

Role of Technological Innovation in Agriculture on Food Security in Oyo State, Nigeria

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ABSTRACT

Over the years, especially in most African countries, there has been discussion over improving on food security. While technology has played a critical role in developed countries, developing countries, like Nigeria, even though technological innovation has gradually been integrated into the agricultural sector, still face challenges of food insecurity and declining food productivity, affecting sustainable agricultural practices. As a result, this study evaluates the influence of technological innovations in agriculture on food security in Nigeria, with specific attention to Ibadan, Oyo State. The research employed a cross-sectional research design, sourcing primary data from the calculated sample size of 380 respondents comprising household farmers, FADAMA beneficiaries, and staff from Akinyele LGA and Ibadan Southeast LGA in Oyo State, using a structured questionnaire prepared on a five-point Likert scale. However, retrieved questionnaire of 363 from respondents were analysed using descriptive statistics such as tables, frequency and percentages. The study revealed that the adoption of agricultural technologies such as mechanised equipment, improved seeds, bio-fertilizers, and irrigation systems contributed to food security. It further revealed that national policies and specialized programmes of government have contributed to food safety and security in Ibadan, Oyo State. However, challenges including high costs, limited funding, poor infrastructure, and inadequate training hinder wider technology adoption among the respondents in Oyo State. The study concludes that technological innovations play a critical role in ensuring food security in Oyo State, while the reality of declining and unsustainable agricultural practices is a result of other factors. The study recommends increased investment in agricultural technology, enhanced farmer training programs, improved infrastructure development, and stronger institutional support to facilitate technology adoption and ensure sustainable food security in Nigeria.

Keywords: Food security, Agricultural technology, Food availability, Food accessibility, Nigeria, sustainable agriculture, Technological innovation

INTRODUCTION

Food security is a fundamental pillar of sustainable development and human advancement, yet it remains a significant global challenge. Addressing the need for a consistent, sustainable food supply is critical to the fight against hunger (McCarthy *et al.*, 2018). When "all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life," food security is attained (Food and Agriculture Organisation 2019).

In a world where food scarcity and hunger have affected the livelihood of people and have resulted in loss of lives, insecurity, starvation, poverty, and malnutrition, the United Nations have taken the responsibility in ensuring food insecurity issues are addressed in the SDG goals No. 1 and 2 (No Poverty, and Zero Hunger). This is because, a food-secure nation can guarantee economic stability, reduce malnutrition, build a healthy society, thereby saving the government's health budget, reduce poverty, and foster a stable community, with a multiplier effect on government stability. Food security is a moral imperative in that all people should have equal and unrestricted access to food. Beyond this, food security is an investment in wider stability and security; where

there is food insecurity, there is displacement of people and increased instability that can triple throughout countries, regions and beyond (World Food Programme 2025).

Despite the importance of food security, there have been persistent challenge of food insecurity, which has remains a critical global concern, intensified by factors such as climate change, population growth, rising food prices, economic instability, and insecurity (Mirzabaev *et al.*, 2023). In response to these issues, the United Nations Sustainable Development Goals (SDGs), adopted in September 2015, emphasise on the eradication of poverty and the attainment of zero hunger as key priorities for ensuring food security and improving nutrition (Food and Agriculture Organisation, 2019). These goals were built on the earlier Millennium Development Goals, which were not fully achieved by their 2015 deadline (Global Strategic Framework, 2017). The 2020 Global Hunger Index states that "zero hunger by 2030 is still off track."

Given the importance and challenges that faces food security, the role of agriculture in addressing food insecurity cannot be overemphasized, and it remains a key avenue for solutions (United Nations, 2015). In Nigeria, the the agricultural sector is the most vibrant non-oil sector and has great potential to address the food security crisis. In line with this, the Nigerian government has implemented numerous programs over the years, including the Agricultural Credit Guarantee Scheme Fund (ACGSF), Agricultural Credit Support Scheme (ACSS), Operation Feed the Nation (OFN), National Accelerated Food Production Programme (NAFPP), Agricultural Development Projects (ADPs), and the River Basin Development Authorities (RBDAs), among others. Despite these efforts, Nigeria continues to face significant food security challenges, as supported by the Nigeria's 2024 Global Food Security Index ranking Nigeria 110 out of 127 countries in global food security, a significant drop from its 2022 ranking of 42 out of 100 (World Bank Group 2024). This represents the reality on the ground that needs serious government attention by turning around the situation of things for better.

One important disruption factor of economic sectors or industry in recent time is technological innovation (Adeyemo *et al.*, (2024; Akapnio *et al.*, (2025). Several sectors have experience growth and progress as a result of technological innovation, and agricultural sector is not left behind. Over time, technology has been applied as a sustainable solution to agricultural development, ultimately enhancing food security through innovations such as semi-autotrophic hydroponics for cassava multiplication, precision agriculture, vertical farming, and drone technology. However, in regions like Africa, Asia, Latin America, and other developing countries, including Nigeria, the decline in technological application or ecological degradation, both of which reduce output from given inputs, has long been cited as a significant cause of poor agricultural performance (Collier, 1988). Moreover, while indigenous methods such as crop rotation and traditional farming practices have helped maintain soil structure and fertility, they appear insufficient or even outdated in addressing current food production challenges across developing nations, hence the problem of food shortages for over 250 estimated population in Nigeria.

Empirically, this study found limited empirical research on the impact of technological innovation in agriculture on overall food security in Nigeria. Although, while Onomu and Aliber (2024) explored the opportunities and challenges associated with technological adoption in agriculture, their study lacked empirical analysis and did not evaluate the implications for national food security. Similarly, Atata *et al.*, (2020) focused their research on agricultural technology, productivity, and food consumption among rural households in Nigeria, offering a micro-level view that did not extend to broader food security concerns. Also, at the state level, this study found dearth of studies focusing on the link between technological innovations and food security in Ibadan Oyo State, thereby providing a knowledge gap that this study needs to fill to contribute to knowledge from Nigeria. Consequently, this study investigated the impact of technological innovations in agriculture on food security in Ibadan, Oyo State Nigeria.

LITERATURE REVIEW

Food Security

Food is a fundamental human need, essential for sustaining life and maintaining health. When food is unavailable or in short supply, human survival and well-being are at serious risk. Thus, it is crucial to understand the concept of food security at the individual, household, national, regional, and global levels. As such, food security is

recognised as a fundamental human right by the United Nations (1948) in Article 25 of the Universal Declaration of Human Rights. The declaration affirms that "Everyone has the right to a standard of living adequate for the health and well-being of himself and of his family, including food, clothing, housing, medical care and necessary social services, and the right to security in the event of unemployment, sickness, disability, widowhood, old age or other lack of livelihood in circumstances beyond his control." Despite this acknowledgement and the establishment of numerous initiatives and institutions designed to combat food insecurity, many parts of the world continue to grapple with this challenge.

Food security is an expansive, multifaceted concept that intersects with various disciplines. Norhasmah (2021) describes it as a multidimensional phenomenon encompassing a wide range of issues, including animal and crop production, nutrition, urbanisation, and environmental sustainability. It includes elements such as agricultural practices, food safety and preservation, dietary habits, technological advancement, affordability, and sustainable consumption (Havas & Salman, 2011; Sastry *et al.*, 2011). According to Jones *et al.* (2013), the concept has been interpreted through multiple disciplinary lenses: agriculture, nutrition, sociology, economics, anthropology, and food science, each offering a unique perspective.

The 1996 World Food Summit introduced four critical pillars of food security: First, Physical Availability of Food, which refers to the supply aspect and is influenced by food production levels, stock reserves, and net trade flows. Second, economic and physical access to food which explains that even if food is available at the national or international level, it does not ensure that all households can access it. Hence, income levels, market prices, and infrastructure play significant roles in determining food accessibility. Third, food utilization, a pillar that emphasises how the body processes nutrients, expounding that proper nutrition results from healthy feeding practices, food preparation, dietary diversity, and fair food distribution within households. The fourth pillar is stability over time that explained that food security must be consistent. A person may be food secure today but vulnerable tomorrow due to disruptions like adverse weather, economic downturns, or political instability. Therefore, periodic or chronic instability in access to food contributes to food insecurity.

Summarily, the definition of food security and what qualifies as food security or food insecurity has been the subject of extensive academic debate. Numerous scholars, researchers, and institutions have proposed various definitions of food security over time. According to Norhasmah (2021), there are approximately 200 definitions of food security, yet none are universally comprehensive due to the concept's evolving nature (Jones, 2013). Pinstrup-Andersen (2009) noted that food security was initially understood as a nation's ability to produce enough food to meet the population's caloric and nutritional requirements.

Technological Innovation in Agriculture and Food Security

Over time, technology has been applied as a sustainable solution to agricultural development, ultimately enhancing food security through innovations such as semi-autotrophic hydroponics for cassava multiplication, precision agriculture, vertical farming, and drone technology. In regions like Africa, Asia, Latin America, and other developing countries, including Nigeria, the decline in technological application or ecological degradation have reduced output from given inputs, cited as a significant cause of poor agricultural performance (Collier, 1988).

Moreover, while indigenous methods such as crop rotation and traditional farming practices have helped maintain soil structure and fertility, they appear insufficient or even outdated in addressing current food production challenges across developing nations. This shortfall has led to the widespread promotion and subsidisation of chemical and organic fertilisers by the Nigerian government, despite notable corruption issues associated with their procurement and distribution (Idachaba, 2004).

Government-led technical and economic efforts, especially those targeting small-scale farmers for land improvement, should not be seen as wasteful resource use (Davies, 2009). Instead, these initiatives are crucial, particularly in macroeconomic terms, because market forces alone cannot meet the urgent food security needs. Moreover, a key obstacle to attaining food security in Nigeria is the concern over the safety of genetically modified organisms (GMOs), which are a result of agricultural biotechnology. Biotechnology is a scientific advancement that holds the promise of sustainably increasing agricultural productivity.

Biotechnological approaches in agriculture include genetic modification of crops for improved nutrition, cloning of animals, tissue culture techniques, and genetic engineering. The perception is that biotechnology can shorten the gestation and maturity periods of crops, plants, and animals. Yakubu (2024) in his publication at the national dailies mentioned that "In Benue State, the supposed food basket is becoming empty, not because Benue people are not producing food, not because they do not have GMOs. It is because ethnic and foreign interests are taking over. GMOs are biological weapons and agents of mass destruction."

"Recognising the importance of biotechnology for food security, the Nigerian government has embraced its use by establishing the National Biotechnology Development Agency in Abuja and allocating sum of 26 million naira (around \$185,000) to support this effort. The Institute of Agricultural Research at Ahmadu Bello University, Zaria, has been specifically tasked with using biotechnology to improve crop farming systems for sorghum, maize, cowpea, cotton, and sunflower" (see Vanguard, February 16, 2005). Nigerian agricultural scientists are strongly committed to advancing biotechnology and have actively assured the public of the safety of GMOs. They also advocate increased government funding for research to maximise agricultural productivity through biotechnological innovations (Akinyosoye, 2007).

Despite the government's support and the scientific community's enthusiasm, significant barriers remain in fully utilising biotechnology in agriculture. Firstly, the financial investment in biotechnology is considerably inadequate. While encouraging private-sector involvement may seem economically sound, most companies capable of making such investments are foreign and are unlikely to engage in local agricultural research that does not yield substantial commercial returns. Secondly, extension services, which play a critical role in educating farmers about the benefits of biotechnology, remain underdeveloped and require urgent improvement. Moreover, media, particularly radio, which reaches rural areas, should be leveraged to communicate with farmers in their native languages about the benefits and risks of agricultural technologies, including the misuse of agrochemicals. Lastly, public scepticism about GMOs remains a significant hurdle, fuelled by superstition and misinformation. The reality, however, is that without embracing agricultural biotechnology, Nigeria may continue to struggle to achieve food security (Davies, 2009).

Food Security in Nigeria

Resources are abundant in Nigeria, which makes the country Africa's leading producer of oil and has the largest natural gas reserve on the African continent. Its population exceeds 200 million, with one of the world's largest youth demographics, and features a diverse ecological landscape (Omorogiuwa *et al.*, 2014). In all of these, poverty has ravaged the continent's most populous black nation, with 83 million Nigerians (40%) who are living below the poverty line, and another 25 million (25%) are at risk of falling into poverty. The COVID-19 pandemic has intensified these economic challenges. As population growth outpaces economic development, the World Bank (2020b) estimates that an additional 7 million people could be pushed into poverty due to the pandemic.

Nigeria has not been spared from the global food crisis. According to the World Bank, the world is experiencing a worsening food crisis, with an estimated 670 million people projected to remain hungry by 2030. Ongoing global threats, including climate change, water scarcity, biodiversity loss, and other environmental shocks, continue to threaten food systems (World Bank Weekly Bulletin). According to projections by the OECD and FAO (2009), global food production will need to increase by more than 40% by 2030 and 70% by 2050 (relative to the 2005-2007 average levels) to meet future demand.

Ojo and Adebayo (2012) traced Nigeria's food insecurity challenges to the discovery of oil in the 1950s. This discovery led to a gradual shift away from agriculture, marking what they called "a holiday for hoes and machetes." Before this shift, "Nigeria was self-reliant in food production and a major exporter of various agricultural commodities. Each region contributed unique products: groundnuts from the North, cocoa from the West, palm oil and kernels from the East, and rubber from the Midwest. However, with oil's dominance in the economy, agriculture's role diminished" (Matemilola & Elegbede, 2017; Oriola, 2009).

Before the return of democracy in 1999, different administrations of government had attempted various agricultural policies aiming to address the issue of food insecurity and to restore prosperity in the country, which recorded little or no progress. This includes the Operation Feed the Nation in 1970 under General Olusegun

Obasanjo; the Green Revolution in 1979 under President Shehu Shagari; and the Directorate of Food, Roads and Rural Infrastructure (DFRRI) in 1985 under General Ibrahim Babangida. Similarly, there were public-private initiatives also which were attempted, which include the FADAMA Development Project; community-based agricultural programs; the Special Programme for Food Security (SPFS); and import bans on specific items, such as rice (Ojo & Adebayo, 2012).

Theoretical Review

This study is anchored on Structural Change Theory. The structural change theory was propounded by W. Arthur Lewis in 1970 to highlight how developing countries transform from traditional agricultural societies with surplus labour to modern industrial ones by moving away from subsistence and traditional agricultural systems. The theory characterises the economy in two ways: a traditional, low-productivity agricultural sector and a modernised, highly productive manufacturing and service sector. "It focuses on the mechanism by which underdeveloped economies transform their domestic economic structures from over reliance on traditional subsistence agriculture to a more modern, more urbanised and more industrially diverse manufacturing and service economy" (Sewell, 1992).

Recently there has been effort by the Nigerian government in adopting modernised agricultural technology as noted by Etuk (2025) in the Punch Newspaper report on the unveiling of specialised modernised agricultural equipment by Tinubu government, "...there are over 2000 advanced tractors, 50 industrial grade land preparation booths, 12 full equipped mobile workshops, and 8000-plus specialised farming implements...we envision Nigeria as a global agricultural powerhouse, supplying quality produce to international markets while ensuring every citizen has access to affordable nutrition" (Tinubu, 2025). To buttress this, Abgbenyo (2020) observes that, given the location of technological advancement, catch-up in the post-1950 globalised economy is only possible if developing countries develop the capabilities to acquire, master, and adapt international technology.

Countries like China, India, Hong Kong, Germany, and Russia illustrate this point. In contrast, those nations that are unable or unwilling to engage with global technology flows tend to fall behind and become marginalised in the world economy (Szirmai, 2008). The use of technological innovation in agriculture has led to the adoption of better farming practices, thereby enhancing food security and sustainable practices. The use of modernised technology has the potential to increase farmers' output, improve storage, and protect harvests from bacteria through the use of disease-resistant seed.

This theory was criticised for being overly reliant on industrialisation, which can lead to urban bias in development, thereby benefiting cities over rural areas. The fact that the theory assumes surplus labour may not be sufficient to explain the actual development pattern. Also, it has the shortcoming of failing to acknowledge that international trade drives development, since some countries may have a comparative advantage over others (Agbenyo 2020).

Empirical Review

Akpabio *et al.*, (2025) examined a relationship between e-agriculture and food security in Nigeria. The study questioned the state of food insecurity, despite the large population of the country relying on agriculture for its livelihood. The study employed a desk review methodology and relied on secondary sources of data according to books, journals, and periodicals. They found that non-adoption of e-agriculture contributed to food insecurity or shortages in Nigeria. Not only that, but they submitted that even though e-agriculture adoption comes with several potentials, some critical factors such as insurgencies, climate change, and lack of technical expertise are present

Vretenar (2025) analyses technology and innovation in agriculture through descriptive methods. He argues that decisions on technology investments by manufacturing companies often have long-term impacts on their businesses. Recently, technological developments in agriculture, especially digital technologies that boost efficiency and productivity, have advanced rapidly. Concepts like precision agriculture, smart farms, and integrated systems such as satellite guidance and sensor technologies are key components of modern farming. Nonetheless, research indicates significant obstacles to adopting new technologies, particularly among smaller farms.

In another study conducted by Adeyemo *et al.*, (2024) on how technological innovation can boost agricultural activity in Nigeria, and how it compares to the activities of the oil sector. The researchers adopted the auto-regressive distributed lag method of data analysis and discovered a strong negative effect from the current agricultural productivity ($AGTFP < 1$), which therefore connotes a strong limitation in technology adoption. Technological innovation, represented by TFP, significantly influences agricultural productivity, having a substantial negative long-term effect (-90.71) and a positive, yet statistically insignificant, effect on agricultural total yield.

Hunag and Wang (2024) evaluated the impact of technological innovations on agricultural Total Factor Productivity and environmental sustainability in China for ten years period (2012 to 2022). The researchers employed a comprehensive methodological framework, which was integrated with fixed-effects, random-effects, and multilevel mixed-effects models to analyze crucial factors including rural education, technological capability, and environmental conservation initiatives. The study further utilizes structural equation modeling to evaluate both the direct and indirect effects of these determinants on productivity. The results demonstrate that technological innovations substantially enhance agricultural productivity, particularly in provinces with higher socioeconomic development.

Akinwale and Grobler (2023) conducted research on the interplay of research and technological innovation, food security, and economic growth in Nigeria from 1980 to 2018. In their study, they utilised secondary data and estimated using a vector error correction mechanism after augmented dickey fuller and Johansen co-integration. They found a causal relationship between GDP to food security and research and technological innovation in the short run. While in the long run, causality moves from food security to research and technological innovation and from GDP, to FST and to RTI without feedback, indicating that growth of the economy drives food security, which then supports research and technological innovation in Nigeria.

Yusuf *et al.*, (2022) investigated the implementation of digital agriculture in Nigeria and its implications for sustainable development and food security, using time-series data. They concluded that although food security could still be restored, several challenges remain, including inadequate production, gender inequality, poor policy implementation, corruption, civil unrest, climate change, and low-level processing and storage technologies. The study recommended that the government address these issues by creating a conducive environment, promoting decent employment in both agricultural and non-farm sectors, and providing accessible credit facilities, particularly for vulnerable populations in rural areas.

In a study by Kuwornu *et al.*, (2021) on the comparative analysis of food security status of farming households in the coastal and forest communities of the central region of Ghana, the researchers adopted a multistage sampling technique to identify households. These households data were collected with the use of a structured questionnaire. The investigation shows that over 65% of the households were food insecure. Therefore, farming households in the forest areas were less food insecure compared to their counterpart in the coastal areas. Food-insecure farming households in coastal areas consume significantly fewer calories—34% below their recommended daily intake—compared to food-insecure households in forest areas, which are 26% below their recommended intake. This substantial gap has led researchers to conclude that food crop farmers are the most affected by food insecurity, especially when compared to other groups of farmers, such as tree crop and vegetable farmers.

Eneanya (2021) employed a qualitative research design to explore how innovation and technology can help contribute to sustainable food security in Nigeria. The sourced primary data were from a key informant through an interview, and the data were analysed narratively. They discovered that traditional agricultural practice together with government subsidies to agriculture yielded an inadequate and inappropriate level of productivity that can support sustainable food security in Nigeria, thereby supporting integration of technology to boost food security

Eze and Abeh (2021) empirically investigated the role of green agriculture in promoting food security in Nigeria. The study was based on a mixed-method approach, where both quantitative and qualitative methods were used. They employed primary data that were sourced from a sample of 132 farmers using a questionnaire across different agroecological zones in Nigeria. The study raises questions about farm characteristics, awareness and

adoption of specific green agricultural technologies, perceived benefits and barriers to adoption, food security indicators, and institutional factors such as access to credit and extension services, and food security was accessed through the Household Food Insecurity Access Scale (HFIAS). The study used exploratory factor analysis and structural equation modelling to analysed the data, and their empirical findings indicated a significant positive relationship between green agricultural technological adoption and food security, while environmental factors exhibited an insignificant negative effect on food security in Nigeria.

Omodero (2021) worried about the continuous increase in poverty in the face of several poverty alleviation programmes of government. Therefore investigated how sustainable agriculture and food production drives poverty reduction in Nigeria, from 2009 to 2019. By exploring ex-post and experimental research designs, the study specified that purchasing power parity is a function of food production index and agricultural output. The model was estimated using regression analysis which revealed that while the food production index significantly increases poverty, the sustainable agriculture has a positive but an insignificant effect on poverty reduction. The result indicates that sustainable agriculture is not empirically substantive, which affected food security which rather than reducing poverty, increases it.

In order to assess the impact of agricultural technology across regions, Rongjian *et al.*, (2019) conducted a comprehensive review across China, Pakistan and Nigeria, their study reveals a contrasting scenarios in agricultural technological advancements. While China has made strides in introducing technological innovations to enhance agriculture, Pakistan, despite being agriculturally self-sufficient, has harnessed such advances effectively. In stark contrast, Nigeria, despite its vast farmland endowment, lags due to backwardness in agricultural technology

Ayodeji and Oladokun (2018) examined how agricultural output influences poverty reduction in Nigeria through co-integration testing and regression analysis. Data was analysed for six years (2000-2016), and it was discovered that public resources and the funds received from commercial banks to farmers are inadequate to solve the issue of poverty. Conversely, the study revealed that increases in funds from micro-finance bank credit schemes and an increase in food production have a chain reaction to alleviating poverty.

Suharyanto and Indrasti (2017) investigated the factors influencing food security in the province of Bali, focusing on the districts of Buleleng, Gianyar, and Tabanan. The study found that 49.07% of households were food secure, 37.9% were at risk of food insecurity, 8.79% were food deficient, and 4.17% were considered food insecure. The research highlighted that factors such as the education level of housewives, household income, and the ability to preserve food positively influenced food security, while family size, rice prices, and the cost of instant noodles negatively impacted it.

Maziya *et al.*, (2017) analyzed the factors influencing household food security among smallholder farmers in Msinga, Kwazulu-Natal, South Africa. Using data collected through a questionnaire from 250 agricultural households and analyzed with a Tobit regression model, the study showed that gender, household size, level of education, marital status, income, agricultural experience, and livestock ownership significantly affected household food security.

Etim *et al.* (2017) explored the implications of food insecurity, poverty, and hunger on Nigeria's national security. Using data from secondary sources, the study relied on the relative deprivation hypothesis, which posits that people's behaviour is driven by the perceived gap between their expectations and their actual experiences. The researchers concluded that the only path to restoring peace and stability in Nigeria lies in identifying and addressing the root causes of deprivation. The study recommended increased agricultural production through the adoption of new technologies and other agricultural innovations to eradicate food insecurity.

Mutyasira *et al.*, (2018) investigated how smallholder farmers in Ethiopia's highlands adopt sustainable agricultural practices. They used an integrative approach that combined the Ordered Probit Model with Partial Least Squares Structural Equation Modelling. The study found that access to credit, income levels, availability of inexpensive labour, and livestock ownership are crucial factors influencing the adoption of sustainable methods.

METHODOLOGY

This study adopted a descriptive research design, by relying on only primary data to comprehensively examine the role of technological innovations in agriculture on food security in the Akinyele and Ibadan South-East Local Government Areas (LGAs) of Oyo State, areas characterized by a strong agricultural presence and the implementation of relevant government programmes like FADAMA. The study's population consisted of household and commercial farmers within these LGAs. Given the infinite and unascertainable nature of this population, a proportionate sample size of 384 was determined using Cochran's formula, with a 95% confidence level and a 5% margin of error. A multi-stage sampling technique was then employed, beginning with the stratification of the two LGAs into 24 wards, followed by purposive selection of respondents based on their relevant experience, and concluding with a random selection of farmers to ensure balanced representation. Data was collected using a structured questionnaire, which was deemed suitable for standardizing responses and addressing literacy considerations. The questionnaire was distributed to 400 farmers and FADAMA staff, with research assistants aiding in its administration across the wards, the total of 363 questionnaire were retrieved and found usable for this study. The instrument was divided into six sections covering demographics and key study variables, with items measured on a five-point Likert scale. To ensure the validity of the instrument, it was reviewed by an academic expert to confirm content and construct validity. Data was analysed using descriptive statistics such as tables, frequency and percentages.

Analysis and Interpretation

This study employed descriptive statistics to characterize the variables, focusing on measures of central tendency such as mode. Tables, frequency, and percentages were all used in the analysis

Table 1: Reliability Test

Cronbach's Alpha	N of Items
0.619	14

Source: Field Survey, 2025

A reliability test was conducted for the research instruments to determine its internal consistency. For 14 items, an alpha of 0.619, approximately 62% was recorded. Though not as strong as it is, below the 70% required benchmark, it is moderately sufficient to determine the reliability of the questions raised in the questionnaire.

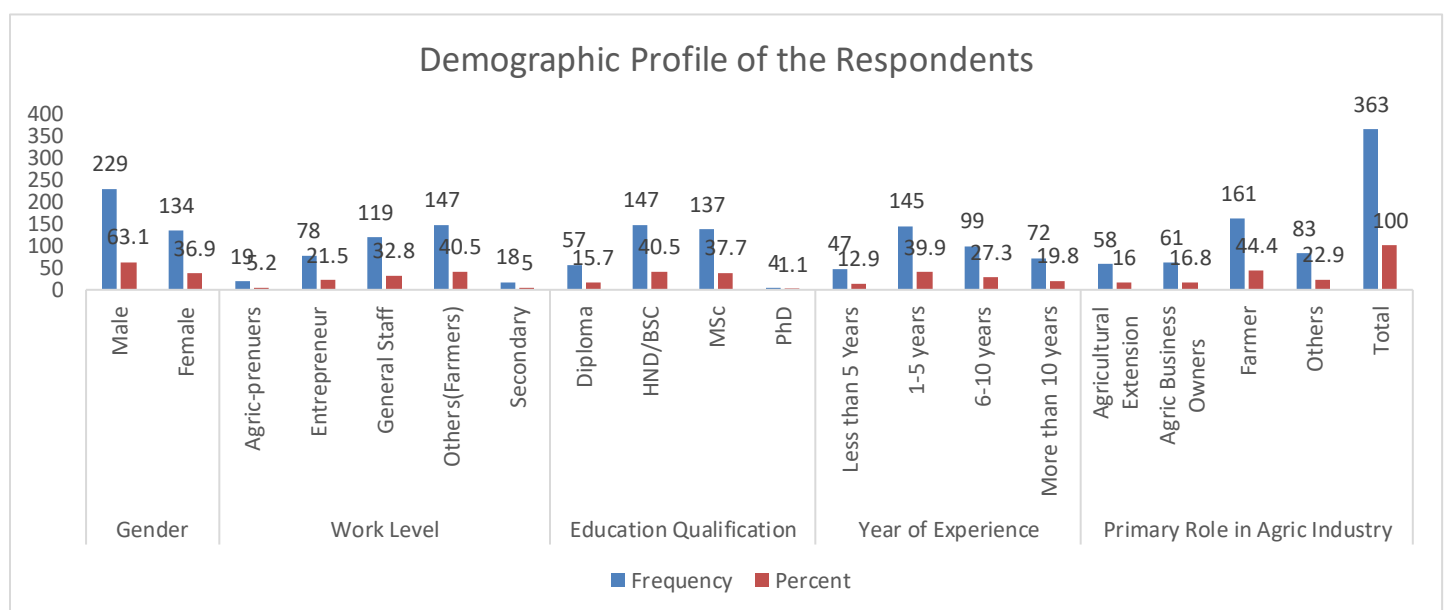


Figure 1: Demographic Information of the Respondents

Source: Field Survey, 2025

Figure 1 reports the analysis of the respondents' demographic data. The respondents used for this study are household farmers across Ibadan South-East and Akinyele LGAs. The findings showed that 229 (63.1%) of the respondents were male, while 134 (36.97%) were female. This suggests that the majority of individuals involved in agricultural activities are male, indicating a gender disparity in the sector, with men more dominantly represented. It also reveals that 147 (40.5%) of respondents belong to the other (farmers) category, followed by 78 (21.5%) who were entrepreneurs. General staff accounted for 119 (32.8%), while 19 (5.2%) were Agripreneurs. This implies that most respondents are into farming, others have various sources of livelihood other than farming. More importantly, about 18 (5%) of the respondents hold at least secondary education, 57 (15.7%) holds diploma qualifications, 147 (40.5%) hold first degree in form of HND/BSc, 137 (37.7%) are holders of MSc degree while 4 (1.1%) of the respondents are PhD holders. This shows that the majority of respondents are highly literate, well skilled indicating that agricultural business is not mostly embraced by illiterate and low level individuals, but has attracted high level of individual with formal education, making an agriculture business a lucrative one. Additionally, 145 (39.9%) of respondents have been into agriculture business for 1-5 years, followed by 99 (27.3%) with 6-10 years of experience. Additionally, about 72 (19.8%) have been involved for more than 10 years, while 47 (12.9%) have less than 1 year of experience. This indicates that the majority of respondents are individuals with staunch knowledge and experience in agriculture, and this may be likely be due to the government's recent efforts to make the sector more attractive. Regarding the primary role of the respondents in agriculture industry, it was found that 161(44.4%) of respondents are farmers, while 83 (22.9%) involved in other roles in the industry. Agric business owners workers constituted 58 (168%) of the respondents while agriculture extension workers constitute 58 (16%). This suggests that direct farming and agribusiness ownership are the most common roles among participants, highlighting a strong entrepreneurial and production-focused presence in the agricultural sector.

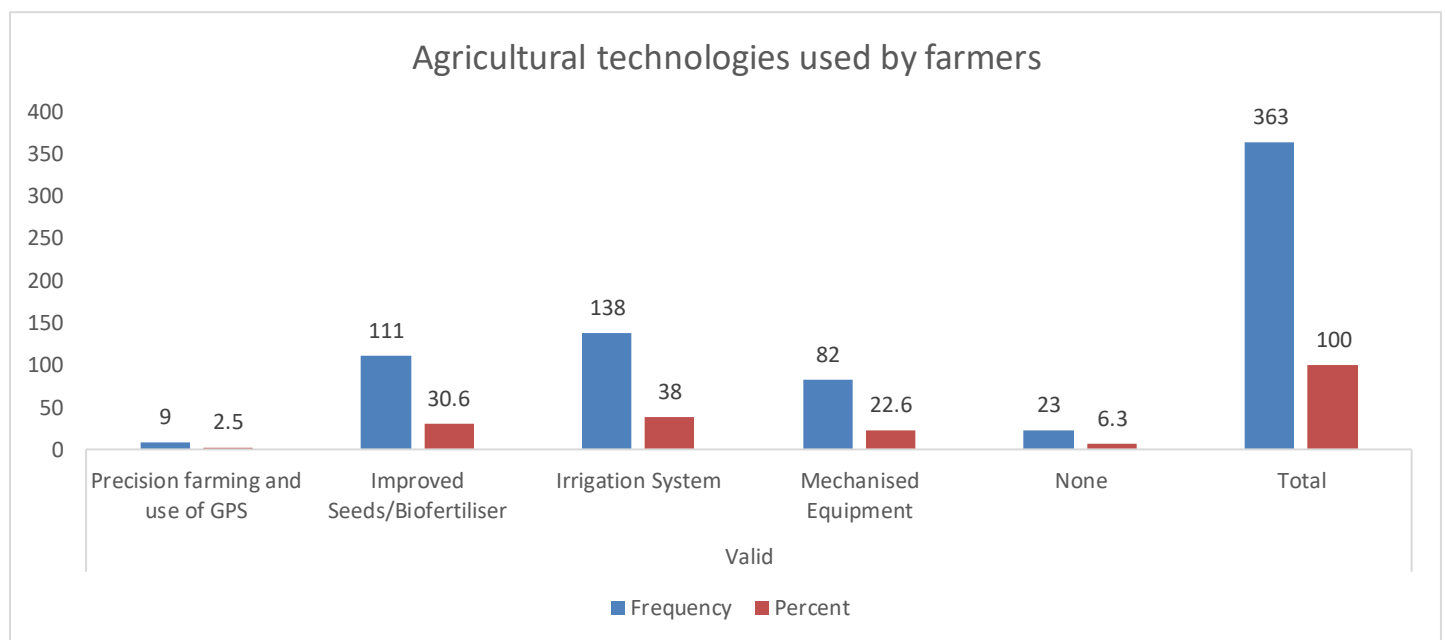


Figure 2: Technological innovation in Agriculture

Source: Field Survey, 2025

Figure 2 displayed different agricultural technology used by the respondents in their farming/agriculture business. It was revealed that Irrigation system has the highest frequency 138 (38%) which indicated that majority of the respondents embedded irrigation system into their agriculture business. This was followed by improved seeds or bio fertilisers which has 111(30.6%) respondents adopting this innovation in the agric-business. 82 (22.6%) of the respondents also have integrated mechanised equipment such as tractors or harvesters. 9 of the respondents (2.5%) used precision farming and GPS for farming, while 23(6.3%) indicated they have not used any of agricultural technology. This indicates that while input-based technologies are commonly adopted, digital tools such as precision, GPS remain underutilised. While farmers use improved seeds and irrigation, digital adoption is low which may affect agriculture productivity in this period of wider use technology in agriculture all over the world

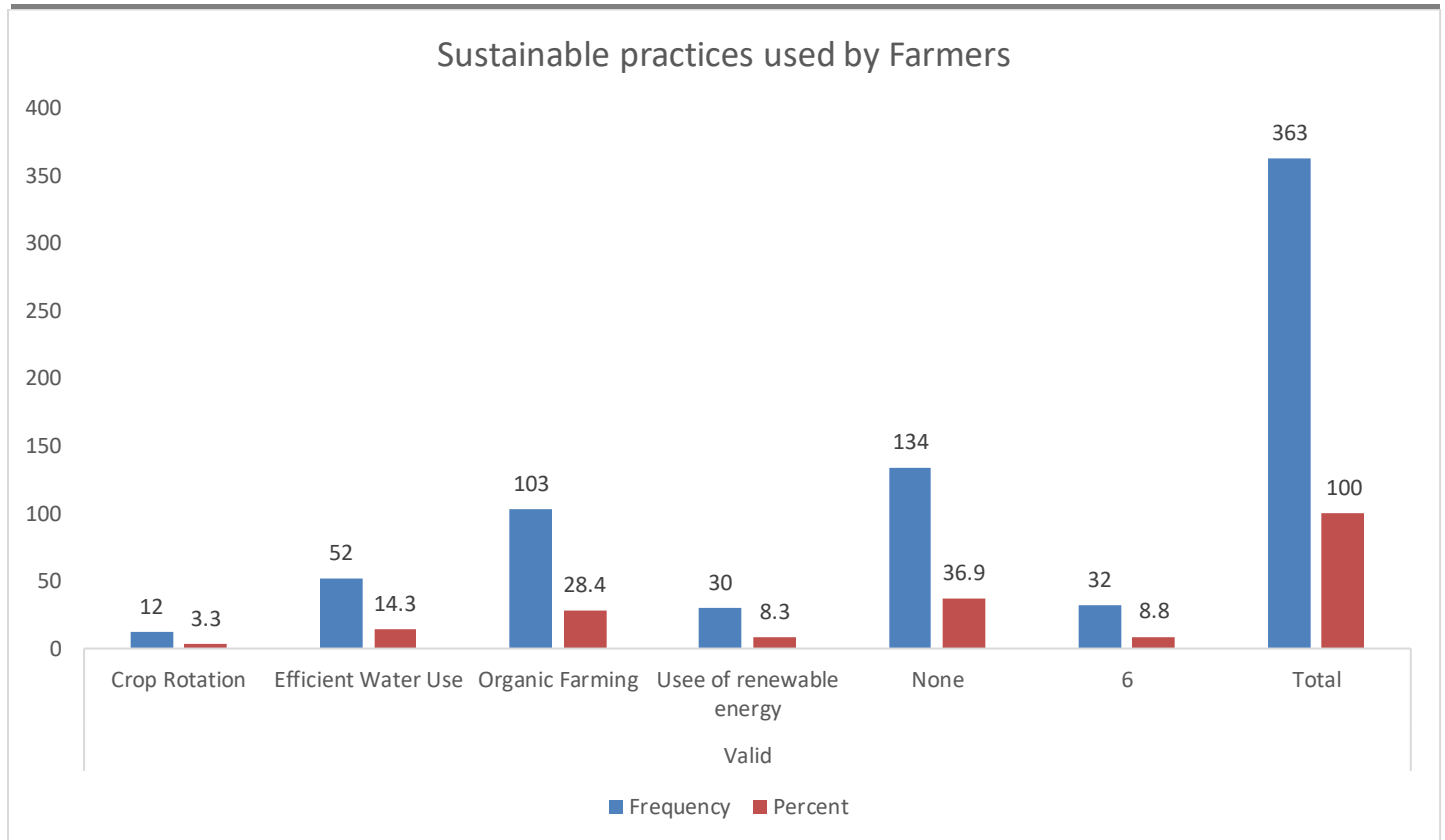


Figure 2: Sustainable Practices by Farmers

Source: Field Survey, 2025

Figure 3 presented different sustainable agricultural practices adopted by the respondents. Findings revealed that while 134 (36.9%) of the respondents do not employ any practices other than just planting, 103 (28.4%) of the respondents employed organic farming, 52 (14.3%) of the respondents employed efficient water in their farms, and 30 (8.3%) employed renewable energy, while only 12 (3.3%) of the respondents engaged in crop rotation. These results indicate that farmers or agripreneurs are aware of the importance of sustainable agricultural practices, which are environmentally friendly. In contrast, almost 134 of respondents do not adopt anyone, which could be counterintuitive and affect the environment in the long run. Hence, it is a cause for concern and needed more awareness among the farmers on the reasons why they must engage in sustainable agriculture practices.

Perception Analysis of the Respondents

This section presented the perception of respondents to the use of technological innovation, the embracement of sustainable agricultural practices, and the role of national policies and political stability on food safety and security in Ibadan, Oyo State.

Table 2: Has the use of agricultural technologies increased your farm yield?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	29	8	8	8
	Agree	154	42.4	42.4	50.4
	Strongly Agree	180	49.6	49.6	100
	Total	363	100	100	

Source: Field Survey, 2025

Table 2 presented the respondents' positions as regards the extent to which the use of technological innovation has increased their farm yield. Findings revealed that out of 363 respondents, 180 (49.6%) and 154 (42.4%), representing 92% of the respondents, strongly agree and agree that the use of technology on their farms yielded

increased outputs for them, while 29 (8%) of the respondents remain neutral. This indicates that technological innovation plays a critical role in ensuring an increase in farm yield, which is good for food security in an economy.

Table 3: Does technological innovation in agriculture guarantee food safety?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	12	3.3	3.3	3.3
	Neutral	38	10.5	10.5	13.8
	Agree	147	40.5	40.5	54.3
	Strongly Agree	166	45.7	45.7	100
	Total	363	100	100	

Source: Field Survey, 2025

Table 3 raises a question as to whether technological innovation in agriculture guarantees food security and safety in Oyo State. Findings revealed that 166 (45.7%) and 147 (40.5%), representing positive responses of about 86.2% of the respondents, strongly agree (5) and agree (4) that the use of technological innovation in agriculture does not only ensure food security but also guarantee food safety in the state. This indicates that the use of technological innovation in agriculture does not only increase the far yield of the farmers but also guarantees food safety, which is the first important thing to put into consideration while applying these innovations because the health of people is paramount.

Table 4: Has the use of technology in agriculture stimulated sufficient food production and food security in the country?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	3	0.8	0.8	0.8
	Neutral	53	14.6	14.6	15.4
	Agree	151	41.6	41.6	57
	Strongly Agree	156	43	43	100
	Total	363	100	100	

Source: Field Survey, 2025

Table 4 presented the respondents' responses to whether the use of technological innovation in agriculture stimulated food production and food security in the state. The findings showed that 156 (43%) and 151 (41.6%) of the respondents, representing 84.6%, strongly agree (5) and agree (4) that technological innovation in agriculture has stimulated food production and food security in the state. This indicates that technology provides greater benefits to the nation, especially in the agriculture sector, which produces the food that nations feed from. The implication is that investment in technology that can be used in the agricultural sector would play a greater role in ensuring adequate food is produced and every individual in the nation has access to food.

Table 5: Do national policies and special programme for food security influence sustainable agricultural practices?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	11	3	3	3
	Disagree	46	12.7	12.7	15.7
	Neutral	63	17.4	17.4	33.1
	Agree	138	38	38	71.1
	Strongly Agree	105	28.9	28.9	100
	Total	363	100	100	

Source: Field Survey, 2025

Table 5: Do national policies and the Special Programme for Food Security influence the attainment of food security in Nigeria?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	6	1.7	1.7	1.7
	Disagree	36	9.9	9.9	11.6
	Neutral	62	17.1	17.1	28.7
	Agree	142	39.1	39.1	67.8
	Strongly Agree	117	32.2	32.2	100
	Total	363	100	100	

Source: Field Survey, 2025

Table 5 displayed the responses of the respondents as regards the influence of the national policies and special programme of government for food security on food security in Oyo State to know whether these farmers in Oyo State also benefited from these policies and special programme. The study found that 117 (32.2%) and 142 (39.1%), representing 71.3% of the respondents, strongly agree (5) and agree (4) that the national policies and special programme of government for food security, like Fadama, influence food security in the state. While 62 (17.1%) are neutral, 36 (9.9%) and 6 (1.7%), representing 11.6% of the respondents, disagree with the question. This indicates that national policies and special programme like Fadama cut across the nation and are well benefited from by the farmers. Those in disagreement might not have the necessary information about its policies, and they may be those who do not engage in agricultural business.

Table 6: Political stability affects the formulation and success of national policies towards food security in Nigeria.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	9	2.5	2.5	2.5
	Neutral	33	9.1	9.1	11.6
	Agree	142	39.1	39.1	50.7
	Strongly Agree	179	49.3	49.3	100
	Total	363	100	100	

Source: Field Survey, 2025

Table 6 displayed the respondents' opinions as regards political stability influence on formulation and success of national policies towards good security. Findings revealed that the majority of the respondents are in agreement that political stability plays an important role in ensuring food security in an economy. Specifically, 179 (39.3%) and 142 (39.1%), representing 88.4% of the respondents, strongly agree (5) and agree (4) that political stability plays a critical role in ensuring attainment of food security in an economy. In contrast, 33 (9.1%) remain neutral (3), while 9 (2.3%) disagree with this question. Since the majority of the respondents are in agreement with this question, it indicates that well-formulated and coordinated national policies towards the agricultural sector are capable of ensuring attainment of food security in an economy.

Table 7: What challenges do you face in accessing or using agricultural technologies?

	Frequency	Frequency	Valid Percent	Cumulative Percent
Valid	High cost	78	20.5	20.53
	Lack of training	66	17.4	37.89
	Poor infrastructure	91	23.9	61.84
	Limited funding	124	32.6	94.47
	Others	21	5.5	100
	Total	380	100	

Source: Field Survey, 2025

Table 7 presented the respondents' responses regarding the major challenges facing them in using agricultural technologies. It was revealed that the respondents face so many hurdles such as limited funding, poor infrastructure, high cost of inputs, lack of training, and others. Specifically, 124 (32.6%) of the respondents selected lack of funding, 91 (23.9%) selected poor infrastructure, 78 (20.5%) selected high cost of inputs, 66 (17.4%) selected high cost, and 21 (5.5%) were grouped under others. These findings indicate that financial constraints and infrastructural issues are the most significant barriers hindering wider access to and use of agricultural technologies among farmers.

DISCUSSION OF FINDINGS

This study was conducted to determine the role of technological innovation in agriculture on food security in Nigeria, with a specific focus on Ibadan, Oyo State, due to its population and the need for people to be certain of their future meals. It was acknowledged that there are other factors that contribute to food security in Nigeria that this study did not cover; however, the study's interest is on technological innovation such as precision farming and the use of GPS, improved seeds/biofertiliser, irrigation systems, mechanised equipment, and the extent to which farmers have embedded them in their agricultural business and their role in food security. This study was limited to descriptive statistics to capture the farmers' perceptions regarding this research focus. The study revealed that the majority of the respondents are male, deeply involved in farming as their major occupation, and well-educated, with the majority holding a first degree and master's certificate, indicating that they understand the questions raised in this study, with the majority having 1-5 years of experience. The study further found that farmers have been adopting technologies in their farming business, with the majority adopting irrigation systems and improved seeds, which are very essential to food security. Furthermore, findings showed that even while technological innovation has been prevalent among the respondents, sustainable agricultural practices are not well embraced by the majority of the farmers, which could be environmentally hazardous, affecting the earth and climate change. organic farming is well embraced by most of the respondents with efficient water use.

Perception analysis of the respondents also revealed that use of agriculture has increased the respondents' farm yield, guaranteed food safety, and stimulated food production and food security. They further agree that national policies and special programme food security play a major influence in sustainable practices and have helped in attaining food security in the state. They are of the opinion that political stability has contributed to the progress so far recorded in attaining food security in the state. However, they identified several challenges such as limited funding, poor infrastructure, high cost of inputs, and lack of training as major impediments to fully embracing technology in their farming business.

The findings of this study regarding the perception analysis of the respondents on the role of technological innovation in agriculture on food security are very essential in unraveling that to attain desired food security for the population of Ibadan and Nigeria by extension, technology must be embraced by all the agriculture investors and farmers because continually relying on subsistence farming or leaving the agricultural business in the hands of a few illiterates cannot guarantee us, as a country, food security for the Nigerian population. Embracing technology in agriculture assures climate shock mitigation, reduces post-harvest losses for farmers, and improves farmers' yields, and with the attainment of food security, SDGs 1 and 2 can be achieved in Nigeria. This position aligns with the study of Akinwale and Globler (2023), who submitted that technological innovation, food security, and economic growth causes each other, indicating that investment in technology in agriculture causes food security and as well causes economic growth and vice versa. It also corroborated with the findings of Akapnio *et al.*, (2025), who stated that non-adoption of e-agriculture, a subset of technological innovation in agriculture, contributes to food insecurity in the country. It also supported the finding of Hunag and Wang (2024), who submitted that technological innovations substantially enhance agricultural productivity. In this case, agricultural productivity, which is the measure of agricultural value added, plays a crucial role in food security. However, it contradicts Eneanya's (2021) finding that government policies do not contribute to food security. This conclusion could be reasoned from the corruption tendencies that could affect farmers not accessing the subsidies.

CONCLUSION AND RECOMMENDATIONS

This study examined the role of agricultural technology in agriculture on food security in Nigeria. Based on the findings of this study, the study concluded that technological innovation in agriculture plays an essential role in

attaining food security in Nigeria and national policies and special programmes of government contributed to food security, while challenges of limited funds stand as impediment in embracing technology innovation by agricultural investors in Ibadan, Oyo State. Therefore, the study recommended that:

- i. *There should be promotion of technological innovation such as agri-based digital tools, training programmes on seed trackers, semi-autotrophic hydroponics (SAH), and biotechnology to improve farmers' capacity and motivation and improve farming productivity to boost food security in Ibadan, Oyo State Nigeria.*
- ii. *Additionally, the government at all levels in Nigeria should invest intensively in farming infrastructure to enable farmers and agribusiness owners to move beyond playing typical roles of producing on a small scale to mechanised or large-scale farming, thereby impacting food security in Nigeria.*
- iii. *Likewise, there should be financial support and infrastructure development to support small-scale/local farmers by providing secure funds and improvised equipment and technologies through low-interest loans and grants, which can address the major challenges of limited funding with the motive of addressing food insecurity in Nigeria.*

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