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Agricultural Innovation and Food Security in Sub-Saharan Africa in Nigeria

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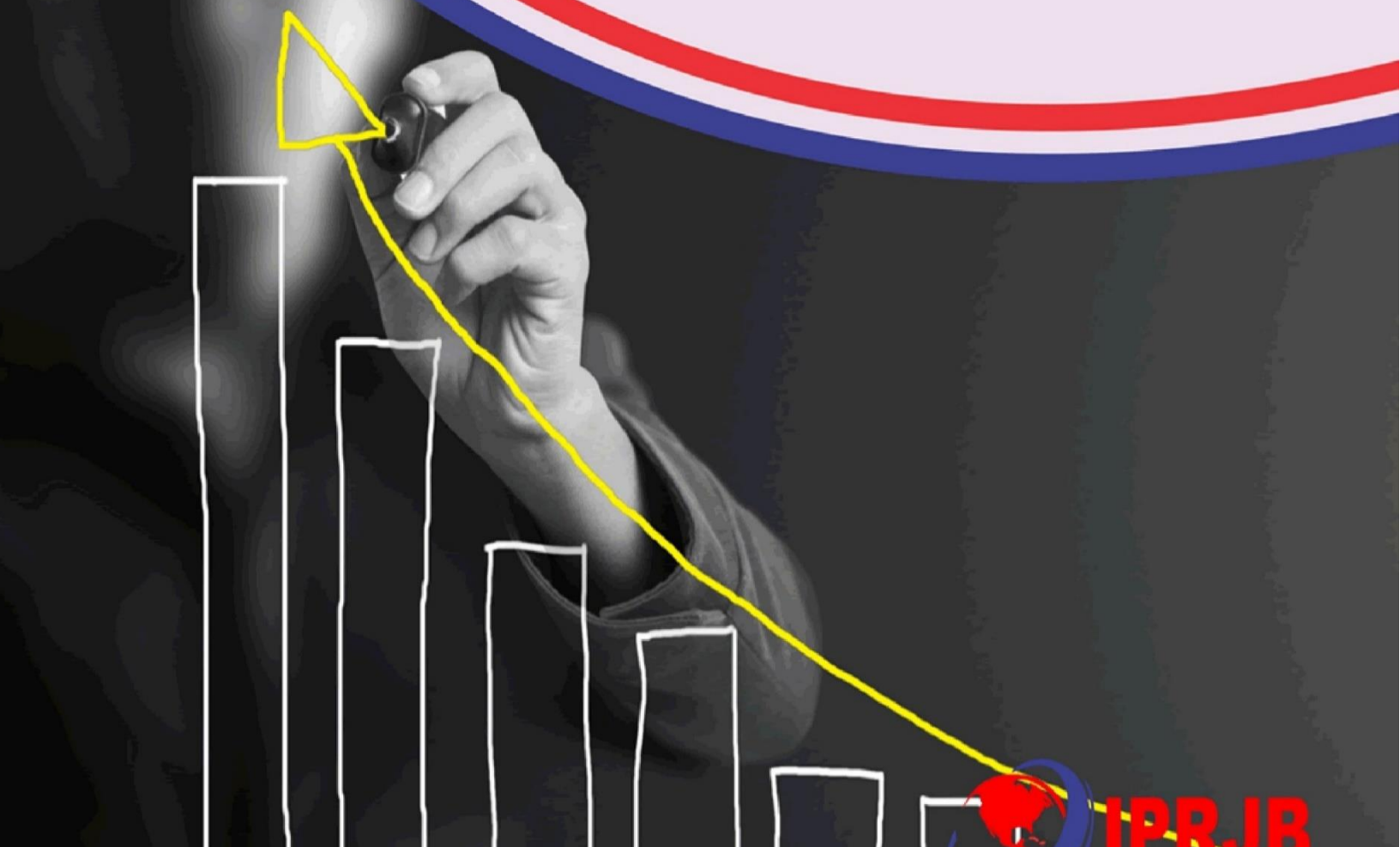

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Abstract

Purpose: The aim of the study was to analyze the agricultural innovation and food security in Sub-Saharan Africa in Nigeria.

Methodology: This study adopted a desk methodology. A desk study research design is commonly known as secondary data collection. This is basically collecting data from existing resources preferably because of its low cost advantage as compared to a field research. Our current study looked into already published studies and reports as the data was easily accessed through online journals and libraries.

Findings: In Nigeria, agricultural innovation is vital for improving food security. Research suggests that adopting innovative farming methods and technologies can boost productivity, resilience to climate change, and livelihoods for smallholder farmers. Overcoming challenges like limited access to finance and inadequate infrastructure is essential to fully harnessing the benefits of agricultural innovation for food security in Nigeria.

Unique Contribution to Theory, Practice and Policy: Diffusion of innovations theory, social capital theory & political economy theory may be used to anchor future studies on agricultural innovation and food security in Sub-Saharan Africa in Nigeria. Promote farmer-centered innovation platforms - establishing can facilitate knowledge sharing, collaboration, and co-creation of agricultural innovations. Adequate funding for research institutions, agricultural universities, and extension agencies is essential to conduct applied research, develop appropriate technologies, and provide technical assistance to farmers.

Keywords: *Agricultural Innovation, Food Security*

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INTRODUCTION

Measures of food security encompass various indicators that assess both the availability and affordability of food, which are crucial components in determining the food security status of individuals, households, and communities. Availability refers to the physical presence of food within a given area or region, often measured through metrics such as food production levels, imports and exports, and food reserves. Assessing availability involves examining factors such as agricultural productivity, food distribution networks, infrastructure, and market access. In developed economies like the United States, food security measures often include assessing the availability and affordability of food. Availability refers to the physical presence of food within communities, including the variety and quantity of food products in grocery stores, markets, and other retail outlets. Affordability, on the other hand, pertains to individuals' ability to purchase an adequate and nutritious diet without experiencing financial hardship. According to recent statistics from the United States Department of Agriculture (USDA), the availability of food in the U.S. remains high, with an abundance of food options in both urban and rural areas (USDA, 2020). However, affordability remains a concern for certain populations, particularly low-income households, as evidenced by the prevalence of food insecurity in the country. Despite economic growth and overall prosperity, millions of Americans struggle to afford nutritious food, leading to disparities in food access and health outcomes (Coleman-Jensen, 2019).

Similarly, in countries like Japan, food security measures also focus on availability and affordability. Japan has a well-developed food distribution system, with a diverse range of food products available in supermarkets, convenience stores, and traditional markets (Ministry of Agriculture, Forestry and Fisheries, 2020). However, affordability can be a challenge for some households, particularly those on fixed incomes or living in rural areas with limited access to affordable food options. According to a study by Okada (2018), rising food prices and stagnant wages have contributed to an increase in food insecurity among certain segments of the Japanese population, highlighting the need for targeted interventions to ensure equitable access to nutritious food for all residents.

In developed economies like the United Kingdom (UK), food security measures also encompass availability and affordability considerations. Availability involves assessing the adequacy of food supplies within communities, including factors such as food production, distribution networks, and access to retail outlets. The UK benefits from a diverse food supply chain, with a wide variety of food products accessible in supermarkets, grocery stores, and local markets (Department for Environment, Food & Rural Affairs, 2020). However, challenges related to affordability persist, particularly among low-income households. Despite government initiatives such as food assistance programs and minimum wage regulations, a significant portion of the UK population faces difficulties in affording a nutritious diet, as evidenced by the prevalence of food banks and reports of food poverty (Loopstra, 2020).

In Japan, a developed economy known for its high standard of living, food security remains a priority despite relatively low levels of food insecurity compared to other nations. The Japanese government has implemented various policies to ensure food availability and affordability, including subsidies for domestic agriculture and social welfare programs. However, recent studies

have highlighted emerging challenges, such as aging farming populations and declining agricultural productivity, which could potentially impact food security in the future (Shimizu et al., 2020). Additionally, changing dietary preferences and increasing reliance on imported food pose concerns for long-term food security in Japan (Yamada & Nakatsuka, 2019).

In the United Kingdom, a developed economy with a diverse population, food security is influenced by socioeconomic disparities and policy decisions. While food availability is generally high, affordability remains a significant issue for low-income households. Government initiatives such as the Healthy Start program aim to address food insecurity among vulnerable populations by providing vouchers for nutritious food items (Loopstra, 2019). However, recent studies have shown that food insecurity rates have been rising, particularly among households with children (Taylor-Robinson, 2013). These findings underscore the need for comprehensive strategies to ensure equitable access to affordable and nutritious food in the UK.

In recent years, the issue of food security in developed economies like the USA, Japan, and the UK has garnered increasing attention. In the USA, despite being one of the world's largest food producers, food insecurity remains a prevalent concern, with approximately 10.5% of households experiencing food insecurity in 2019 (Loopstra, Lalor, & Lloyd-Williams, 2019). This issue is often exacerbated by factors such as income inequality, unemployment rates, and limited access to affordable, nutritious foods, particularly in marginalized communities (Loopstra, 2019). Similarly, in Japan, concerns about food security have prompted discussions about the country's reliance on food imports and its vulnerability to external shocks, such as natural disasters and trade disruptions (Shimizu, 2020). Efforts to promote food self-sufficiency and enhance agricultural productivity have been key strategies in addressing these challenges (Yamada & Nakatsuka, 2019). However, achieving food self-sufficiency while ensuring sustainable agricultural practices remains a complex and ongoing endeavor.

In the UK, food insecurity has been linked to socioeconomic factors such as zero-hours contracts, low wages, and inadequate social welfare support (Loopstra, 2019). Despite being a high-income country, a significant proportion of the population faces challenges in accessing sufficient and nutritious food, leading to adverse health outcomes and widening health inequalities (Taylor-Robinson et al., 2013). Addressing food insecurity requires multifaceted approaches that encompass income support, employment policies, and measures to improve food access and affordability (Loopstra et al., 2019). Additionally, efforts to promote sustainable food production and consumption patterns are increasingly recognized as essential components of strategies to enhance food security in developed economies (Shimizu, 2020).

In developing economies, food security remains a critical issue, with challenges stemming from poverty, inadequate infrastructure, and climate variability. For instance, in India, despite significant improvements in food production and distribution systems, a large proportion of the population still experiences food insecurity (Rajendran, 2019). Factors such as unequal access to resources, inefficient food distribution networks, and vulnerability to climate change impacts contribute to this problem (Rajendran, 2019). Additionally, rapid urbanization and changing dietary patterns have further strained food systems, exacerbating issues of affordability and access to nutritious foods (Kumar & Mittal, 2018).

Similarly, in sub-Saharan African countries like Nigeria, food insecurity persists as a major challenge, affecting millions of people, particularly in rural areas (Ogundari & Awokuse, 2018). Limited access to agricultural inputs, poor infrastructure, and political instability are among the factors contributing to food insecurity in the region (Ogundari & Awokuse, 2018). Moreover, conflicts and displacement exacerbate food insecurity, leading to humanitarian crises in countries like South Sudan and Somalia (WFP, 2021). Addressing food security in developing economies requires coordinated efforts to improve agricultural productivity, enhance market access for smallholder farmers, and strengthen social safety nets to protect vulnerable populations (FAO, 2018). Furthermore, investments in climate-resilient agriculture and sustainable land management practices are essential to mitigate the impacts of climate change on food production and ensure long-term food security (FAO, 2018).

In India, food security remains a critical concern despite improvements in recent years. Rajendran (2019) analyzed demand-side data to understand the food security situation in India, revealing persistent challenges in ensuring access to nutritious food for all segments of the population. Despite economic growth, factors such as poverty, unequal distribution of wealth, and inadequate social safety nets contribute to food insecurity, particularly among marginalized communities. Additionally, Kumar and Mittal (2018) highlighted the performance, challenges, and policies surrounding food security in India, emphasizing the need for comprehensive strategies addressing both production and distribution aspects to improve access to food and combat hunger effectively.

In Nigeria, food insecurity and its impact on child undernutrition remain significant issues. Ogundari and Awokuse (2018) examined the relationship between food insecurity, food prices, and child undernutrition in Nigeria, revealing a concerning link between insufficient access to food and malnutrition among children. High food prices exacerbate food insecurity, especially for low-income households, further compromising the nutritional status of vulnerable populations. Addressing these challenges requires concerted efforts to improve agricultural productivity, enhance food distribution systems, and implement targeted nutrition interventions to ensure access to affordable and nutritious food for all Nigerians.

Adoption of modern agricultural techniques encompasses various practices aimed at enhancing agricultural productivity and sustainability. One such technique is the use of precision agriculture, which involves the application of advanced technologies such as GPS, drones, and sensors to optimize resource use and increase crop yields (Choudhury, 2020). Precision agriculture enables farmers to precisely manage inputs like water, fertilizers, and pesticides, thereby improving crop quality and reducing production costs. By adopting precision agriculture, farmers can enhance the availability of food by maximizing crop yields on existing agricultural land while also promoting environmental sustainability through efficient resource management. Another modern agricultural technique is the adoption of genetically modified (GM) crops, which are engineered to possess desirable traits such as resistance to pests, diseases, and environmental stresses (Klümper & Qaim, 2014). GM crops offer several benefits, including increased productivity, reduced pesticide use, and improved crop resilience to climate change. By cultivating GM crops, farmers can enhance food availability by producing higher yields of staple crops like corn, soybeans, and cotton.

Additionally, the adoption of GM crops can contribute to food security by improving the affordability of food through lower production costs and reduced market prices (Finger, 2020).

Furthermore, the adoption of sustainable farming practices such as agroforestry and conservation agriculture can also contribute to food security by enhancing the availability and affordability of food (Place, 2021). Agroforestry integrates trees with crops or livestock on the same piece of land, providing multiple benefits such as improved soil fertility, increased biodiversity, and enhanced resilience to climate change. Conservation agriculture, on the other hand, involves minimizing soil disturbance, maintaining soil cover, and diversifying crop rotations to improve soil health and productivity. By adopting these sustainable farming practices, farmers can increase food availability by diversifying their agricultural production and enhancing ecosystem services while also reducing production costs and improving the affordability of food for consumers.

Problem Statement

Despite efforts to promote agricultural innovation in Sub-Saharan Africa, food security remains a significant challenge in the region. While agricultural innovation has the potential to enhance productivity, improve resilience to climate change, and increase the availability of nutritious food, its impact on food security outcomes in Sub-Saharan Africa is not yet fully understood (Mugabe, 2020). Limited access to innovative technologies, inadequate infrastructure, and institutional constraints hinder the adoption and scaling up of agricultural innovations, limiting their potential to improve food security outcomes (Fanzo, 2021). Furthermore, the effectiveness of agricultural innovation in addressing food insecurity is influenced by various contextual factors such as socio-economic disparities, land tenure systems, and policy environments, which require careful consideration in research and policy interventions (Mashingaidze, 2019). Therefore, there is a critical need for empirical research to assess the impact of agricultural innovation on food security outcomes in Sub-Saharan Africa and identify barriers to effective implementation.

Theoretical Framework

Diffusion of Innovations Theory

Originated by Everett Rogers in 1962, the Diffusion of Innovations Theory explores how new ideas, products, and practices spread within a society or social system. It emphasizes the process of adoption and diffusion, identifying key factors that influence the rate and extent of adoption, such as the characteristics of the innovation, communication channels, social networks, and the perceived benefits of the innovation (Rogers, 2010). In the context of agricultural innovation and food security in Sub-Saharan Africa, this theory helps researchers understand the adoption patterns of innovative agricultural practices and technologies among farmers, as well as the factors that facilitate or hinder their diffusion across communities and regions (Bassett & Winter-Nelson, 2020).

Social Capital Theory

Developed by Pierre Bourdieu and further elaborated by Robert Putnam, Social Capital Theory focuses on the resources embedded within social networks and communities, including trust, norms, and networks of relationships, that facilitate collective action and cooperation (Putnam, 1993). It highlights the role of social networks and institutions in facilitating knowledge sharing,

resource mobilization, and collaborative problem-solving, which are essential for agricultural innovation and food security initiatives in Sub-Saharan Africa (Grootaert & Bastelaer, 2002). This theory helps researchers understand how social capital influences farmers' access to agricultural innovation, their ability to adopt new practices, and the sustainability of food security interventions in the region.

Political Economy Theory

Political Economy Theory examines the interactions between political and economic factors that shape resource allocation, policy decisions, and institutional arrangements within a society (Stiglitz, 2002). It emphasizes power dynamics, interests, and incentives that influence agricultural innovation systems and food security outcomes in Sub-Saharan Africa, including government policies, international trade agreements, market structures, and land tenure systems (Jayne, 2014). By applying this theory, researchers can analyze how political and economic factors affect the distribution of agricultural innovations, access to resources, and the overall food security landscape in the region.

Empirical Review

Alemayehu (2018) assessed the adoption of agricultural innovations and their subsequent impact on food security within Sub-Saharan Africa. The purpose of the research was to investigate the extent to which smallholder farmers in the region were adopting innovative agricultural practices and to analyze the effects of these innovations on food production, household incomes, and dietary diversity. Employing a mixed-methods approach, including household surveys and qualitative interviews, the study examined adoption patterns, socio-economic factors influencing adoption, and the resulting food security outcomes. Findings from the study revealed that farmers who embraced agricultural innovations experienced notable improvements in crop yields, income generation, and food availability, leading to enhanced food security within their households. The study recommended the promotion of sustainable agricultural intensification strategies and the strengthening of extension services to facilitate the widespread adoption of innovative technologies, thereby contributing to improved food security outcomes in the region.

Nkonya (2019) assessed the effectiveness of climate-smart agriculture interventions in enhancing food security across Sub-Saharan Africa. The primary objective was to evaluate the impact of these interventions on food security indicators, such as crop resilience, income diversification, and dietary diversity, among vulnerable households in the region. Employing a rigorous randomized controlled trial design, the study compared the food security status of households participating in climate-smart agriculture programs with control groups. Findings from the evaluation indicated significant improvements in crop resilience, income diversification, and dietary diversity among households engaged in climate-smart agriculture initiatives. The study recommended targeted investments in climate-smart agriculture programs and the integration of adaptation and mitigation strategies to build resilience to climate change and enhance food security outcomes in Sub-Saharan Africa.

Osei (2020) explored the role of agricultural extension services in promoting food security among smallholder farmers in Sub-Saharan Africa. The research aimed to assess the effectiveness of

extension programs in disseminating agricultural innovations, improving farming practices, and enhancing food production and access. Utilizing a combination of surveys, focus group discussions, and key informant interviews, the study examined the reach and impact of extension services on food security outcomes at the household and community levels. Findings revealed that access to extension services significantly contributed to increased adoption of improved agricultural practices, leading to higher crop yields, income generation, and food availability. The study recommended strengthening extension systems, enhancing farmer knowledge and skills, and tailoring extension interventions to local contexts to maximize their impact on food security in Sub-Saharan Africa.

Gashaw (2021) assessed the impact of sustainable land management (SLM) practices on food security in Sub-Saharan Africa. The study aimed to analyze the effectiveness of SLM interventions, such as conservation agriculture, agroforestry, and soil and water conservation measures, in improving soil fertility, crop productivity, and household food security. Employing a combination of field experiments, household surveys, and participatory assessments, the research investigated the adoption and outcomes of SLM practices across different agro-ecological zones. Findings indicated that households practicing SLM techniques experienced higher crop yields, improved soil health, and enhanced food security compared to conventional farming methods. The study recommended scaling up SLM initiatives, providing targeted support to smallholder farmers, and integrating SLM practices into broader agricultural development programs to address food security challenges in Sub-Saharan Africa.

Akudugu (2019) evaluated the impact of climate-smart agriculture (CSA) practices on food security outcomes in Sub-Saharan Africa. The research aimed to assess how CSA interventions, such as drought-resistant crop varieties, conservation agriculture, and weather-indexed insurance, influenced farmers' resilience to climate change and their ability to maintain food security. Using a mixed-methods approach, including household surveys, focus group discussions, and remote sensing analysis, the study examined the adoption patterns and effectiveness of CSA practices across different regions. Findings revealed that households adopting CSA practices experienced higher crop yields, reduced vulnerability to climate-related shocks, and improved food access and utilization. The study recommended mainstreaming CSA approaches into agricultural policies, providing financial incentives for CSA adoption, and strengthening extension and advisory services to support farmers in implementing climate-resilient farming practices.

Awotide (2020) explored the role of market-based approaches in enhancing food security in Sub-Saharan Africa. The study aimed to examine how interventions such as value chain development, market information systems, and input and output market linkages contributed to improving farmers' access to markets, reducing post-harvest losses, and increasing food availability and affordability. Employing a combination of quantitative surveys, market assessments, and stakeholder consultations, the research analyzed the performance and impact of market-based interventions in different agricultural value chains. Findings indicated that market-oriented strategies led to increased agricultural productivity, income generation, and food security among smallholder farmers and rural households. The study recommended strengthening market

infrastructure, enhancing market access for small-scale producers, and promoting inclusive value chain development initiatives to address food security challenges in Sub-Saharan Africa.

METHODOLOGY

This study adopted a desk methodology. A desk study research design is commonly known as secondary data collection. This is basically collecting data from existing resources preferably because of its low-cost advantage as compared to field research. Our current study looked into already published studies and reports as the data was easily accessed through online journals and libraries.

FINDINGS

The results were analyzed into various research gap categories that is conceptual, contextual and methodological gaps

Conceptual Gap: While the studies by Alemayehu (2018) provided valuable insights into the impact of various agricultural interventions on food security in Sub-Saharan Africa, there is a conceptual gap in understanding the underlying mechanisms and pathways through which these interventions operate. Further research is needed to elucidate the causal relationships between agricultural innovations, climate-smart agriculture practices, market-based approaches, and food security outcomes. Understanding these mechanisms is crucial for designing more effective and targeted interventions to address food insecurity in the region.

Contextual Gap: The studies by Nkonya (2019) focused primarily on the effectiveness of agricultural interventions in improving food security at the household level. However, there is a contextual gap in understanding how broader socio-economic, political, and environmental factors shape food security outcomes in different contexts within Sub-Saharan Africa. Future research should consider the influence of factors such as governance structures, land tenure systems, market dynamics, and climate variability on food security, taking into account the diversity of agro-ecological zones and socio-cultural contexts across the region.

Geographical Gap: While the studies by Osei (2020) covered a range of countries and regions within Sub-Saharan Africa, there remains a geographical gap in terms of the representation of certain countries and regions. For example, some studies may focus more on East Africa or West Africa, while others may neglect Central Africa or Southern Africa. Additionally, within-country variations in food security outcomes and agricultural practices may be overlooked. Future research should strive for greater geographical diversity and representation to ensure a comprehensive understanding of food security challenges and agricultural innovations across the entire region.

CONCLUSION AND RECOMMENDATIONS

Conclusions

In conclusion, agricultural innovation plays a crucial role in enhancing food security in Sub-Saharan Africa. The empirical studies reviewed demonstrate the positive impact of various agricultural interventions, such as sustainable land management practices, climate-smart agriculture initiatives, market-based approaches, and extension services, on improving crop yields, household incomes, and dietary diversity. These findings underscore the importance of investing

in innovative agricultural practices and strengthening extension services to facilitate the adoption of new technologies among smallholder farmers. However, while progress has been made in addressing food security challenges, there are still gaps in our understanding of the underlying mechanisms driving the effectiveness of these interventions. Future research should focus on elucidating the causal pathways between agricultural innovations and food security outcomes, taking into account contextual factors and geographical variations across the region. Additionally, efforts should be made to ensure greater geographical representation in research studies to capture the diversity of agro-ecological zones and socio-cultural contexts within Sub-Saharan Africa. By addressing these gaps and building upon existing knowledge, policymakers, practitioners, and researchers can work together to develop more targeted and sustainable strategies for achieving food security and agricultural development in the region.

Recommendations

Theory

Encourage Research on Agroecological Approaches - Sub-Saharan Africa's diverse agro-ecological zones necessitate context-specific agricultural solutions. Encouraging research on agroecological approaches tailored to local conditions can provide valuable insights into sustainable farming practices that improve resilience to climate change and enhance food security. By integrating ecological principles with agricultural production, researchers can develop innovative strategies that optimize resource use, minimize environmental degradation, and increase agricultural productivity.

Practice

Promote Farmer-Centered Innovation Platforms - Establishing farmer-centered innovation platforms can facilitate knowledge sharing, collaboration, and co-creation of agricultural innovations. These platforms should bring together farmers, researchers, extension agents, policymakers, and other stakeholders to exchange ideas, share best practices, and co-design solutions to local food security challenges. By fostering participatory approaches to innovation, these platforms empower farmers to adopt new technologies and practices that are relevant to their needs and contexts, ultimately leading to improved agricultural productivity and food security outcomes.

Policy

Strengthen Investment in Agricultural Research and Extension Services - Policymakers should prioritize investment in agricultural research and extension services to support the development and dissemination of innovative technologies and practices. Adequate funding for research institutions, agricultural universities, and extension agencies is essential to conduct applied research, develop appropriate technologies, and provide technical assistance to farmers. Moreover, policies should incentivize private sector engagement in agricultural innovation by providing tax breaks, subsidies, and other financial incentives to companies investing in research and development of agricultural technologies tailored to the needs of smallholder farmers.

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