REVIEW OF MODERN AGRICULTURAL INNOVATIONS IN COMBATING SECURITY CHALLENGES IN NIGERIAN AGRICULTURAL SECTOR, 2015-2023

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ABSTRACT

This paper examines the role of modern agricultural innovations in addressing insecurity in Nigeria, focusing on the agricultural sector, including both crop and animal production. It highlights the clashes between farmers and herders in rural areas over access to land and water resources, which exacerbate food insecurity and socio-economic instability. The study explores various innovative approaches in crop cultivation and animal husbandry, demonstrating how these technologies can enhance productivity and resilience among farmers and herders. Additionally, the paper discusses significant challenges to adopting these innovations, such as limited access to finance, inadequate infrastructure, and socio-cultural factors that impede implementation. Information and Communication Technologies (ICT) are also explored as crucial tools for facilitating these advancements. The study concludes with recommendations to strengthen agricultural innovations I n Nigeria, emphasizing the importance of improving access to finance, developing infrastructure, enhancing capacity building, and implementing supportive policies. Public-private partnerships are also suggested as vital for fostering collaboration and resource sharing. By addressing these challenges and leveraging modern technologies, Nigeria can improve agricultural productivity and resilience, ultimately contributing to greater food security and stability in the face of insecurity.

Keywords: Agriculture, Agricultural innovation, modern approaches, insecurity,

Introduction

Agriculture has long been a cornerstone of Nigeria's economy, contributing significantly to GDP and employment. Historically, the sector has faced numerous challenges, including inadequate infrastructure, poor access to markets, and fluctuating commodity prices. However, the period from 2015 to 2023, under President Muhammadu Buhari's administration, has been particularly marked by escalating security challenges that have severely impacted agricultural productivity. These challenges include conflicts between farmers and herders, banditry, and insurgency, which have disrupted farming activities and displaced communities (Adebayo, 2021).

The security landscape in Nigeria has been characterized by increasing violence, particularly in the northern regions, where clashes between pastoralists and sedentary farmers have become commonplace. According to the National Bureau of Statistics (2022), agricultural output in affected regions dropped by over 30% due to these conflicts, leading to food insecurity and increased poverty levels. The government recognized the urgent need to address these security challenges to ensure food security and stabilize the agricultural sector.

In response, the Buhari administration implemented various initiatives aimed at promoting agricultural innovations as a means to combat these security challenges. The National Agricultural Technology and Innovation Policy (NATIP) was introduced to enhance agricultural productivity through the adoption of modern technologies and practices (Federal Ministry of Agriculture and Rural Development, 2021). This policy framework emphasized the importance of integrating technology into agriculture to improve efficiency and resilience against security threats. Modern agricultural innovations have emerged as critical tools in addressing these challenges. Technological advancements, such as the use of drones for surveillance and monitoring, have gained traction among farmers. Drones can provide real-time data on crop health and land use, enabling farmers to make informed decisions and mitigate risks associated with security threats (Ogunleye, 2022). Additionally, precision agriculture techniques have been adopted to optimize resource use and enhance productivity, allowing farmers to adapt to changing environmental conditions.

Sustainable agricultural practices have also been promoted to build resilience against security challenges. Climate-smart agriculture, which focuses on sustainable land management and resource conservation, has been encouraged to help farmers cope with the impacts of climate change and insecurity (World Bank, 2023). Furthermore, financial innovations, such as access to credit and insurance, have been introduced to support farmers in investing in modern technologies and practices.

Despite these efforts, significant challenges remain. Infrastructure deficits, including poor road networks and inadequate storage facilities, continue to hinder the effective implementation of agricultural innovations. Additionally, issues related to policy execution and coordination among various government agencies pose obstacles to achieving the desired outcomes (Adebayo, 2021).

In conclusion, the period from 2015 to 2023 has seen the Nigerian government actively promoting modern agricultural innovations to combat security challenges in the agricultural sector. While progress has been made, efforts are needed to address the underlying issues and ensure the sustainability of these innovations for the future of Nigeria's agriculture.

Overview of Insecurity in Nigerian Agricultural Sectors

Agriculture is the main economic stay of the Nigerian teeming population. The sector accounted for 70% of job provision in the country. Moreover, it contributes significantly to the national Gross Domestic Product (GDP) (National Bureau of Statistics, 2020). Despite its importance, the sector has been facing mounting challenges such as conflicts over natural resources, particularly between sedentary farming communities and Fulani nomadic pastoralists. These conflicts usually referred to as farmer-herder clashes have intensified in recent years and they threaten agricultural productivity and stability in rural among the rural dwellers (Adisa, 2012; Olaniyan et al., 2015).

Nature and Causes of Farmer-Herder Conflicts

The clashes between the sedentary farming communities and nomadic pastoralists in Nigeria are centred on economic, social, and environmental causes that are usually interwoven complex phenomena. However, all the issues revolve around land hunger, which creates too much

competition. In Nigeria traditionally, the Fulani monads are involved in seasonal migrations looking for good pasture and water for their livestock. These movements happen in a given area and in long-distance places. Therefore, the nomadic have contact with farmlands throughout their daily and long-distance grazing. As a result of desert encroachment in the Northern part of the country, land degradation, and climate changes in Nigeria, the competition over resources is heightened (Benjaminsen *et al* 2012). Rising temperatures and erratic rainfall patterns have exacerbated desertification in northern Nigeria, forcing herders to migrate southward in search of greener pastures. These movements often bring Fulani nomadic pastoralists into direct conflict with farmers in many states in the country (Abbas, 2009; Fiki & Lee, 2004).

In addition, the expansions of agricultural land and urbanisation have led to a significant reduction in grazing lands and traditional livestock routes. Many herders who previously had access to grazing are now blocked as the grazing areas have been converted into farmland or restricted through policies that fail to consider the needs of nomadic communities, which led to clashes (Okello et al., 2020). There haven conflicts between the farmers and herders due to intense competitions over the land for farming and grazing which have recently developed to arm banditry and incensed killings (Adelakun et al., 2015). One of the factors that have exacerbated communal clashes in Nigeria is lack of effective institutions committed to shared resource management and conflict resolution (Benjaminsen et al., 2012).

Impact on Agricultural Productivity and Rural Communities

Violent clashes between farmers and herders primarily lead to the destruction of crops, loss of livestock, and the abandonment of farming activities, which resulted in the reduction of agricultural yields and income (Blench, 2010; International Crisis Group, 2017). These conflicts led to many households that live in conflict-prone areas report to have significant income losses. The herders also suffer losses in terms of livestock mortality and restricted access to grazing lands (Olaniyan et al., 2015).

Conflicts, therefore, have forced thousands of Nigerian farmers to abandon their homes and farmlands and to relocate to safer areas. Henceforth, the conflicts lead to the disintegration of rural communities and it leads to an increase in internally displaced persons (IDPs) (International

Crisis Group, 2017). This displacement, as mentioned earlier, disrupts social structures, strains community resources, and hinders educational and health services in many rural and suburban communities. These conflicts also exacerbate existing ethnic and religious tensions. It leads to clear divisions between farmers and herders that frequently align with ethnic and cultural identities (Higazi, 2016). Consequently, insecurity not only undermines the agricultural sector but also destabilises rural communities impeding development efforts and hindering Nigerian socio-economic growth.

Modern Agricultural Innovations

Modern agricultural innovation is application of modern techniques and equipment in crops and animals' production. Innovation is used to increase productivity and efficiency in cultivation crops and animal husbandry. The modern agricultural technique in Nigeria is necessitated by urbanisation, population growth, desertification, and completion over land and water. The following are some of the techniques that have been proven effective in Nigeria:

Drought-resistant crop: The scheme also involves varieties of drought-resistant crops. One of such crops that show a remarkable result in Nigeria is Drought-tolerant maize (DTMA). These maize varieties are introduced in different parts of the country especially in the Northern Nigeria that is a Sahelian region. The participant farmers have yielded bumper harvests despite the weather fluctuations (Olagunju, 2015). International Maize and Wheat Improvement Centre (CIMMYT) in collaboration with various partners such as the African Development Bank and National Agricultural Research Institutions launched the Scheme in Nigeria in 2007 (Bänziger et al., 2011). The programme yielded a fruitful result and it was demonstrated in 2020 where it involved over 2 million participants. The result obtained showed that there was an increase in the harvest with 30% despite mild drought experienced in the year *(Kibata et al., 2020 & Bänziger et al., 2011).*

Precision Agriculture: Precision Agriculture is another agricultural innovation that could restore security in Nigerian agricultural sector. This innovative agricultural scheme involves using of Information and Communication Technology (ICT) to manage crops production with high precision. The approach permits the producers to apply inputs such as water, fertilisers, and pesticides exactly when the crops require them. The approach adopts technologies using GPS,

remote sensing, and data analytics. These ICT gadgets and facilities allow the farmers to monitor the crop growth, health, and soil conditions. One of the advantages of this method is it leads to utmost resource utilisation and crops higher yielding (Mandal & Maity, 2013). In Nigeria, there have been efforts of the introduction of precision agricultural techniques by using mobile applications that provide the farmers with timely weather forecasts, soil quality updates, pest management information, and market prices. However, the result of the technique brought an increase of the crops yield. In addition, during the trail, over use of chemical such as fertiliser, herbicide and insecticide were drastically reduced **(**Abubakar et al., 2017 & Sani et al., 2018). Specifically, the precision method implemented among farmers in Benue state showed an increase in the productivity to 25% in comparison to those that used traditional method of irrigation (Sani et al., 2018).

Improved irrigation schemes:

Irrigation innovation is another method that could also reduce insecurity in Nigerian agricultural sectors as the country is endowed with several rivers, lakes, dams, and underground water. Adoption of the improved agricultural scheme would improve agricultural practices in the country as the country has been facing unreliable rainfall patterns that threaten crop cultivation and forces migration of herders. The improved irrigation scheme involves technologies like drip irrigation and sprinkler systems. The practice facilitates an effective maximisation of the water facilities for irrigation purposes and it is suitable to Northern Nigeria, which is covered by arid and semi-arid lands. The Nigerian government in corroboration with other non-governmental organisations have been trying to promote the drip irrigation among the farmers chiefly in Northern Nigeria

The most acknowledged efforts is the *Irrigation for Climate Resilience that is introduced (IITA)* by Nigerian government, the International Institute of Tropical Agriculture (IITA) in collaboration with various NGOs**.** The project aimed to increase agricultural productivity and improve water management practices in arid and semi-arid regions (IITA, 2020).Adeniji et al (2020) reported that an experimental work on the drip irrigation revealed 40% of the increase of water efficiency and crop yielding. Similarly, the Sokoto State that began drip irrigation has reported increases in yield up to 50% in tomatoes and vegetables when compared to conventional

irrigation methods (Olorunfemi et al., 2021). Also the technique shows that use of water is reduced by 40-60. (IITA, 2020) asserted that the full adopting of this drip irrigation would alleviate competition for water resources between agricultural and pastoral activities.

Innovations in Animal Husbandry

Moreover, adaptation of modern and innovative animal production and management could reduce the farmers and herders' conflicts in Nigeria. The innovative approaches on the animal husbandry centred on improving livestock productivity, enhancing disease management, and promoting sustainable grazing practices among the Nigerian nomadic pastoralists.

The modern Rural Grazing Area (RUGA) initiative:

This is an innovative approach for addressing the recurring farmer-herder conflicts in Nigeria. The modern RUGA provides grazing zones for nomadic pastoralists in contract to seasonal migration of Fulani that leads to direct conflicts with sedentary farming communities over land and water resources as the result of limited land and water (Olaniyan et al., 2015). Modern RUGA has essential infrastructure include, schools, veterinary services, water supplies, and shelter. The provision of these resources curtails the nomadic lifestyle (International Crisis Group, 2017). Moreover, the adopting of modern RUGA would bring potential economic to both the pastoralists and farmers. Equally, the RUGA allows the Fulani pastoralists to manage their herds more effectively (World Bank, 2021). The innovation, modern RUGA settlement is aligned with climate-smart agricultural practices. It also serves as a peace-building measure in country as the cattle are restricted, which would enhance the coexistence of farming and pastoralist communities (Adelakun et al., 2015). Such initiatives are crucial in promoting long-term, structured solutions for sustainable agriculture and conflict resolution in Nigeria's rural areas.

Selective Breeds: Selective breeding in livestock focuses on developing animals that are not only productive but also resilient to the unique climate and disease challenges in Nigeria. In addition, these breeds provide milk and meat than the local Nigerian livestock. Equally, the breeds can adopt to the Nigerian temperature extremes during the heat season and cold periods. They are also resistance to humidity and common diseases in the country. The selected breeds could be

by-product of genetic improvement such cattle, goat, and poultry (FAO, 2019**)**. This kinds of livestock drastically, reduce economic loss usually incur from adverse disease and extreme weather conditions**.** With these improved traits, livestock can thrive in environments where traditional breeds might struggle, leading to fewer losses and yields that are more consistent. This helps farmers by ensuring a stable income, as they face fewer threats from infections and climate-related stressors (Dossa et al., 2015). Ultimately, selective breeding supports not only increased productivity but also enhances food security by providing healthier, more robust livestock to sustain Nigerian agricultural communities

Advanced Veterinary Care: This scheme is also known as Mobile Veterinary Clinics for Livestock Health Management and its one of the most important approaches for combatting the farmers-herders conflicts. The aim of this approach is to enable veterinary to take care and control livestock diseases such as foot-and-mouth disease and avian influenza. These common diseases threats greatly affect animal husbandry in Nigeria that led to considerable economic losses (Obi et al., 2018). Advanced Veterinary Care involves an establishment of mobile veterinary clinics and digital health tracking systems. The innovative approach makes veterinary care services more accessible in rural areas. In addition, the approach involves Mobile apps that allow herders to record livestock health data, access information on disease outbreaks, and receive vaccination reminder (Onono et al., 2013). One successful programme that started to appear in Nigeria is the *Mobile Veterinary Clinics Initiative* that was established by the Nigerian Veterinary Medical Association (NVMA) in collaboration with local governments and international partners. The programme provided essential services such as vaccinations, disease diagnosis, and treatment to over 100,000 livestock in Northern Nigeria since their inception in 2016. Herders as well as participating farmers have reported a substantial decrease in livestock mortality rates due to improved access to veterinary care (Obi et al., 2018). Additionally, the initiative has integrated digital platforms to track livestock health records that enable herders to monitor their animals' health more effectively.

Benefits of Agricultural Innovations for Reducing Conflict

As is indicated above, modern agricultural innovations combat frequent conflicts in agricultural in Nigeria. In addition, the schemes would also create sufficiency crops and livestock production in the country**.** World Bank (2021) reiterated that climate-smart agriculture (CSA) is one of the most promising modern agricultural practices to be adopted by developing countries for food efficiency. The system focuses on improving the environmental challenges and at the same time, it enhances yielding. This type of agriculture deals with the varieties of crops that are developed through genetic research and selective breeding. The crops varieties can survive longer dry spells. Therefore, the scheme reduces the crops' failures and it ensures food security in drought-prone areas mostly in Northern Nigeria (AGRA, 2019).

Modern approach to agriculture in Nigeria equally could help mitigate resource-based conflicts in the country as the study demonstrated the schemes provide efficiency and equitable use of water and land by reducing the large tracts of land and extensive use water sources and constant competition between farmers and herders (FAO, 2019). In addition, the increase of production of crops and livestock help in the provision of food security and provide a stable income for rural dwellers (Adelakun et al., 2015).

Challenges of Agricultural Innovations In Nigeria

The modern agricultural innovations as it supported by Information and Communication Technology (ICT) provide significant opportunities in the Nigerian agricultural sector there by eliminating insecurity. However, these modern approaches are hindered by many obstacles as explained below:

Limited Access to Financing: Access to finance among the Nigerian peasant farmers has remained one of the crucial barriers to adopting agricultural innovations in the country. Most of the farmers in Nigeria who are smallholders lack the necessary capital to invest in modern agriculture that includes innovative technologies, improved seeds, and irrigation systems. The World Bank (2020) estimates that over 80% of smallholder farmers in Nigeria do not have access to credit from banks and they therefore depended on obtaining loans from informal ways and usually with high interest rates (World Bank, 2020). Without financial support, the farmers in Nigeria are unable to invest in the agriculture to purchase the necessary tools and agricultural inputs. Adebayo & Daramola (2020) pointed out that the Nigerian financial institutions often

have the opinion agriculture as a high-risk sector. Therefore, they enforce stringent lending criteria that many farmers cannot meet. The lack of access to credit by the farmers stifles their potential for adoption the agricultural innovations.

Inadequate Infrastructure: Another obstacle to the adoption of innovative agriculture by the Nigerian farmers is inadequate infrastructure development primarily in the rural areas what poses a significant challenge to the adoption of agricultural innovation. The Nigerian rural areas where agriculture is the most predominant economic activity are challenged by lack of feeder roads. Also the area do not have enough storage facilities and electricity that are the complementary part of the modern and digital practices that have been crucial to the sche*me (Adeniyi et al., 2019). In addition, poor road networks hinder farmers' ability to access markets to sell their produce, which lead to lost many produce.* Therefore, many farmers are motivated to invest in new technologies that require many infrastructural facilities that include lack of a consistent electricity supply. Electricity is one of the basic to technology-dependent tools that include modern irrigation systems and mobile applications. Tologbonse et al. (2018) identified that farmers in rural Nigeria often face difficulties in charging devices necessary for accessing ICT solutions due to unreliable power supply.

Lack of Technical Knowledge and Skills: Another problem in adoption of innovative agriculture in Nigeria is low level of technical knowledge and skills among the farmers. Most of the peasant farmers in Nigeria lack the training needed to adopt and maintain new technologies in agriculture effectively. A study conducted by Abdu et al. (2017) revealed a large percentage of the Nigerian farmers have insufficient understanding ICT tools that include mobile applications for market information and weather forecasts as a result of lack of effective training. FAO, (2020) reported that agriculture; primarily extension services are underfunded and cannot reach a large number of farmers effectively. It is estimated 2,500 agricultural extension agents serve over 35 million farmers in Nigeria. This lack of extension services leads a significant gap in the dissemination of agricultural knowledge and practices.

Socio-Cultural Factors: One of the most important aspects of the implementation of the modern agriculture is social orientation centre of the culture view and practices of the society. Agriculture in Nigeria has been one of the oldest economic activities that is enshrouded by

different believe systems. Therefore, many farmers do not easily accept changes in their methods of agricultural practices, as they are not confidence in new technologies (Okunlola et al., 2020). Among other things, many cultural beliefs and norms that are attached to agriculture that can influence farmers' decision-making processes, which could lead to resistance against innovations as technologies and methods are perceived as foreign or incompatible with local practices.

Poor Policy Framework: Another issue attached to agriculture in Nigeria is lack of coherent agricultural policies and regulations. From 1986, agriculture became a private affair in Nigeria, which limited the government full intervention in the sectors. This hampers the adoption of innovations and ICT in Nigerian agriculture in Nigerian as a government innovative approach. As the result of lack of government support and a lack of coordination among various agricultural agencies in the country, can create uncertainty for farmers regarding the availability of resources and assistance for adopting new technologies (Nigerian Economic Summit Group, 2021). Furthermore, the absence of clear policies supporting research and development in agriculture limits the creation of context-specific innovations that address the unique challenges faced by Nigerian farmers.

Conclusion

Nigeria is a country possesses a vast population of people who struggle among themselves for their economic survival. The increased demands of food crops and livestock to sustain the Nigerian teeming population lead to competitions and conflicts over the land utilisation. Food and national security could be achieved through adoption of modern agricultural inventions that have been the most reliable fostering sustainable practices for both crop cultivation and animal husbandry in the country. These innovative approaches cater for climate-smart agricultural inventions, improved irrigation schemes, advanced livestock management schemes as well as modern and sustainable grazing methods. The innovations first facilitate productivity, lessen the effects of climate change, and reduce conflicts among the farmers and herders through the promotion of efficient resource utilisation

Recommendations

Based on the findings, this study recommends:

1. Government and cooperative societies should improve the farmers' accessibility to financial services. Moreover, much attention should be given to the smallholder farmers, which would enable them participate and adopt of agricultural innovations and ICT. Financial institutions such as the microfinance banks and cooperatives societies should develop financial products that are committed to cater the agricultural sector.
2. Government should have a financial assistance that include **low-interest loans,** which would allow them to invest in modern technologies and **grant programmes and agricultural insurance schemes** to mitigate the risks associated with climate change and other uncertainties, encouraging farmers to invest in innovations without the fear of total loss
3. Government should improve infrastructure and infrastructure plays a crucial role in the successful adoption of agricultural innovations and ICT. The Nigerian government, in collaboration with private sector stakeholders, should prioritise on **road networks, electricity supply** and **storage facilities**
4. Government and agricultural stakeholder should ensure capacity building and training programs such as **extension services, workshops and training programs** and **peer learning platforms**:
5. Furthermore, government should have supportive policy framework is essential for promoting agricultural innovation and ICT in Nigeria. The policies should centre at National **Agricultural Policy Review**, **incentives for Innovation Adoption** and **collaboration with Research Institutions:**
6. The farmers should strengthen Promoting Public-Private Partnerships (PPPs). The government should facilitate collaborations between public institutions and private sector players through **Encouraging Investment**, **Leveraging Technology Providers** and **Supporting Agribusiness Start-ups** that focus on innovative solutions and services for farmers.

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