demonstration sessions, and digital climate information services, these centres enable decisive, localized climate action. Such collaboration enhances transformative capacity, empowering communities to adopt sustainable practices, diversify livelihoods, and build long-term resilience to climate shocks.

Significance/Implication of the Study

This study is significant because it demonstrates that effective mitigation of CO_2, CH_4, and N_2O emissions in Nigeria depends not only on technological or agricultural innovations but also on strong knowledge systems and information infrastructures. Applying resilience theory and PRISMA-based evidence synthesis, the study highlights the critical yet underexplored role of information professionals particularly university and public librarians as knowledge intermediaries who translate climate research into accessible, actionable, and locally relevant information for smallholder farmers, women, and youth. The findings imply that strengthening researcher–community partnerships, climate literacy, and library-led climate information services can

substantially enhance absorptive, adaptive, and transformative capacities of Nigerian communities. Policy-wise, the study underscores the need to integrate libraries and information institutions into national climate and agricultural extension strategies, while practically it provides a framework for bridging persistent knowledge-to-practice gaps that hinder the adoption of climate-smart agriculture and community-level climate resilience in Nigeria.

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