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Food Security And Challenges Of Sustainable Development In Rivers State, Nigeria

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Abstract: Food security is foundational to sustainable development, critically influencing economic stability, public health, and environmental preservation. Rivers State, located in Nigeria's Niger Delta, is rich in natural resources yet grapples with persistent food security challenges exacerbated by industrial activities, environmental degradation, and socio-economic disparities. The study examines industrial pollution's effect on agriculture, evaluating environmental and economic challenges to aquaculture, and exploring public health impacts to propose actionable strategies. This research is grounded in Political Ecology Theory and the Sustainable Livelihoods Framework, providing a comprehensive lens to understand how the aforementioned factors influence environmental and food security outcomes. A qualitative research design was employed, utilizing an extensive literature review and stakeholder interviews across strategic Local Government Areas (LGAs). Data was gathered from community members, policymakers, and environmental experts, with thematic analysis used to identify patterns and derive meaningful insights. Findings revealed that traditional farming methods and limited financial resources limit agricultural productivity in Rivers State, oil spills and gas flaring have severely impacted arable land and waterways, poverty and limited market access worsen food insecurity, youth disengagement from agriculture remains a concern, and rapid urbanisation and population growth have strained resources. Thus the study recommends modernizing agriculture through financial and educational support, enforcing environmental regulations, promoting climate

adaptation strategies, and engaging youth in agriculture. Additionally, sustainable urban planning and community-based initiatives are critical for long-term resilience.

Keywords: Food Security, Sustainable Development, Environmental Degradation.

Introduction: The critical importance of ensuring consistent access to adequate, safe, and nutritious food as a foundation for sustainable development is increasingly recognized by scholars and policymakers alike (Viana et al., 2022). Research highlights the complex interplay between agricultural productivity, economic stability, environmental sustainability, and social equity in achieving food security. Numerous studies have explored diverse regions and contexts to identify the principal factors affecting food security (Pandey & Pandey, 2023). These investigations propose strategies to enhance agricultural practices, reduce poverty, and address environmental degradation. Collectively, this body of work underscores the need for integrated approaches to overcome food security challenges and promote sustainable development.

Food security is indispensable to sustainable development, directly impacting population welfare, which in turn supports economic stability, social cohesion, and environmental health (Munirah & Norfarizan-Hanoon, 2022). Achieving food security aligns with and directly contributes to the Sustainable Development Goals (SDGs), especially SDG 2, which focuses on eradicating hunger, ensuring food security, improving nutrition, and promoting sustainable agriculture (Fonseca et al., 2020). Furthermore, food security interconnects with other SDGs, including poverty reduction (SDG 1), health and well-being (SDG 3), gender equality (SDG 5), access to clean water and sanitation (SDG 6), and climate action (SDG 13). Establishing sustainable food systems is essential for maintaining ecological balance, reducing carbon emissions, and enhancing resilience to climate-related and economic shocks.

In Nigeria, the most populous country in Africa, food security challenges are multi-dimensional and vary significantly across regions. Although Nigeria was once self-sufficient in food production, ongoing food insecurity is compounded by factors such as outdated agricultural practices, inadequate funding, corruption, policy instability, and a population growth rate that outpaces agricultural advancement (Bello et al., 2024). Agricultural productivity in the northern regions, especially in the Sudan Savanna, is constrained by limited rainfall and short growing seasons. The Boko Haram insurgency has intensified food insecurity in the northeast through displacement and disrupted livelihoods (Eke-Okocha & Eze, 2023). The Middle Belt and southern regions, including the fertile Niger Delta, enjoy better agricultural conditions but face distinct challenges, such as environmental degradation from oil extraction and industrial activities.

Rivers State, located in the oil-rich Niger Delta region of southern Nigeria, presents a unique case for examining sustainable development and food security dynamics (Oruma et al., 2021). Nigeria's economy is heavily reliant on its extensive natural resources, especially oil, which is central to Rivers State's economy. The state's socio-economic landscape is diverse, encompassing urban centers like Port Harcourt and rural communities that primarily depend on agriculture and fishing (Kalagbor, 2024). Rivers State's abundant river systems and wetlands offer fertile grounds for aquaculture. Addressing food security in this region necessitates tailored strategies that account for the specific opportunities and constraints of the local socio-economic and environmental context.

Despite extensive research efforts, the root causes of persistent food security challenges in specific regions like Rivers State, Nigeria, remain inadequately addressed. Rivers State presents a complex socio-economic and environmental landscape that has not been thoroughly studied, particularly concerning how these factors impact both food security and sustainable development. A heavy reliance on the oil and gas sector has resulted in severe environmental degradation, such as oil spills, gas flaring, and water contamination, which adversely affect agricultural land, water quality, and air quality. This issue is exemplified by the state's "black soot" crisis, a byproduct of industrial activities that has posed significant health risks to the population (Whyte et al., 2020). The consequences of environmental pollution not only undermine food production but also impede the broader goals of sustainable development by compromising public health, economic stability, and ecosystem vitality.

The region's abundant river systems and wetlands create a promising environment for aquaculture. However, these water resources are themselves compromised by environmental degradation. Frequent flooding and severe pollution hinder fish farming, creating a paradox where the very features that could support aquaculture contribute to its decline. This conflict between environmental resources and the industries they could support highlights the complexities of achieving sustainable development in an

area heavily impacted by industrialization.

Furthermore, current research falls short of comprehensively examining the specific local factors affecting both food security and sustainable development in Rivers State. There is limited analysis on how factors such as industrial pollution and population growth collectively shape the region's development trajectory. Additionally, while some studies offer generalized strategies for enhancing agricultural productivity or environmental resilience, few provide insights into the effectiveness of tailored approaches in contexts with high industrial activity and environmental sensitivity (Bello et al., 2024; Oruma et al., 2021; Munirah & Norfarizan-Hanoon, 2022). Addressing these gaps, the present study aims to investigate the intertwined challenges and opportunities for achieving food security and sustainable development in Rivers State, acknowledging the need for strategies that are responsive to its unique socio-economic and environmental conditions.

This study evaluates the impact of industrial activities, especially in the oil and gas sector, on agricultural productivity and food security in Rivers State by examining how environmental degradation affects land and water quality. It investigates the socio-economic and environmental challenges to sustainable aquaculture development, focusing on how pollution and flooding hinder fish farming in the region's river systems and wetlands. Additionally, the research explores the public health impacts of environmental degradation—such as air pollution and water contamination—on local communities, assessing how these issues impede sustainable development goals. Also, the study analyzes the effectiveness of community-based initiatives for enhancing food security, while evaluating the feasibility of strategies tailored to Rivers State's unique socio-economic and environmental conditions. This study is significant as it addresses a critical gap in the understanding of food security challenges within the unique context of Rivers State. By focusing on this region, the study provides insights into how industrial activities, particularly in the oil and gas sector, impact agricultural productivity and food availability. Additionally, the study contributes to the broader discourse on sustainable development by highlighting the interconnectedness of economic growth, social inclusion, and environmental protection in achieving food security.

Literature Review Conceptual Framework Food security

Food security, as defined by the Food and Agriculture Organization (FAO), is a complex state that is crucial for the welfare of individuals and the progress of societies. Food security is the condition in which every person consistently has sufficient access to safe and nutritious food that meets their dietary requirements and personal preferences, enabling them to lead an active and healthy life (Mbow, et al 2020). This concept highlights the complex interaction of different elements that contribute to food security, underlining its intricate nature and the need for a comprehensive approach to attain it. Food security is essential for the overall physical and mental health of individuals, as well as for maintaining a stable economy and fostering social cohesion. It has a direct influence on the productivity of individuals and the advancement of society, serving as the foundation for sustainable development. In the absence of food security, populations are exposed to heightened health hazards, diminished educational achievements, and hindered economic progress. Furthermore, the issue of food security is intricately linked to political stability and peace, as a shortage of food can result in societal unrest and conflicts (Behnassi, & El Haiba, 2022).

Dimensions of Food Security

Food security is a comprehensive concept encompassing four interconnected dimensions: availability, access, utilization, and stability. Each dimension addresses a critical element of ensuring that food systems remain robust, inclusive, and resilient. Food availability focuses on the existence of adequate food that meets necessary standards, derived from sources such as local production, imports, or food assistance. It emphasizes the supply side of food security, highlighting the importance of a stable and sufficient food production system (Chauhan et al. 2021). Factors affecting food availability include agricultural output, climate conditions, technological advancements, and infrastructure quality. To secure food availability, investment in sustainable agricultural practices, efficient supply chains, and infrastructure is crucial for reducing post-harvest losses and ensuring the timely distribution of food.

Food access pertains to individuals' ability to obtain sufficient resources to acquire nutritious food. It encompasses both economic and physical resources that people can use to secure a healthy diet. Economic access is influenced by income levels, food prices, and market dynamics, whereas physical access depends on the presence of markets and the adequacy of transportation infrastructure. Policies promoting

equitable economic development, poverty reduction, and improved infrastructure are necessary to enhance market access and food affordability.

Food utilization involves the proper use of food, considering nutrition knowledge, food handling, and access to clean water and sanitation. It ensures that food consumption meets individuals' nutritional needs and promotes overall health. Effective food utilization includes safe preparation and storage, a balanced diet rich in diverse nutrients, and access to uncontaminated water and sanitation. Public health initiatives, nutrition education, and investments in water and sanitation systems are vital for optimizing food utilization and promoting well-being.

Food stability refers to the consistent availability of adequate food, unaffected by disruptions stemming from economic, climatic, or political factors. It underscores the need for resilient food systems capable of withstanding and recovering from sudden or prolonged crises. Measures to strengthen food stability include safety nets, strategic food reserves, early warning systems, and climate adaptation strategies to mitigate the impact of adverse events. Ensuring stability involves proactive risk management in food production, supply chains, and market fluctuations.

Sustainable Development Goals (SDGs)

The Sustainable Development Goals (SDGs) are a universal call to action adopted by all United Nations Member States in 2015 as part of the 2030 Agenda for Sustainable Development. These goals are designed to address a wide range of global challenges, including poverty, inequality, climate change, environmental degradation, peace, and justice. The SDGs comprise 17 interlinked goals, each with specific targets and indicators, aiming to create a more prosperous, equitable, and sustainable world.

The Sustainable Development Goals relative to Food Security

- No Poverty (SDG 1): Reducing poverty ensures people have the economic means to access sufficient, nutritious food, enhancing food security and stability in communities

- Zero Hunger (SDG 2): Directly focused on ending hunger and promoting sustainable agriculture, this goal addresses food security by increasing agricultural productivity and resilience.

- Good Health and Well-being (SDG 3): Ensuring good health supports better nutrition and food safety, reducing the prevalence of malnutrition and diet-related illnesses.

- Gender Equality (SDG 5): Empowering women boosts food security as women often play crucial roles in agriculture and household food distribution, leading to more efficient and equitable access to food.

- Clean Water and Sanitation (SDG 6): Safe water and sanitation are critical for food production and preparation, ensuring food safety and preventing waterborne diseases.

- Climate Action (SDG 13): Addressing climate change is vital for maintaining sustainable food systems, as climate-related hazards can disrupt food supply chains and agricultural practices.

Dimensions of Sustainable Development

Sustainable development is a comprehensive approach aimed at balancing economic growth, social inclusion, and environmental protection. These three dimensions are interconnected and must be tackled together to create a sustainable and equitable future.

Economic Growth focuses on the expansion of goods and services production over time, traditionally measured by Gross Domestic Product (GDP). It is fundamental for enhancing living standards and alleviating poverty. However, sustainable economic growth emphasizes long-term resilience, stability, and inclusivity rather than mere output increases. It involves boosting productivity through innovation, technological advancements, and efficient resource use, which necessitates investments in research, education, and workforce training (Geissdoerfer et al., 2017). Furthermore, sustainable economic growth should ensure the creation of quality employment, uphold labor rights, and provide fair wages and safe working conditions, especially for vulnerable workers. Supporting small and medium-sized enterprises (SMEs) is crucial, as they are significant job creators. Economic diversification is another key strategy, reducing dependence on any single industry and building resilience to economic disruptions. This diversification extends to agriculture, manufacturing, and services, each adopting sustainable

practices to promote longevity and reduce environmental impact. Moreover, robust infrastructure—covering transport, energy, and digital networks—is vital for facilitating economic activities while also investing in sustainable industries and green technologies (Sachs et al., 2020).

Social Inclusion ensures that all individuals have

equitable access to opportunities, resources, and the ability to participate in social, economic, and political spheres. This dimension addresses disparities based on gender, race, socioeconomic status, and disability, striving for equal access to essential services such as education, healthcare, clean water, and sanitation. Bridging these gaps requires policies that promote fairness and remove barriers that marginalize certain groups. Empowering communities to engage in governance processes is critical, advocating for democratic principles and inclusive policy-making where all voices are heard (UNDP, 2019). Social protection mechanisms, including unemployment benefits, pensions, and social safety nets, are essential for reducing vulnerabilities and offering a safety net to individuals facing economic and social hardships. Cultural diversity is also integral to social inclusion, promoting mutual respect and understanding across different traditions and identities, which fosters a more cohesive society. This focus on inclusion not only enhances societal harmony but also drives innovation by embracing diverse perspectives and ideas (Ferraro & Beunza, 2018).

Environmental Protection emphasizes the need to safeguard ecosystems and natural resources to sustain life and support economic and social development. This requires the responsible and equitable management of resources such as water, forests, and minerals to prevent overuse and degradation. Conservation and sustainable harvesting practices ensure resources remain available for future generations (Rockström et al., 2009). Effective pollution control and waste management are also crucial. This entails enforcing environmental regulations, adopting technologies that reduce emissions, and promoting the recycling and reuse of materials. Addressing climate change is a major focus, requiring both mitigation—reducing greenhouse gas emissions and shifting to renewable energy—and adaptation strategies that enhance societal resilience to climate impacts (IPCC, 2021). Biodiversity protection is another vital component, as healthy ecosystems are essential for ecological balance and human well-being. Conservation initiatives and habitat restoration efforts are fundamental for maintaining ecosystem services and

supporting a variety of species, both for their intrinsic value and the benefits they provide to human societies (Dasgupta, 2021).

Theoretical Framework

Sustainable Livelihoods Framework (SLF)

The Sustainable Livelihoods Framework (SLF) is a tool used to understand and analyze the complexities of poverty. It was developed by the British Department for International Development (DFID) and has been adapted by various development agencies. The Sustainable Livelihoods Framework (SLF) focuses on the assets, capabilities, and activities required for a means of living. It examines how these factors interact with policies, institutions, and processes to determine the sustainability and resilience of livelihoods. The framework is centered around the concept of 'Sustainable Livelihoods' and is used to enhance the efficiency of development cooperation.

The livelihoods approach prioritizes people over the resources they use, recognizing that development issues often stem from institutional structures that cannot be overcome through simple asset creation. It adopts a holistic perspective to understand stakeholders' livelihoods comprehensively, identifying the most pressing constraints they face. This dynamic approach is adaptable and responsive to changes, helping to mitigate negative impacts while supporting positive effects. It focuses on identifying strengths rather than needs and problems, thereby contributing to stakeholders' robustness and their ability to achieve their own objectives. The approach emphasizes bridging the gap between macro and micro levels of development activity, stressing the importance of links between these two levels. Sustainability is a key consideration, defining a livelihood as sustainable if it is resilient to external shocks and stresses, independent of external support, able to maintain the long-term productivity of natural resources, and does not undermine the livelihood options of others.

This framework is particularly useful for understanding how individuals and communities in Rivers State utilize their resources and capacities to achieve food security amidst environmental and socio-economic challenges. At the household and community levels, the SLF facilitates a

detailed analysis of how various forms of capital—natural, financial, human, social, and physical—are leveraged to attain food security. It helps to elucidate the adaptive strategies employed by local populations to cope with and mitigate the impacts of environmental and socio-economic adversities. This understanding is crucial for identifying the most effective pathways to support and enhance the resilience of these

communities.

The SLF also incorporates the vulnerability context, which includes factors such as shocks (e.g., environmental disasters), trends (e.g., economic shifts), and seasonal variations (e.g., agricultural cycles). These elements are critical for comprehending the dynamic nature of food security in Rivers State. By accounting for these variables, the framework provides a comprehensive perspective on the factors that influence food security and the ways in which communities can be supported to become more resilient.

Furthermore, the SLF emphasizes the importance of building resilience and enhancing the adaptive capacities of communities. It offers valuable insights into practical interventions and support systems that can improve food security and sustainable development outcomes. This focus on resilience and adaptation is particularly relevant for Rivers State, where environmental degradation, economic instability, and social inequalities present significant challenges to achieving sustainable food security. The SLF is flexible and can be adapted to meet the specific needs of different organizations or different contexts. It provides a structure for holistic poverty alleviation action and focuses on creating human-centered, participatory, and dynamic development opportunities.

Political Ecology Theory

Political Ecology Theory examines the intricate relationships between political, economic, and social factors and environmental issues and changes. This interdisciplinary field investigates how power dynamics and inequalities influence the distribution of environmental benefits and burdens, affecting resource access, distribution, and control. The term "political ecology" was first coined by Frank Thone in 1935 and was later revitalized by anthropologist Eric R. Wolf in 1972. The field emerged prominently in the 1970s and 1980s, integrating insights from geology, anthropology, and history.

Political ecology is concerned with how political, economic, social, and cultural forces affect, and are affected by, ecological and environmental trends. It explores how human activities impact environments, leading to natural resource scarcity or abundance. Key topics in political ecology include degradation and marginalization, environmental conflict, conservation and control, and environmental identities and social movements. Many political ecologists argue for forms of democracy that include representation for nature to foster a healthy relationship between humankind and the environment.

In the context of this study, Political Ecology Theory provides a robust framework for analyzing how industrial activities, particularly in the oil and gas sector, impact agricultural land, water quality, and food security. The region's food security challenges are significantly influenced by the environmental impacts of the oil and gas industry. Political Ecology helps to understand how industrial pollution, land degradation, and water contamination affect agricultural productivity and food security.

This theory also examines the role of governance, policy, and institutional arrangements in shaping food security outcomes. It provides insights into how policy decisions, regulatory frameworks, and their enforcement (or lack thereof) impact food security and sustainable development in Rivers State. Furthermore, Political Ecology emphasizes the importance of understanding power relations and social inequalities that affect resource access and food security. This focus is crucial in a region where marginalized communities may be disproportionately affected by environmental degradation and policy failures. By utilizing Political Ecology Theory, this study aims to uncover the underlying political and social factors contributing to food security challenges in Rivers State, thereby informing more effective and equitable policy interventions.

Empirical Review

Food Security and Agricultural Development in Nigeria

Oguchi (2018) provides valuable insights into the historical context and contemporary challenges that Nigeria's food security is currently grappling with. The research emphasizes the challenges

faced by Nigeria in terms of food production, which was previously self-sufficient. These challenges arise from various factors including outdated agricultural technology, inadequate funding, corruption, and inconsistent policies. The decline in food security can be attributed to a variety of factors, both internal and external. One significant factor is the rapid population growth, which has surpassed the development of agricultural activities.

According to Amaechi (2018), sustainable agricultural

development in Nigeria holds significant importance. Amaechi highlights the importance of enhancing policy execution, monitoring, evaluation, and support for agriculture, thereby emphasizing the socio-economic consequences associated with sustainable agriculture. The research delineates a range of policies and strategies that the government could potentially adopt in order to effectively tackle these challenges. The findings of this study provide significant insights that can be utilized by policymakers in Rivers State to enhance the productivity and sustainability of local agricultural practices.

Haruna and Murtala (2019) conducted a study that specifically examines the Sudan Savanna Ecological Zone in Nigeria. Their research focuses on analyzing the duration of the growing season by utilizing rainfall data spanning from 1981 to 2010. The research findings indicate that the average duration of the growing season is approximately 125 days. The study emphasizes the significance of integrating efficient water conservation methods alongside rain-fed agriculture, particularly in light of the comparatively brief growing season observed in this particular region. The provided insights offer valuable perspectives on the food security challenges, while also presenting potential solutions to effectively tackle these challenges.

Food Security and the Sustainable Development Goals

According to Brooks (2016), sustainable agriculture plays a crucial role in achieving various Sustainable Development Goals (SDGs), with a specific emphasis on SDG 2, which aims to eliminate hunger and promote sustainable agriculture. The research highlights the interdependence of different Sustainable Development Goals (SDGs), emphasizing the importance of incorporating initiatives related to food security with poverty alleviation, water resource management, sustainable consumption, climate action, and ecosystem conservation. The adoption of a holistic approach is crucial in the formulation of policies in Rivers State, as it

addresses the intricate interplay between food security, environmental factors, and socio- economic dynamics.

Lucky and Chris (2021) conducted an analysis of socioeconomic variables from 1995 to 2019. Nigeria, being the largest economy in the region, continues to face substantial challenges in its pursuit of Sustainable Development Goals (SDGs) and targets. The significance of customized development strategies and regional collaboration in tackling disparities and expediting progress towards Sustainable Development Goal (SDG) achievement in Rivers State and other regions is emphasized by this research.

Domingo et al. (2021) provide significant contributions to the understanding of food security within the Williams Treaties First Nations community in Ontario, Canada. This research study highlights the importance of revitalizing local food systems in order to attain food security and sovereignty, utilizing a community-based participatory research approach. The significance of incorporating community priorities and traditional knowledge into policy-making processes is emphasized by this approach. In the context of Rivers State, the implementation of community- based approaches has the potential to enhance stakeholder engagement and promote the establishment of sustainable food systems that are specifically designed to meet the unique needs and circumstances of the local community.

Food Security and Environmental Sustainability

Kashakova et al. (2022) conduct an analysis of the environmental impact of the agro-food industry, with a specific focus on the post-pandemic period. The study identified the primary risks and challenges that impede the industry's sustainability. By implementing measures to mitigate environmental impacts and promoting sustainable practices, Rivers State can effectively safeguard the long-term sustainability of its agricultural sector.

Unuigbe and Ehizojie (2021) in their discussion of Malawi's interrelated problems with food, water, and energy security, push for a nexus strategy to enhance sectoral cooperation and sustainability. Rivers State has the potential to implement comparable strategies in order to improve resource management and effectively tackle the interconnectedness of food, water, and energy security. In order to optimize resource utilization and promote long-term resilience, Rivers State can adopt a holistic approach to sustainable development.

Wani et al. (2024) further emphasized the significance of effective food waste management in attaining both food security and environmental sustainability. The study examines the potential of sustainable food waste management technologies, specifically the conversion of food waste into biofuels and biopolymers. These technologies have the ability to effectively address environmental concerns and decrease greenhouse gas emissions. The utilization of findings from this study has the potential to inform waste management strategies in Rivers State, thereby improving environmental

sustainability and strengthening initiatives related to food security.

Oh and Lu (2023) highlight the use of IoT technologies and improved monitoring in optimizing vertical farming methods, presenting vertical farming as a sustainable way to improve urban food security. The potential implementation of vertical farming initiatives in urban areas of Rivers State has the potential to address food security challenges and foster sustainable agriculture in densely populated regions. By harnessing cutting-edge technologies, Rivers State can improve the efficiency and resilience of food production in urban settings.

According to Dodo (2020), the issue of food security in sub-Saharan Africa remains a significant concern due to various factors such as rapid population growth, economic inequality, and climate change. The complexity of these issues necessitates further attention and action, despite the implementation of ongoing policy initiatives. The challenges faced by Rivers State can serve as valuable lessons for the implementation of comprehensive policies aimed at addressing the underlying causes of food insecurity. By doing so, the state can promote sustainable development and enhance resilience within the region.

Mathez-Stiefel et al. (2018) highlight the distinct vulnerabilities of mountain populations to food insecurity due to poverty, political marginalization, and unequal resource access. They argue for developing sustainable food systems that provide universal food access, support the right to food, reduce poverty, and enhance social-ecological resilience. Their focus on nutrition-sensitive agriculture in Ethiopia, Kyrgyzstan, Nepal, Pakistan, and Peru emphasizes cross-national capacity building, which could be adapted to similar contexts like Rivers State.

Dame (2018) examines how livelihood dynamics in Ladakh, India, are shaped by socio- economic changes, leading to reduced land-based food production and increased reliance on markets and subsidies. The study highlights the gender and generational challenges arising from

these shifts, stressing the need for cross-sectoral policy approaches. This perspective can inform strategies in Rivers State, where industrial activities may similarly influence agricultural practices and food security.

According to Connell et al. (2020), Small Island Developing States (SIDS)—which are typified by a scarcity of available land, vulnerability to natural disasters, and a significant reliance on international markets—face particular challenges with regard to food security. The vulnerabilities mentioned are exacerbated by the effects of climate change and changes in trade and nutritional patterns. Although Rivers State is not geographically isolated, it exhibits comparable susceptibilities, including susceptibility to environmental fluctuations and reliance on external markets. Understanding the experiences of Small Island Developing States (SIDS) can provide valuable insights for Rivers State in formulating strategies to improve food security resilience and adaptability to evolving circumstances.

Georgeou et al. (2022) investigate the correlation between smallholder farming and food security in the Pacific Island Countries and Territories (PICTs). The researchers specifically focus on community adaptation, resilience, crop diversification, and gender dynamics within the context of agricultural production. This research highlights the significant importance of smallholder farming in improving food security and promoting economic development. The promotion of smallholder farming practices in Rivers State has the potential to strengthen local food security and improve economic resilience. The enhancement of Rivers State's agricultural sector and the improvement of food security outcomes can be achieved through the provision of support to smallholder farmers and the prioritization of community-based approaches.

Climate Change, Food Security, and Sustainable Development

In their study, Tumushabe (2018) explores the complex interplay between climate change, food security, and sustainable development in the African context. The research highlights the susceptibility of Africa to climate variability and change, emphasizing the need for synchronized policy and adaptive approaches to enhance food security. The study notes that proposals have been put forth to establish task forces focused on food security at both national and regional levels, with the aim of bolstering sustainable development endeavors.

Adamou et al. (2021) examine the complex issues surrounding food security in Niger, encompassing climate change, water scarcity, and energy deficits. This research highlights the importance of adopting integrated approaches in order to effectively manage natural resources. The impact of their research aligns with the difficulties encountered in Rivers State, underscoring the significance of renewable energy and sustainable agricultural methods in bolstering food security.

In a study conducted by Said et al. (2023), the researchers examine the effects of climate change on food security in Somalia. The study focuses on the changes in precipitation and temperature patterns, which have been found to contribute to land degradation and decreased agricultural productivity. The research proposes the implementation of policy interventions that focus on climate adaptation and sustainable agricultural practices. These interventions have the potential to contribute to food security initiatives in Rivers State.

Also, Máté et al. (2020) investigate the intricate relationship between food security, climate change, and energy consumption in Central Europe. The study reveals a positive correlation between climate change and food affordability and accessibility. Additionally, it reveals a negative association between temperature rise and food quality. The research indicates that the adoption of renewable energy resources has the potential to effectively tackle the three fundamental aspects of food security. This suggests that there are potential solutions that can be applied to the specific context of Rivers State.

In their recent study, Behera, Haldar, and Sethi (2023) delve into the intricate relationship between agricultural production, food security, and climate change in South Asia, a region that exhibits notable resemblances to Nigeria. The empirical analysis conducted in this study provides strong evidence supporting the positive influence of agricultural production on food security. However, it also highlights the significant obstacles posed by climate change factors. The research places significant emphasis on the significance of climate-resilient agricultural practices and decarbonization, providing valuable insights for the agricultural sector in Nigeria.

Sustainable Agricultural Practices and Food Security

McElwee et al. (2020) assess a range of land management and food production strategies, focusing on how they affect the Sustainable Development Goals (SDGs) and Nature's

Contributions to People (NCPs). The study emphasizes the importance of positive interventions such as enhanced cropland management and agroforestry in Rivers State. These interventions provide valuable insights for enhancing food security while simultaneously ensuring environmental sustainability.

In their study Akinwale and Grobler (2023) aim to explore the intricate connection between food security, agricultural research, technology innovation, and economic growth within the context of Nigeria. The significance of economic growth in promoting agricultural technology innovation and enhancing food security is highlighted by their research findings. This implies that allocating resources towards agricultural research and technology is essential for enhancing food security in Rivers State.

According to Pixley et al. (2018), the Seeds of Discovery (SeeD) program uses genetic resources to address changing consumer demands and climate change. This initiative places a strong emphasis on ensuring fair and equal access to genetic resources, as well as promoting sustainable development through capacity building. It aims to provide potential solutions for improving food security and fostering sustainable development in Rivers State.

The study conducted by Ilham et al. (2022) investigates the potential of Agriculture 4.0 technologies in the context of the Smart Village program, with the aim of improving food security. The advantages of digitalizing agricultural activities are emphasized, emphasizing the compatibility of these technologies with sustainable agriculture principles. This research provides potential avenues for enhancing agricultural efficiency and resilience in Rivers State.

Food Security and Geopolitics

Li and Song (2022) provide an extensive bibliometric examination of the literature on food security from 1991 to 2021. This study aims to identify emerging trends, key topics, and future research directions in the field through a comprehensive analysis. The research emphasizes the growing emphasis on interdisciplinary viewpoints, as evidenced by the prominent presence of themes such as climate change, agriculture, and sustainable development in existing literature. This analysis offers valuable insights into the field of global food security research. However, it highlights the importance of conducting region-specific studies, specifically in West Africa, to effectively address the unique challenges and opportunities that arise in this context.

Jiayi (2022) explores the geopolitical obstacles that impede the attainment of the Sustainable Development Goal of eradicating hunger. This research aims to provide insights into the intricate relationship between natural resource competition, disruptions in international trade, armed conflict, and climate change, and their collective impact on the global issue of food insecurity. The context of Rivers State is influenced by various geopolitical factors, which have a notable

impact on food security. These factors include oil-related conflicts and environmental degradation. The comprehension and resolution of geopolitical dynamics play a pivotal role in the development of efficient strategies aimed at improving food security at the local level.

In their study, Wanyonyi et al. (2024) conduct an evaluation of the Farm Input Support Program (FISP) implemented in Bungoma County, Kenya. The primary objective of this program is to improve food security by offering complimentary fertilizers and certified maize seeds to households that are considered vulnerable. The research conducted in this study sheds light on various challenges, including political interference and governance issues. However, it also emphasizes the program's potential to enhance agricultural productivity and safeguard food security. Based on the findings of this assessment, it is suggested that the implementation of comparable support programs in Rivers State may present potential opportunities for increasing agricultural productivity and improving food security. However, it is crucial to effectively tackle governance and implementation challenges in order to achieve these goals.

Community-Based Approaches and Institutional Collaboration on Food Security

Kote et al. (2024) offer a thorough analysis of youth involvement in agriculture and its effects on economic growth, food security, and sustainable development. The researchers aim to explore the motivations, challenges, and opportunities associated with promoting youth involvement in agriculture. By doing so, they provide valuable insights that can inform the development of youth-centric agricultural policies and programs in Rivers State.

Lamalice et al. (2018) investigate Nunavik community gardening and greenhouse initiatives, addressing how environmental and social changes are upsetting indigenous food systems. Their research emphasizes the advantages of producing fresh food locally and sheds light on the difficulties presented by geographical isolation and climate. This provides valuable insights for community-driven projects in Rivers State.

In their study, Wijekoon and Marikar (2024) explore how the Sri Lanka Army contributes to improving food security by implementing agricultural projects, developing infrastructure, and adopting technology. The authors highlight the importance of collaboration and sustainable practices in attaining long-term food security. They propose potential approaches for Rivers State to involve local institutions and utilize their resources in agricultural endeavors.

Gaps in literature

Research on food security and agricultural development in Rivers State is limited, often overshadowed by studies focusing on broader Nigerian regions, which fail to account for the state's unique ecological and socio-economic dynamics. Key research gaps include the underexplored impact of industrial activities, particularly from the oil and gas sector, on agricultural resources and food security. Furthermore, the role of youth in agriculture and the effectiveness of state-level policies remain poorly understood, necessitating targeted research to guide policy and program development. Lastly, the adoption and impact of modern agricultural technologies in Rivers State require deeper investigation to foster sustainable agricultural advancement and resilience.

Methodology

The research design is qualitative, combining a comprehensive literature review with stakeholder interviews to explore food security challenges and opportunities in Rivers State, Nigeria, within a sustainable development framework. The study's literature review examines existing data from academic and policy sources, while interviews are conducted across strategically selected LGAs: Obio Akpor and Phalga (industrial hubs), Emohua, Ogba/Egbema/Ndoni, Ahoada East, Ahoada West, and Ikwerre (illegal oil refining areas), Andoni, Opobo/Nkoro, Akuku-Toru, Asari-Toru, Degema, Bonny (water and ocean hubs), and Eleme, Khana, Gokana (areas affected by oil exploration). A total of 48 persons have been interviewed, including community members, farmers, policymakers, and environmental experts, providing localized insights. These interviews, along with the thematic analysis of the literature, offer empirical and practical guidance for sustainable development in the region.

Findings

Limited Agricultural Productivity and Technological Gaps

A significant challenge highlighted is the region's limited agricultural productivity. Interviews with farmers in Emohua and Ikwerre LGAs revealed their heavy reliance on traditional and inefficient farming techniques.

We are stuck in a cycle of poverty. Without money to buy high- yield seeds, we work hard, but the yields are small, and that affects everyone in the community (a Farmer from Emohua).

These farmers depend on conventional farming methods, resulting in low crop yields, exacerbated by inadequate access to essential agricultural inputs such as fertilizers, quality seeds, and modern machinery. Agricultural extension officers in Ahoada West further noted that the absence of financial resources prevents smallholder farmers from investing in more productive techniques or upgrading to modern equipment.

Even when farmers are aware of better methods, there's no capital or support to implement these changes (An agricultural extension officer in Ahoada).

Local policymakers echoed these concerns, stressing that a lack of government support and insufficient infrastructure investments have contributed significantly to the stagnation in agricultural productivity.

Moreover, even with some awareness of new agricultural technologies, a knowledge gap persists.

We've heard about new methods, but we don't have the training or money to use them (A farmer in Elele).

This statement underscores the pressing need for focused educational and extension initiatives. Agricultural experts in the region stressed that equipping farmers with the skills and resources necessary to adopt technologies like precision farming and drought-resistant crops could transform agricultural productivity. However, this requires not only education but also substantial government intervention, including subsidies and access to affordable credit.

Climate Change and Environmental Degradation

Climate change is another formidable challenge, deeply impacting the region's agricultural landscape. Farmers from Ahoada East and Bonny Island detailed how erratic weather patterns, including unpredictable rainfall and frequent flooding, have disrupted planting and harvesting schedules.

The rains come late and stop early, and when they do come, it floods our farms, (a farmer from Ahoada East).

Soil erosion, exacerbated by extreme weather and poor land management, has led to severe soil fertility loss, further decreasing agricultural productivity.

The environmental toll is compounded by industrial activities, notably oil exploration, which has wreaked havoc on the ecosystem. Environmental experts in Gokana LGA raised serious concerns about land and water contamination from oil spills and gas flaring.

The spills from oil pipelines have made the soil barren and the rivers toxic. We've lost so much land that used to feed our people (A community leader from Eleme).

The cumulative environmental degradation has made it difficult for farmers to maintain consistent crop yields, threatening the sustainability of the region's food systems. The contamination of soil and waterways has not only disrupted agriculture but also posed severe health risks to local communities.

Our rivers are full of oil, and our farmlands have been taken over by gas flaring sites. It's hard to even think of farming when you see what's happening (a youth leader from Gokana).

Industrial Activities and Their Environmental Impact

Industrial pollution from the oil and gas sector has emerged as a dominant issue impacting food security and public health. Community members from industrial hubs like Obio Akpor and Phalga described widespread environmental damage.

The land is unfit for farming, and we constantly breathe polluted air, this was explemified by the black soothe we experienced some time ago. It was indeed devastating impacting on our health as well (a local farmer in Obio Akpor)

Oil spills and gas flaring have not only degraded agricultural lands but have also introduced toxic pollutants into air and water bodies. These environmental hazards disrupt irrigation practices, limit clean water availability, and compromise food production.

Industrial effluents have severely affected the quality of water used for irrigation, which is a critical component of agriculture in the region (An Environmental scientist)

The health implications of these pollutants are profound, with residents reporting increased cases of respiratory diseases and other health concerns.

The pollution has destroyed our farmlands, and people are getting sick from the contaminated water (An environmental activist from Eleme).

The dire environmental situation reflects a harsh trade-

off: while the oil industry brings economic benefits, it severely undermines agricultural productivity and community health, posing a long-term threat to the region's sustainability.

Socioeconomic Constraints and Youth Disengagement

Socioeconomic factors, including poverty, inequality, and market access limitations, further complicate food security in Rivers State. Smallholder farmers in Khana and Andoni expressed frustration over their inability to access financial credit, which hampers their capacity to invest in better farming practices.

We can't get our crops to bigger markets, and when we do, we often get unfair prices (A trader in Asari-Toru).

This limited market access and lack of financial resources perpetuate a cycle of poverty, trapping farmers in subsistence-level agriculture with little room for economic advancement.

Youth disengagement from agriculture poses an additional, long-term challenge. Young people in Emohua and Ogba/Egbema/Ndoni overwhelmingly view farming as labor-intensive and low- status work.

Agriculture is not attractive. There's no money, and it's seen as a job for the old (A Youth from Emohua).

The barriers they face include limited land access, lack of financing, and inadequate support. Development experts suggested that youth engagement could be revitalized through targeted programs offering economic incentives, digital farming platforms, and vocational training.

If young people see agriculture as profitable and modern, they'll be more willing to get involved, (a community development officer in Ikwerre)

Population Growth, Urbanization, and Resource Strain

The region's rapidly growing population and urbanization further exacerbate food security concerns. Leaders from Bonny and Opobo/Nkoro emphasized that urban expansion has led to fierce competition for land, reducing the availability of arable farmland.

Our communities are growing, but there's not enough land for everyone to farm. We have to compete with industries like the NLNG, (a community leader from Bonny).

Urban sprawl and industrial development have intensified resource strain, contributing to significant land degradation. Environmental specialists warned that over-cultivation and the overuse of agricultural land without sustainable practices have left the soil infertile, diminishing the region's agricultural output.

Urban planners in Obio Akpor highlighted how rapid urbanization has also overwhelmed existing infrastructure, exacerbating waste management problems and increasing pollution.

Our cities are growing faster than our infrastructure can handle (a town planner from Obio-Akpor).

The need for sustainable urban planning and better land management policies is crucial to balance development with agricultural and environmental needs.

Food Security and Sustainable Development

Food security is foundational to achieving Sustainable Development Goals (SDGs) and fostering a resilient society. Proper nutrition not only improves individual well-being but also enhances productivity and economic stability. Local health officials and educators in Bonny stressed the importance of nutrition for academic success:

Children who have access to nutritious food not only grow healthier but also do better in school, (a teacher from Bonny).

Improved nutrition reduces healthcare costs and enables a more skilled workforce, contributing to economic growth (SDG 1 and SDG 4). Furthermore, food security fosters social stability by reducing conflicts over scarce resources.

Food scarcity often leads to tensions and conflicts (A community leader in Asari-Toru).

Food security also promotes environmental sustainability by encouraging practices that conserve natural resources and combat climate change.

We must move away from intensive farming that degrades the soil and adopt methods that protect our environment (An agricultural scientist in Obio Akpor).

Practices such as sustainable irrigation and organic farming help achieve clean water goals (SDG 6) and reduce carbon emissions (SDG 13).

Balancing Food Security with Sustainable Development

However, balancing food security and sustainable development goals presents difficult trade- offs. Economic benefits from oil exploration come at the cost of environmental degradation, reducing agricultural productivity and threatening long-term food security. Farmers in Gokana shared how oil contamination has devastated their crops,

Our land used to be fertile, but now it's poisoned. We

can't grow anything anymore (One of the farmers in Gokana).

Conservationists in Bonny also warned of habitat loss from expanding agricultural land, stressing the need to balance food production with ecosystem preservation.

While intensive farming methods might increase short-term yields, they often result in soil degradation and water pollution, undermining long-term sustainability.

Short-term gains from overusing chemical inputs will cost us in the long run if we don't adopt environmentally friendly practices (An agricultural expert in Obio Akpor).

The need for integrated approaches that balance immediate food needs with environmental conservation is evident.

Discussion of Findings

One of the primary findings relates to limited agricultural productivity, primarily driven by farmers' dependence on traditional, inefficient farming techniques and a lack of access to essential resources. Interviews conducted with farmers in regions such as Emohua and Ikwerre underscored this reality, as many expressed the difficulty of breaking free from a cycle of poverty exacerbated by insufficient financial support and low crop yields. Agricultural extension officers from Ahoada West emphasized the limited availability of capital, which restricts the adoption of modern farming methods and equipment. These observations align with Oguchi's (2018) findings on Nigeria's outdated agricultural technology and underscore a critical need for government investment in agricultural training and financial support. Although previous studies have highlighted nationwide agricultural inefficiencies, this research provides a localized perspective, emphasizing the economic barriers unique to Rivers State. Addressing these gaps through targeted education, extension services, and government interventions could revolutionize agricultural productivity. The justification for this recommendation lies in the clear connection between financial empowerment and technological advancement in improving agricultural outcomes.

Climate change and environmental degradation emerged as formidable challenges impacting food security in the region. Farmers from Ahoada East and Bonny Island detailed the adverse effects of unpredictable weather patterns and frequent flooding, which disrupt agricultural cycles and erode soil fertility. This finding is compounded by the devastating environmental consequences of industrial activities, particularly oil exploration, which has contaminated land and water resources. Residents from Gokana and Eleme provided vivid accounts of the destruction caused by oil spills and gas flaring, with one community leader lamenting the barren, toxic state of once-fertile lands. These findings are consistent with research by Eke-Okocha and Eze (2023), which highlighted the environmental consequences of insurgencies in other Nigerian regions, and Oruma et al. (2021), who examined pollution in the Niger Delta. However, this study uniquely emphasizes the dual impact of climate variability and industrial pollution in Rivers State. The rationale for emphasizing these interconnected factors lies in the understanding that food security cannot be achieved without addressing environmental degradation and adopting climate-adaptive agricultural strategies.

The environmental impact of industrial activities, particularly from the oil and gas sector, is another critical finding that threatens both agricultural productivity and public health. Community members from Obio Akpor and Phalga detailed widespread pollution that has degraded agricultural land and compromised air and water quality. This environmental crisis is exemplified by the "black soot" phenomenon, which has posed severe health risks to local populations. The study's findings are underpinned by Political Ecology Theory, which explains how socio-political forces and industrial interests exacerbate environmental challenges. The concerns raised by residents and environmental scientists echo Whyte et al. (2020) but provide a deeper exploration of how these impacts specifically undermine food security and community health in Rivers State. This discussion justifies the urgent need for policy reforms and stricter environmental regulations to balance economic benefits from oil with the environmental and social well-being of local communities.

Socioeconomic constraints, including poverty, inequality, and limited market access, further compound food security issues in Rivers State. Farmers in Khana and Andoni expressed frustrations over the difficulty of accessing financial credit and fair market prices. Traders lamented poor transportation infrastructure that hinders market access and perpetuates poverty. Furthermore, youth disengagement from agriculture emerged as a pressing concern. Young residents in Emohua and Ogba/Egbema/Ndoni overwhelmingly view farming as

unappealing due to perceived low economic returns. This study expands on Lucky and Chris (2021), who discussed regional economic disparities affecting SDG achievements, by emphasizing the need for youth-centric agricultural programs. The disinterest among youth underscores a missed opportunity for revitalizing the agricultural sector, and the justification for addressing this lies in the potential for economic transformation through targeted incentives and training programs for young people.

Finally, the study highlighted the impact of rapid population growth and urbanization on food security, as increasing competition for land reduces the availability of arable farmland. Urban

planners from Bonny and Opobo/Nkoro noted the strain urban expansion places on land resources and infrastructure, exacerbating waste management and pollution issues. The experiences of community leaders from Bonny illustrate the struggle between urbanization and agricultural needs. These observations are in line with Domingo et al. (2021), who analyzed urbanization challenges in different global contexts, though this research uniquely addresses the competition between industrial and agricultural land use in Rivers State. The need for sustainable urban planning and strategic land management policies is paramount to mitigate these issues. Understanding these dynamics justifies the call for integrated approaches that consider the long- term sustainability of both urban and agricultural areas.

Recommendations

Firstly, to address the issue of limited agricultural productivity, Rivers State must modernize farming practices by providing financial support systems such as subsidies, grants, and credit lines. Training programs focused on advanced agricultural techniques, such as precision farming and climate-resilient crops, will enable farmers to transition from subsistence to commercial farming, leading to improved crop yields and enhanced food availability.

Secondly, to mitigate environmental degradation, the state government should enforce stricter regulations on oil companies, mandate the clean-up of contaminated lands and water bodies, and establish an independent monitoring body. Additionally, promoting eco-friendly practices within the oil and gas sector, such as pollution control technologies, will safeguard both food security and community health.

Thirdly, climate adaptation strategies are necessary to protect agriculture from the effects of climate change. This includes the implementation of flood defenses, soil erosion control, and efficient irrigation systems. Moreover, providing training on sustainable land management and climate-smart farming practices will increase resilience against unpredictable weather patterns.

Fourthly, engaging youth in agriculture is crucial for the sector's future. Programs offering financial incentives, agribusiness subsidies, and technology-driven training will attract young

people to the agricultural industry. Collaboration with universities to create agricultural entrepreneurship hubs will foster innovation and ensure long-term youth involvement.

Fifthly, improving market access through better infrastructure, including rural roads and market facilities, is essential for farmers. Establishing cooperatives and digital platforms will further enable farmers to access larger markets, secure better prices, and reduce post-harvest losses, ultimately stabilizing their incomes. Additionally, sustainable urban planning should balance development with agricultural needs. Zoning laws that protect farmland, coupled with green spaces and effective waste management systems, will promote long-term food security and environmental protection.

Finally, community-based initiatives, such as community gardens and cooperative farming, should be promoted to strengthen local food systems. Partnerships with NGOs and research institutions will provide tailored solutions, empowering communities to lead sustainable food security efforts. Furthermore, Rivers State should invest in agricultural products from neighboring states with more favorable conditions for farming. The development of storage facilities within the state will also preserve food, ensuring a steady supply for citizens and residents and ultimately enhancing food security.

Conclusion

This study has explored the intricate connections between food security and sustainable development in Rivers State, Nigeria, shedding light on the challenges and opportunities unique to this resource-rich yet environmentally degraded region. The findings underscore the need for holistic, integrated strategies that address the critical issues of agricultural inefficiency, environmental degradation caused by oil

and gas activities, socio-economic disparities, and the consequences of rapid urbanization and climate change. The research contributes to existing knowledge by providing a localized analysis of food security challenges in the context of a heavily industrialized and ecologically sensitive region. Specifically, it highlights the environmental and public health consequences of oil exploration, the socio-economic constraints faced by smallholder farmers, and the critical need to engage youth in modern agricultural practices. Additionally, the study introduces tailored solutions, such as climate-adaptive farming,

stricter environmental regulations, and community-driven initiatives that could serve as blueprints for other regions facing similar challenges.

Future research should expand on this work by conducting longitudinal studies to monitor the long-term impacts of implemented strategies on food security and sustainable development. Investigating the role of emerging technologies, such as precision agriculture and renewable energy, in enhancing agricultural productivity and environmental sustainability would also be valuable. Furthermore, comparative studies between Rivers State and other oil-producing regions in Nigeria or globally could provide deeper insights into effective policy measures and best practices for balancing industrial development with ecological and food security goals.

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