INTERNATIONAL JOURNAL OF ARTS MANAGEMENT AND PROFESSIONAL STUDIES
E-ISSN: 2814-0389, ISSN: 2814-0370
VOL. 5, ISSUE 3, 2025
AVAILABLE ONLINE: www.ijamps.com

INNOVATIVE MODELS FOR CREATING A ROBUST RURAL AGRICULTURAL ECONOMY IN NIGERIA

Eze Chidi Nwauba
Professor of Intrapreneurship
Department of Public Administration,
Prowess University, Delaware-USA
E-mail: dparlay@gmail.com
dr.prince@pu-edu.us
+2349124673109
+22996547204

Abstract

The study studied Nigeria's rural agricultural sector and proposed improvements. The study sought to identify the key barriers to agricultural sustainability and output in Nigeria's rural areas and tested innovative ideas from other locations. The study had four primary questions: What obstacles does Nigeria's rural agricultural economy face? What creative models have worked in other regions that could be used to Nigeria? How can these models be adapted to Nigeria's rural agricultural communities? The socio-economic effects of implementing these models in Nigeria? The research team collected descriptive data from 100 structured questionnaire respondents. Descriptive statistics included mean scores, standard deviations, and kurtosis. Lack of market data, capital constraints, destroyed infrastructure, and climate change's effects on Nigeria's rural agriculture business were among the research's findings. Improvement priorities were "Inadequate Market Information,""Limited Access to Finance," and "Infrastructure Deficiency."" Climate Change and Environmental Degradation" was important but least variable. The study explored precision farming, regenerative agriculture, and community-based production systems. Regenerative agriculture seemed promising, but precision farming was most popular. Experts proposed incorporating indigenous knowledge, strengthening extension services, employing mobile technology, personalizing training programs, and expanding policy support to make these approaches more applicable to rural Nigerians. Federal funds, new technologies, and local knowledge are needed to alleviate rural Nigeria's agricultural difficulties. Comparative regional evaluations, longitudinal research to determine these models' long-term effects, and future agriculture technology studies are needed. Executing the strategies and sustaining a research agenda could boost Nigeria's rural agriculture sector's productivity, sustainability, and social development.

Keywords: Rural Agriculture, Innovative Models, Agricultural Economy, Sustainability. Precision Farming

Introduction

As most of the world's poor live in rural areas, farming cannot be overlooked if poverty is to be alleviated, global income raised, and Mother Earth's resources protected. Agriculture is still the most important productive sector for most low income countries accounting for the largest share in GDP and providing the most significant number of jobs. On the other hand, the world is pursuing a poverty reduction agenda (Sinha, 2019). The non-agricultural business ventures that aims to serve and gain more from the rural populace cannot grow in a country where the more significant percentage of the populace are in agrarian setup if they do not witness an increase in the agrarian income as a whole. Therefore different countries will pick the meaning of agriculture to poverty reduction and broaden GDP growth. Subsistence farming affords income for the huge number of poor people still living in village in Africa. According to Pawlak and Kołodziejczak (2020), 'if the agency of investors is not only a desire to make money, but also a social mind-set concerned with improvement and addressing global challenges outweighing nationalistic interests, our advice to those purpose-driven investors, if they are serious about the task of poverty-reduction and food security in Africa, is to focus on smallholder agriculture.' Considering its outsized impact on every country's economy, agriculture should be considered in any plan to spur early economic growth in Africa. Sustainable rural economic development not only reduces poverty, but also increases the creation of rural jobs, reduces income inequality, and postpones the inevitable rural-urban migration (Plumecocq et al., 2018). The rural poor have a lot to gain from new emerging market niches (Rajeswari et al., 2017). A more pro-poor growth process could get stimulated if this happens. Nigeria could produce large quantity of crops, livestock, forestry, and fisheries products by the number of its agricultural assets, the 68 million' worth of arable land, the 12 million' worth of freshwater resource, the 960 kilometres of coastline, and the ecological diversity (Olaniyi, 2017). More than 70 percent of the poor in Nigeria reside in the rural areas and that is where poverty is most concentrated.

However, results remain controversial despite extensive research which establishes a theoretical connection between agricultural production and GDP growth (Wang et al., 2019). Further research is needed to reflect the detailed nature of the relationship

between agricultural production and economic growth. Notably, the debate on the role of agriculture in development is partly due to the fact that 'structural transformation is a holistic equilibrium process that [cannot be] described by focusing only on agriculture' (Yusuff et al., 2016). Whether and under what conditions agricultural production can be an engine of growth in rural areas has received scant attention, and to this date, the position of major multilateral funding agencies is unclear. Although both globally and in Nigeria specifically there are few studies on this question, data on the relationship between agricultural output and GDP growth – and by association rural poverty – are even scarcer.

Most of Nigeria agricultural potential is yet to be fully harnessed as a result of her favourable climate and ample hectares of arable land. Progress and development in the rural agricultural sector is still impeded by inadequate supply of physical infrastructures, availability of funds and outdated farming technologies (Olayide et al. 2016). In this way, rural areas do not fully play to their great potential as regards their contributions to the national economy. The problem is made worse by the (relatively) lack of innovative strategies that can gradually transform this sector into a robust and sustain

Statement of the Problem

Lack of infrastructural development, lack of exposure to newer technology and less productive agricultural methods are the major pitfalls of the Nigerian rural agricultural industry and the sector is nowhere near its potential as a major sector to drive the economy because it had been under-developed, traditional method of agricultural practice rarely keeps up with the dynamic needs of rural farmers and their community. This study intends to increase the production, sustainability and access to market as ways of reviving the agricultural sector in the rural areas. The production system used to produce farm crops is not same as ten years ago and to sustain people in the rural areas, this study intends to reshape the agricultural sector by finding out and recommending new method of producing farm products and new technologies that would help in mitigating the current problems bedeviling the sector in order to create a stronger and stable agricultural economy of Nigeria.

Research Questions

1. What are the current challenges facing the rural agricultural economy in Nigeria?
2. What innovative models have been successfully implemented in other regions that could be adapted to the Nigerian context?
3. How can these models be tailored to address the specific needs and conditions of rural agricultural communities in Nigeria?
4. What are the potential socio-economic impacts of implementing these models in Nigeria?

2.Literature Review

Nigeria's Agriculture Sector: An Overview

Nigeria must go back to the roots of her agriculture. Her economy has been stagnant for decades especially after the country shifted her economic focus from agriculture to oil. (An oil exchange problem has kept Nigeria stagnant since the 1970s.) And it will be important to study its influence on the GDP growth; especially in the wave of pressure to meet the MGDs. There is no doubt that agriculture is the most important economic activity in Nigeria. It contributes about 40 per cent to the nation's GDP and provides employment opportunities for about more than 70 per cent of its working population (Nkang, 2018). That is, nearly half of the nation's population live in an area where agriculture is the most important economic driver.

To put it mildly, "the resource curse" seems to be plaguing Nigeria (Osabohien et al., 2018). Despite a wealth of both natural and human resources, the attempt of the economy to fuel growth has grossly misfired. Approximately 150 million people currently call Nigeria home, and with 53.83 million of its citizens actively searching for work, (Nkang, 2018), this is more than enough to provide the labour that is essential for economic growth to truly take root. Not only is this country the largest crude oil reserve on the planet, it is also the sixth largest gas reserve in the world, and the biggest oil producer in Africa too (Ebimobowei, 2022). Due to its varied climate and approximately 31 million hectares of arable land, this stretch of land is able to produce goods from tropic and semitropical regions (Azare et al., 2020).

In spite of the nearly complete failure of the sector after independence, the foundation of agricultural production as the motive power of the Nigerian economy has remained intact. Balakeffi et al (2019) say that in the 1960s Nigeria was the largest groundnut exporter, the 2nd largest exporter of cocoa and palm oil and an important exporter of rubber and cotton. Recent studies confirmed that a significant proportion of Nigeria's labour force (about two-thirds), contributes significantly to GDP and a substantial proportion of the non-oil revenue comes from agriculture (Balakeffi et al., 2019). Nigeria, no doubt, has a huge potential for development and growth. With the country's enormous domestic markets, huge arable land and water, and abundant human capital to exploit, there are large untapped opportunities for the growth of agriculture. About 40 per cent of Nigeria's total land area is currently in cultivation with an estimated arable land of about 84 million hectares in the country (Atuahene-Gima Amuzu, 2019). Shoreda (2017) estimated the average farm-holding in Africa at 2.24 hectares, which is very small by any standard. In addition, the technology used in farming is very primitive and offers low inputs to existing farmland. As a result, the dependence on food imports has increased. Nigeria has a lot of surface water (267.7 billion cubic meters) and underground water (57.9 billion cubic meters), and so the supply for irrigational purposes could be harnessed. The vegetation is rich and varied, and obviously supports big herds of livestock (Bosello et al, 2017). The opportunity for a huge and growing domestic market to stimulate agricultural produce comes from the country's huge population.

Besides low productivity, economic indicators also show that economic contribution of the two sub-sectors to the growth of the overall economy are below the norms stipulatedin FAO statistical manual (2021). Further reasons for the growth deceleration of the agricultural sector in Nigeria is low productivity. Poor growth of agriculture sector is attributed to inadequate human capital investments rather than falling TFP (Adetunji, 2019). He clarified as largely attributable to fast rising working-age population and fast growing labour force. The authors did not highlight the inconsistent or insufficient investment in capital. Furthermore, Obayelu et al. (2020) suggests that 'better agriculture production technologies must be implemented to increase per capita productivity'. The authors found that CPI, the growth rate of GDP and the population growth rate of all three agriculture indicators are significant

and consistent positive correlations with one another. They were three key determinants of domestic agriculture output of Nigeria.

Agriculture Sector and Economic Growth

Instead, and in contrast to the alienation feeling that distinguishes the agriculture versus industry dichotomy, the agricultural sector and other industries should be seen as complements to one another (whose needs could potentially be met via communication and collaboration), and the role of industry is extremely vital and any developing country must seek to strengthen its industrial sector (Luo et al 2017; Sertoglu et al 2017). However, we must, as evident with the Nigeria scenario, not fall for the pretence that industry is viable to drive the economy forward by completely disregarding agriculture, perhaps as the former was the focus of the economic push after the abandonment of the path taken by the early nations that attained independence. As the proponents of this agriculture-led-growth (ALG) dynamics put it, non-ALG growth cannot come without prior growth of the agricultural sector. Mostly, this is because an ongoing growth process where industrialisation is associated with it means an upsurge in rural incomes and, more importantly, the supply of raw materials for the industrial sector; it also requires a substantial domestic market to sustain industry, and by far, the release of resources to support the push for industrialisation (Chukwu and Chidubem 2023; Gina et al 2023). An economy characterised by a stagnating economy and expanding disparity between incomes is the destiny of treating industry with envy, and economics with disdain Agriculture is thus a necessary and sufficient condition for initiating industrialisation at the early stage of economic development as the sector does not yield the transformation alone (it is not an automatic catalyst for the transformation of the economy); it does, however, kickstart the first few steps of the transformation (Zaman et al 2021).

Rich nations like China, Japan, Taiwan, South Korea and Hong Kong, had rising savings rates due to incomes (Ortiz-Bobea et al., 2021). Hence, agriculture increases Economic Growth by raising the world of the greater number of the income box thus increasing the ability to save. As estimated by the 2011 paper published by the IFPRI in Ethiopia's growth and transformation plan for better Total Productivity (TP) will require more domestic savings. Therefore, achieving a better Total Productivity (TP)

requires more domestic savings Orbayelu (2012) bedewing the Tobit regression model on multi-stage data in Kwara state in his published paper reveals valid outcomes on the huge impact of domestic saving which is low among the Nigerian people who are living in the rural areas and the farmers due to high food expenditure. Apparently, he indicated that pressure on the farm households' saving capacity comes from high food expenditure which is a direct consequence of their low income as a result of low production. Direction of the economic growth relies upon domestic savings heavily.

Another benefit of the sector is to 'absorb idle hands' for industries. The more productive the agricultural sector, more earnings, and labour force that can be put into making industry the engine of growth because it results in the expansion of the economy. The industrial sector becomes the primary target for structural development to promote and bring about economic change (Osuagwu, 2020), which implies the expansion of the manufacturing sectors.

Innovative Models of Agriculture

In order to meet the current needs of the population as well as food production in today's world, new models of agro- production have been developed in order to increase production of farm products: Some of these models are:

1. Precision Farming

Precision farming is the new tenet in farm management that incorporates IT to provide appropriate humus substances and nutrients to increase plants' health and crop output. Although not its only feature, PA became a practical reality in farming largely due to the money-spending on the on-the-go crop yield monitor installed by AL Myers.

One type of farm and responding to spatial variability on both within- and between-field scales is PA (also known as satellite farming or site-specific crop management, SSCM). A precision agriculture approach, called phytogeomorphology, uses topographic terrain units to correlate inter-annual variations of crop growth stability

and other traits. In the agricultural system, the hydrologic process is generally controlled by the geomorphic component, which makes an approach such as this interesting.

It is opposed to conventional farming that relies on humans and animals to ensure the survival of individual plants. The use of precision farming based on technology involves: sensors, autonomous or semi-autonomous robotics, GPS, mapping to establish spatial information, as well as data processing software such as machine learning.Data and photos collected from fixed or robotised sensors and unmanned aerial vehicles (drones) equipped with cameras are transferred to a computer. In this way, the size of the stem and the shape of leaves, or the relative humidity of the soil can be analysed, for example (which are among the indicators of plant health or stress; Jacobs et al., 2018).Given this information, farmers can make decisions: how much water, herbicide or fertiliser to apply in a particular section. They can also obtain in real time indicators of individual plants as feedback. This is essential information to anticipate when to plant or harvest.

2. Community-Supported Agriculture (CSA)

Community-supported agriculture (CSA) is a way of providing food that democratises the risks and rewards of farming evenly between participating farmers and consumers, so that the entire food system (including the dangers, successes and failures) are shared in common (Galt et al, 2019). Unlike organic certification, which has a top-down model and definition, CSA simply has no such thing. Community supported agriculture (CSA) providers can be organised farmer to member, in which case they invest in a productive unit (often a smallholding or farm) and get a share of the harvest. Providers can also be organised consumer to member, in which case members buy a share of a plot and grow their own food. In some circumstances, hybrid groups say they offer ‘relational returns’, where some members have a greater financial relationship with the food producers, while others have a more significant relationship to the land and food production.

Perhaps the first CSA was a Japanese cooperative calling itself the ‘Seikatsu Club’ which began, in 1965, to buy food – as local and sustainable as possible – from

farmers, and later to own farms of its own. And, in Japan, a very similar movement emerged in the 1970s. The first instance of CSA in the US as such is known to have occurred in the 1980s – although, by now, there are almost 13,000 CSA farms in the US. Now, I'm sure that many more CSAs exist than are reported here but, while the idea caught on dramatically in the world's major food kingdoms, it was in the UK that the CSA idea took off more slowly (Tang et al., 2019). The most popular CSAs in the world are: Some of the globally popular CSAs in the world include: Abundant Earth Co-op, Ash & Elm Horticulture, Banc Organics, Bantu Farm, Bennison Farm CSA, Big Meadow CSA. Black Grove Greens CSA, Blackhills CSA and Blagdon Wharf Barn Farm.

3.Regenerative Agriculture

Sustainability is an insufficient aim for regenerative agriculture, whether assessed on an annual basis as some of the above papers require, or with reference to centuries or even millennia. Regenerating the land requires making purposeful decisions about which farming practices to adopt in each place, all based on the principles of regenerative management. It demands that regenerative agriculture mesh with all the specificities of each farming system, existing plant and tree species, local climate and soils – all while adapting farming practices accordingly.

Environmental effects of regenerative agriculture are multifaceted and offer climate-change mitigation pathways. Within the inclusive definition of regenerative agriculture, as promoted by major food companies, there are several practices that are considered core to regenerative principles, such as agroforestry and direct seeding. Besides assisting in adopting a critical climate change adaptation measure, the sequestration of carbon, over the short, medium and long term, all these measures can boost biodiversity, improve water retention and enhance soil organic matter, thus contributing to strengthen the resilience of the system in relation to climate hazards.

4. Households for Agricultural Production Model

With particular reference to rural settings governed mainly by family-based farming systems, the concept talks about the need to 'Use Households as Main Units of Agricultural Operation' (Households for Agricultural Production, HAP). Engaging

households in the production of food and other non-food crops holds much significance for rural areas from food security, rural livelihoods to local economy. The basis of this concept is primarily on smallholder farming, where each family owns and uses one land (connected with its residence) to undertake farming. Household farms are typically very small in scale and are mainstay for the family. This mostly consists of very small parcels of land on which varied crops and cattle are reared. Here the outputs are produced both for self-sufficiency and for sale to generate income.

In this approach to agricultural production, both subsistence and market-oriented production play important roles. The aim of market-oriented production is growing crops or raising animals for sale (Majid, 2018). Example of commodities produced are grain, roots, legumes, tubers and fruits. On the other hand, subsistence farming stands in contrast to monetised production by aiming to produce enough staple foods to feed the family but not to profit from selling those foods. Indeed, both concepts complement each other as market-oriented production can help to ensure food gets on the family plate. What makes it different from capitalism is it that it heavily relies on family labour, which incurs lower production costs in terms of paid labour. By doing so, it not only secures the household's involvement in farming, but also reinforces intergenerational knowledge and agricultural skills of the farmers.

Despite these advantages, the 'Households for Agricultural Production' paradigm has several obstacles: families lack access to land, water and money, which are fundamental to production. Poverty and food security may persist because households with small landholdings do not generate income high enough to support the household. Some households may be unable to sell their surplus food due to a lack of market access and participation in food value chains, a challenge sometimes amplified by poor infrastructure and transportation. Often referred to as a technology gap, the non-adoption of modern inputs and technologies is another challenge that might hamper many households to be productive in agriculture. More recently, climate change is altering the landscape for food security and economic stability, and many households are increasing susceptible to its impacts such as erratic rainfall and extreme climate events.

3. Methodology

The approach used this study was survey. In detail, the main tool of collect data from this study was questionnaire. It needs participants as respondents to answer by their own. Because of this study was focused to measure innovation and rural economic scale, this questionnaire was derived from a previously existing reference model of scale of innovation and rural economic. There was parts tested by five farmers before, so that we could pick up any ambiguity that was related to the structure or flow of the questions, or the words used. After that, this questionnaire is fine-tuned and ready to disperse.

The target population was all individual farmers in the five geopolitical zones of Nigeria during the time of the data collecting.

As of 2021, latest figures in this sector show that about 35 million farmers (of different kinds) were actively operating in these zones (NBS, 2022). Therefore, the 35 million Nigerian farmers who are currently involved in farming and livestock production today can be considered as the population of interest. The convenience sampling approach of the quantitative survey is not based on probability.

Indeed, Krejcie and Morgan's (1970) estimates suggested that 100 completed replies was the target sample size; I eventually received 82 valid replies. That's good enough for some diversity of opinion.

The collected data was coded into SPSS version 27 which is a statistical package for the social and behavioural science. Then descriptive and inferential statistics were run to be able to sense the respondents personality and outlook towards life.

INTERNATIONAL JOURNAL OF ARTS MANAGEMENT AND PROFESSIONAL STUDIES
E-ISSN: 2814-0389, ISSN: 2814-0370
VOL. 5, ISSUE 3, 2025
AVAILABLE ONLINE: www.ijamps.com

1. Solution and Findings.

Answers to the Research Questions

Research Questions One

What are the current challenges facing the rural agricultural economy in Nigeria?

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
Infrastructure Deficiency	100	35.00	70.00	51.9000	11.32129	-1.190	.478
Limited Access to Finance	100	20.00	90.00	53.8000	22.64259	-1.190	.478
Climate Change and Environmental Degradation	100	15.00	75.00	43.9000	20.83582	-1.380	.478
Inadequate Market Information	100	35.00	80.00	60.6600	13.93580	-.738	.478
Valid N (listwise)	100						

Source: SPSS, 2024

Result

Using data from 100 respondents, the table below describes four major obstacles confronting Nigeria's rural agricultural sector. With a mean score of 60.66, "Inadequate Market Information" is the most pressing issue. The next most variable topic, "Limited Access to Finance," had a mean score of 53.80 and a standard

deviation of 22.64, indicating that people have different views on this matter. The "Infrastructure Deficiency" variable score is 51.90, with a standard deviation of 11.32. In contrast, the least variable score for "Climate Change and Environmental Degradation" is 43.90, suggesting less attention but still a significant worry. Compared to a normal distribution, responses are more uniformly distributed with fewer extreme values, as seen by the negative kurtosis values across all components.

4.1.2 Research Questions Two

What innovative models have been successfully implemented in other regions that could be adapted to the Nigerian context?

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
Households for Agricultural Production	100	30.00	90.00	58.9000	20.19576	-1.267	.478
Precision Farming	100	55.00	85.00	69.5500	10.00240	-1.245	.478
Regenerative Agriculture	100	50.00	80.00	64.5500	10.00240	-1.245	.478
Community-Based Production to be Off-Taken by Processors	100	40.00	70.00	54.5500	10.00240	-1.245	.478
Valid N (listwise)	100						

Source: SPSS, 2024

Result

Four novel agricultural models with a track record of success in other areas and some need for improvement in Nigeria are detailed in the table above. With a mean score of 69.55, "Precision Farming" is clearly the most well-liked option. Additionally, "Regenerative Agriculture" has a moderately high mean score (64.55), suggesting substantial backing. While "Community-Based Production to be Off-Taken by Processors" has the lowest mean score of 54.55, "Households for Agricultural Production" has a moderate mean score of 58.90. It is clear from the standard deviations that attitudes on "Precision Farming,""Regenerative Agriculture," and "Community-Based Production to be Off-Taken by Processors" are more evenly distributed (all around 10.00) than on "Households for Agricultural Production" (20.20). The distributions of responses appear to be flatter and more equally spaced out than a normal distribution, as indicated by the negative kurtosis values across all questions.

INTERNATIONAL JOURNAL OF ARTS MANAGEMENT AND PROFESSIONAL STUDIES
E-ISSN: 2814-0389, ISSN: 2814-0370
VOL. 5, ISSUE 3, 2025
AVAILABLE ONLINE: www.ijamps.com

Research Questions Three

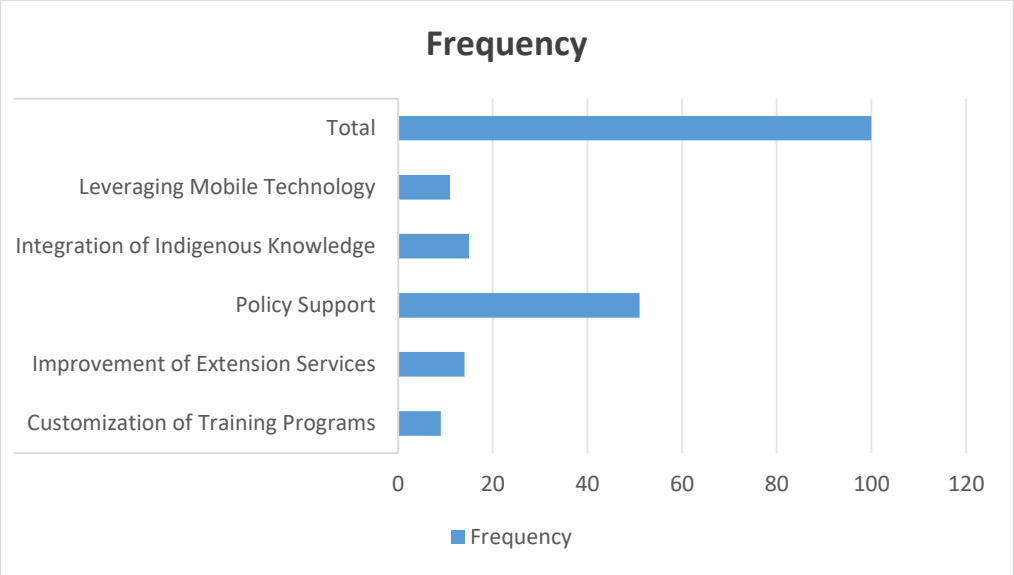
How can these models be tailored to address the specific needs and conditions of rural agricultural communities in Nigeria?

How models can be tailored to address the specific needs and conditions of rural agricultural communities in Nigeria

	Frequency	Percent	Valid Percent	Cumulative Percent
Customization of Training programmes.	9	9.0	9.0	9.0
Improvement of Extension Services.	14	14.0	14.0	23.0
Policy Support.	51	51.0	51.0	74.0
Integration of Indigenous Knowledge.	15	15.0	15.0	89.0

Leveraging Mobile Technology.	11	11.0	11.0	100.0
Total	100	100.0	100.0	

Source: SPSS, 2024



Results

Based on the responses of 100 participants, the table summarizes how various techniques might be customized to meet the unique demands and situations of rural agricultural communities in Nigeria. There is a considerable consensus on the necessity for supporting policies, as 51% of respondents emphasized the importance of "Policy Support" as the most often cited strategy. The next most important at 15% is "Integration of Indigenous Knowledge," which implies that local knowledge is highly valued in agricultural methods. A 14 % response rate for "Improvement of Extension Services" highlights the importance of outreach and training programmes. "Leveraging Mobile Technology" was mentioned by 11% of respondents, while "Customisation of Training programmes" was mentioned by 9%, highlighting the significance of current technology and personalized education. "Leveraging Mobile Technology" reaches a cumulative 100%, showing that all respondents were covered,

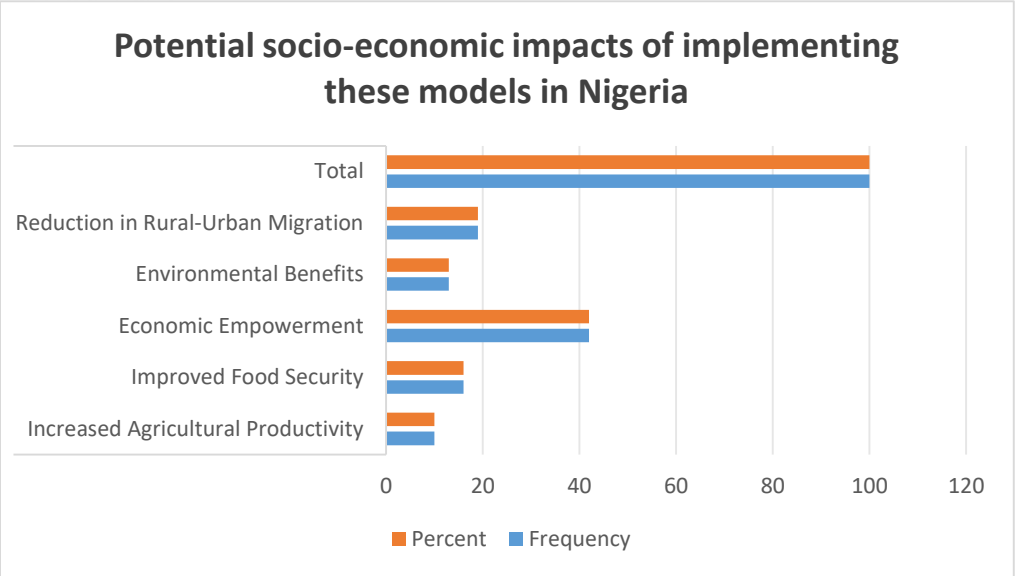
and the cumulative percentages demonstrate the increasing total as each approach is evaluated.

Research Questions Four

What are the potential socio-economic impacts of implementing these models in Nigeria?

Potential socio-economic impacts of implementing these models in Nigeria

	Frequency	Percent	Valid Percent	Cumulative Percent
Increased Agricultural Productivity.	10	10.0	10.0	10.0
Improved Food Security.	16	16.0	16.0	26.0
Economic Empowerment.	42	42.0	42.0	68.0
Environmental Benefits.	13	13.0	13.0	81.0
Reduction in Rural-Urban Migration.	19	19.0	19.0	100.0
Total	100	100.0	100.0	



Results

Based on comments from 100 participants, the table presents the possible socio-economic benefits of implementing new farming practices in Nigeria. With 42% of people emphasizing "Economic Empowerment," it's clear that many think these approaches may greatly boost rural residents' financial security and quality of life. A significant portion of respondents (16%) have highlighted "Improved Food Security," highlighting the role of these models in guaranteeing a steady and ample supply of food. A 19% identification rate for "Reduction in Rural-Urban Migration" implies that increasing the viability of agriculture in rural areas can reduce the exodus of people to cities. 13% of the respondents who took the survey see "Environmental Benefits," which could mean that sustainable activities have a favourable effect on the environment. A 10% mention of "Increased Agricultural Productivity" indicates that more production and efficiency are anticipated. This full coverage of respondents' perspectives on various potential outcomes is shown in the cumulative per cent column, which reaches 100% of these impacts' running total.

Discussion

A comprehensive review of the challenges faced by Nigeria's rural agricultural sector, as mentioned in the first research question, is the starting point for the discussion of the findings. With a mean score of 60.66, indicating great concern among respondents,

the descriptive statistics detailed demonstrate that "Inadequate Market Information" is the most critical issue. This result is in line with what McGuirt et al. (2018) found: market information is crucial for increasing agricultural output. Next, "Limited Access to Finance" had a mean score of 53.80 with a standard deviation of 22.64, indicating that people had different thoughts about its effects. In their discussion of the challenges caused by insufficient funding, Osabohien et al. (2018) and others have stressed the importance of targeted financial solutions in light of this variability. Consistent with the results of both McGuirt et al. (2018) and Osabohien et al. (2018), "Infrastructure Deficiency" appeared with a mean score of 51.90, further demonstrating its crucial role in obstructing agricultural advancement. Despite receiving less attention, the matter of "Climate Change and Environmental Degradation" (mean score: 43.90) is nevertheless very important. Supporting earlier studies on the complex nature of agricultural difficulties in Nigeria, the distribution of responses appears to follow a normal distribution, as seen by negative kurtosis values.

The study finds multiple novel agricultural models with potential for adaption in Nigeria, answering the second research question. With the highest mean score of 69.55, "Precision Farming" stands out and greatly supports its implementation. This agrees with the findings of Giller et al. (2021), who observed that precision farming increased production while decreasing resource use. A mean score of 64.55 indicates that "Regenerative Agriculture" is also highly regarded for its potential in sustainable land management; this aligns with the focus on regenerative models for environmental protection highlighted by McGuirt et al. (2018). With an average score of 58.90, "Households for Agricultural Production" had moderate support, whilst "Community-Based Production to be Off-Taken by Processors" had the lowest score of 54.55. It appears that there is a range of perspectives on these methods (Ogbanje & Salami, 2022). While precision and regenerative agriculture receive more enthusiasm, community-based approaches receive less support (White, 2020). The standard deviations show that the results for regenerative agriculture and precision farming are consistent, which lends credence to the hypothesis that both models could solve certain problems in Nigerian agriculture.

This study provides important information for answering the third research question by outlining ways that rural communities in Nigeria can adopt new models.

According to McGuirt et al. (2018), there must be supportive policies for implementation to be successful. 51% of respondents underlined the importance of this. The fact that "Integration of Indigenous Knowledge" is preferred by 15% shows that local knowledge is valued, which aligns with the context-specific methods suggested by Ortiz-Bobea et al. (2021). Consistent with the conclusions drawn from McGuirt et al. (2018) and Eastwood et al. (2017), the significance of "Improvement of Extension Services," mentioned by 14% of the participants, highlights the necessity for enhanced education and communication. "Leveraging Mobile Technology" (11% of the total) and "Customisation of Training programmes" (9% of the total) both contribute to the larger body of work on rural development strategies by bringing attention to the use of technology and tailored education in improving farming methods.

Significant benefits are shown by the potential socio-economic implications of applying these models, which are explored in the fourth research question. Consistent with the opinions expressed by McGuirt et al. (2018) regarding the monetary advantages of agricultural innovation, "Economic Empowerment" is anticipated by over half of the participants as a significant benefit. Enhanced agricultural methods can help with food security and keep people in rural areas, according to two reasons highlighted by 6.25 per cent of respondents and 19 per cent, respectively. According to research by Giller et al. (2021) and Awunyo-Vitor & Sackey (2018) modern agricultural practices can potentially improve sustainability and efficiency. The highlighted "Environmental Benefits" (13% of the total) and "Increased Agricultural Productivity" (10%) further support this idea.

The study concludes with an in-depth analysis of the possibilities and threats faced by Nigeria's rural agricultural industry. It aligns results with previous research to highlight the need for customized interventions, regulatory backing, and new models to improve agricultural sustainability and production. Future studies should concentrate on applying these models to specific regions to make the most of them.

Summary, Conclusions, Discussion, and Recommendations

Summary

Evaluating the socio-economic implications of applying these novel models was another goal of the study, alongside identifying the difficulties and potential solutions. As part of this process, we looked at how these models could help with environmental sustainability, food security, economic empowerment in rural areas, and agricultural production. This study set out to answer several questions about the potential for change in Nigeria's rural agricultural economy and to give useful advice to those with a stake in the field.

According to the results, insufficient market information, climate change, environmental degradation, infrastructure limitations, and limited access to financing are the main problems confronting Nigeria's rural agricultural sector. Some innovative approaches that have proven effective in other parts of the world and could work in Nigeria include using homes as production units, precision farming, regenerative agriculture, and community-based production systems. Customizing training programmes, enhancing extension services, giving policy support, incorporating indigenous knowledge, and utilizing mobile technologies are some suggestions for adapting these models to the unique circumstances of Nigeria's rural agricultural communities. Increased agricultural output, better food security, economic empowerment, environmental advantages, and a decrease in rural-urban migration are some of the anticipated socio-economic outcomes of using these methods in Nigeria.

Conclusion

In conclusion, this study has offered a thorough evaluation of the problems facing and possible remedies for Nigeria's rural agricultural sector. The analysis emphasizes the important challenges that impede the sector's growth by naming important factors such climate change, insufficient market data, infrastructure deficiencies, and limited access to funding. There are potential ways to enhance rural agriculture in Nigeria by studying innovative models from other areas. These models include community-based production systems, regenerative agriculture, and precision farming. With few tweaks

to fit the local conditions, these models could solve major problems and propel major improvements in agricultural sustainability and productivity.

Recommendations

Based on the findings of the study, the following recommendations are made:

1. Farmers should build and deploy state-of-the-art market information platforms that give farmers access to up-to-the-minute information on supply, demand, and pricing trends in the market. By this, farmers will be able to make better judgments, get access to more markets, and feel more certain about pricing because of this.

2. The Nigerian government and other stakeholders should make low-interest loans, grants, and insurance for goods and services geared toward the agriculture industry available to rural farmers. To help underprivileged populations gain access to financial resources, work with microfinance institutions.

3. The government should prioritize funding for critical infrastructure projects including roads, storage facilities, and irrigation systems to improve rural areas' infrastructure. Better infrastructure will help with distribution and production, lessen losses after harvest, and boost agricultural growth as a whole.

4. Farmers should foster the spread of cutting-edge agricultural models by running field trials, providing training programmes, and setting up demonstration farms to encourage the use of cutting-edge agricultural techniques including regenerative agriculture and precision farming. Because of this, local farmers will be able to use practices that are better for the environment and their crops.

5. In order to encourage the adoption of new models and sustainable farming practices, it is necessary to establish and uphold regulations that achieve just that. Stakeholders

should make sure that policies support agricultural expansion and are in line with what rural farmers require.

6. The availability and quality of agricultural extension services can be improved by increasing training programmes and making better use of contemporary technology. Help farmers enhance their practices and productivity by providing them with practical guidance and support that is specific to their location.

Suggestions for Further Research

In order to expand upon this study's conclusions, future research should focus on a few important areas like longitudinal studies in rural Nigeria to evaluate the effects and viability of new agricultural strategies over the long run, investigating how new technology like block-chain, AI, and big data might affect rural farming, finding out where policies are not being implemented and how to improve them, and examine how modern farming methods might work in tandem with more conventional ones can benefit both sustainability and productivity.

References

Abbas, A. (2018). Reducing Postharvest Losses In Nigeria's Agricultural Sector: Pathway To Sustainable Agriculture. *International Journal of Sciences*, 16–21. http://innoriginal.com/journals/index.php/iijs/article/download/118/pdf

Adegbite, O. O., & Machethe, C. L. (2020). Bridging the financial inclusion gender gap in smallholder agriculture in Nigeria: An untapped potential for sustainable development. *World Development*, *127*, 104755. https://doi.org/10.1016/j.worlddev.2019.104755

Adetunji, A. (2019, February 1). Economic Growth and Employment Nexus In Nigeria's Agricultural And Non-Agricultural Sectors (1981-2014). http://repository.pgcollegeui.com:8080/xmlui/handle/123456789/445

Alehile, K. S. (2023). Climate Change Effects on Employment in the Nigeria's Agricultural Sector. *Chinese Journal of Urban and Environmental Studies*, *11*(03). https://doi.org/10.1142/s2345748123500185

Alizamir, S., Iravani, F., & Mamani, H. (2019). An Analysis of Price vs. Revenue Protection: Government Subsidies in the Agriculture Industry. *Management Science*, *65*(1), 32–49. https://doi.org/10.1287/mnsc.2017.2927

Apata, T. G. (2019). Public spending mechanisms and gross domestic product (GDP) growth in the agricultural sector (1970–2016): Lessons for Nigeria from agricultural policy progressions in China. *Bulletin of Geography Socio-economic Series*, *44*(44), 57–72. https://doi.org/10.2478/bog-2019-0015

Aroh, I. M., Agboje, A. C., Ogbonna, G. N., Anyanka, S. O., Macartan, B. P., Ohanehi, H. A., & Anigbogu, N. M. (2024). Sustainable poultry farming in developing nations: Exploring cassava waste utilization for enhanced poultry production and economic viability. *Animal Research and One Health*. https://doi.org/10.1002/aro2.50

Atuahene-Gima, K., & Amuzu, J. (2019). Farmcrowdy: digital business model innovation for farming in Nigeria. Emerald Emerging Markets Case Studies, 9(2), 1–22. https://doi.org/10.1108/eemcs-03-2019-0065

Awunyo-Vitor, D., & Sackey, R. A. (2018). Agricultural sector foreign direct investment and economic growth in Ghana. *Journal of Innovation and Entrepreneurship*, *7*(1). https://doi.org/10.1186/s13731-018-0094-3

Azare, I., Abdullahi, Adebayo, A., Dantata, I., & Duala, T. (2020). Deforestation, desert encroachment, climate change and agricultural production in the Sudano-Sahelian Region of Nigeria. *Journal of Applied Sciences and Environmental Management*, *24*(1), 127. https://doi.org/10.4314/jasem.v24i1.18

Babu, S. C., Mavrotas, G., & Prasai, N. (2018). Integrating environmental considerations in the agricultural policy process: Evidence from Nigeria. *Environmental Development*, *25*, 111–125. https://doi.org/10.1016/j.envdev.2018.01.001

Balakeffi, L. R., Oboh, V. U., Augustine, U., & Fwangkwal, M. P. (2019). Uncertainties in Global Economic Policy and Nigerias Export Earnings. *International Journal of Business Economics and Management*, *6*(1), 23–38. https://doi.org/10.18488/journal.62.2019.61.23.38

Bashir, A., Suhel, S., Azwardi, A., Atiyatna, D. P., Hamidi, I., & Adnan, N. (2019). The Causality Between Agriculture, Industry, and Economic Growth: Evidence from Indonesia. *ETIKONOMI*, *18*(2), 155–168. https://doi.org/10.15408/etk.v18i2.9428

Bosello, F., Campagnolo, L., Cervigni, R., & Eboli, F. (2017). Climate Change and Adaptation: The Case of Nigerian Agriculture. *Environmental and Resource Economics*, *69*(4), 787–810. https://doi.org/10.1007/s10640-016-0105-4

Brockova, K., Rossokha, V., Chaban, V., Zos-Kior, M., Hnatenko, I., & Rubezhanska, V. (2021). Economic Mechanism of Optimizing the Innovation Investment programme of the Development of Agro-Industrial Production. *Management Theory and Studies for Rural Business and Infrastructure Development*, *43*(1), 129–136. https://doi.org/10.15544/mts.2021.11

Chen, P., Zhu, G., Kim, H. J., Brown, P. B., & Huang, J. Y. (2020). Comparative life cycle assessment of aquaponics and hydroponics in the Midwestern United States. *Journal of Cleaner Production*, *275*, 122888. https://doi.org/10.1016/j.jclepro.2020.122888

Chukwu, & Chidubem, B. (2023). Impact of Agricultural Sector on Economic Growth in Nigeria. *International Journal of Agricultural Sciences and Technology*, *3*(1), 32–59. https://doi.org/10.51483/ijagst.3.1.2023.32-59

Coker, A., & Alabi, O. (2017). Trend and Determinants Of Structural Transformation In Nigeria's Agriculture Sector. *Russian Journal of Agricultural and Socio-economic Sciences*, *72*(12), 134–142. https://doi.org/10.18551/rjoas.2017-12.17

Eastwood, C., Klerkx, L., & Nettle, R. (2017). Dynamics and distribution of public and private research and extension roles for technological innovation and diffusion: Case studies of the implementation and adaptation of precision farming technologies. *Journal of Rural Studies*, *49*, 1–12. https://doi.org/10.1016/j.jrurstud.2016.11.008

Ebimobowei, A. (2022). Oil Revenue and Economic Growth of Nigeria: 1990 – 2019. *African Journal of Economics and Sustainable Development*, *5*(1), 17–46. https://doi.org/10.52589/ajesd-jwzxifnw

Elijah, O., Orikumhi, I., Rahman, T. A., Babale, S. A., & Orakwue, S. I. (2017). Enabling smart agriculture in Nigeria: Application of IoT and data analytics. *2017 IEEE 3rd International Conference on Electro-Technology for National Development (NIGERCON)*. https://doi.org/10.1109/nigercon.2017.8281944

Epaphra, M., & Mwakalasya, A. H. (2017). Analysis of Foreign Direct Investment, Agricultural Sector and Economic Growth in Tanzania. *Modern Economy*, *08*(01), 111–140. https://doi.org/10.4236/me.2017.81008

Finger, R., Swinton, S. M., Benni, N. E., & Walter, A. (2019a). Precision Farming at the Nexus of Agricultural Production and the Environment. *Annual Review of Resource Economics*, *11*(1), 313–335. https://doi.org/10.1146/annurev-resource-100518-093929

Finger, R., Swinton, S. M., Benni, N. E., & Walter, A. (2019b). Precision Farming at the Nexus of Agricultural Production and the Environment. *Annual Review of Resource Economics*, *11*(1), 313–335. https://doi.org/10.1146/annurev-resource-100518-093929

Galt, R. E., Bradley, K., Christensen, L. O., & Munden-Dixon, K. (2019). The (un)making of "CSA people": Member retention and the customization paradox in Community Supported Agriculture (CSA) in California. *Journal of Rural Studies*, *65*, 172–185. https://doi.org/10.1016/j.jrurstud.2018.10.006

Giller, K. E., Hijbeek, R., Andersson, J. A., & Sumberg, J. (2021). Regenerative Agriculture: An agronomic perspective. *Outlook on Agriculture*, *50*(1), 13–25. https://doi.org/10.1177/0030727021998063

Gina, G. A., Mariya, N. A., Natalia, N. C., Nispuana, N. S., Wijaya, N. M. F., & Phalepi, N. M. Y. (2023). THE ROLE OF THE AGRICULTURAL SECTOR ON ECONOMIC GROWTH IN INDONESIA. *Indonesian Journal of Multidisciplinary Sciences*, *2*(1), 167–179. https://doi.org/10.59066/ijoms.v2i1.325

Goddek, S., Joyce, A., Kotzen, B., & Burnell, G. M. (2019). Aquaponics Food Production Systems. In *Springer eBooks*. https://doi.org/10.1007/978-3-030-15943-6

Ike, P. C., & Onoriode, A. E. (2015). Response of Nigeria's Agricultural Sector to Selected Macroeconomics Policy Variables. *Journal of Economics and Sustainable Development*, *6*(4), 162–168. https://www.iiste.org/Journals/index.php/JEDS/article/view/20005

Jacobs, A. J., Van Tol, J. J., & Du Preez, C. (2018). Farmers perceptions of precision agriculture and the role of agricultural extension: a case study of crop farming in the Schweizer-Reneke region, South Africa. *Suid-Afrikaanse Tydskrif Vir Landbouvoorligting/South African Journal of Agricultural Extension*, *46*(2), 107–118. https://doi.org/10.17159/2413-3221/2018/v46n2a484

Jaiswal, S. P., Bhadoria, V. S., Agrawal, A., & Ahuja, H. (2019). Internet Of Things (Iot) For Smart Agriculture And Farming In Developing Nations. *International Journal of Scientific and Technology Research*, *8*(12), 1049–1056. https://www.ijstr.org/paper-references.php?ref=IJSTR-1019-23732

Köhler, J., Geels, F. W., Kern, F., Markard, J., Wieczorek, A., Alkemade, F., Avelino, F., Bergek, A., Boons, F., Fünfschilling, L., Hess, D., Holtz, G., Hyysalo, S., Jenkins, K., Kivimaa, P., Martiskainen, M., McMeekin, A., Mühlemeier, M. S., Nykvist, B., . . . Wells, P. (2019). An agenda for sustainability transitions research: State of the art and future directions. *Environmental Innovation and Societal Transitions*, *31*, 1–32. https://doi.org/10.1016/j.eist.2019.01.004

Koppmair, S., Kassie, M., & Qaim, M. (2016). Farm production, market access and dietary diversity in Malawi. *Public Health Nutrition*, *20*(2), 325–335. https://doi.org/10.1017/s1368980016002135

Lal, R. (2020). Regenerative agriculture for food and climate. *Journal of Soil and Water Conservation*, *75*(5), 123A-124A. https://doi.org/10.2489/jswc.2020.0620a

Liu, Y., & Wang, Y. (2019). Rural land engineering and poverty alleviation: Lessons from typical regions in China. *Journal of Geographical Sciences/Journal of Geographical Sciences*, *29*(5), 643–657. https://doi.org/10.1007/s11442-019-1619-9

Luo, Y., Long, X., Wu, C., & Zhang, J. (2017). Decoupling CO2 emissions from economic growth in agricultural sector across 30 Chinese provinces from 1997 to 2014. *Journal of Cleaner Production*, *159*, 220–228. https://doi.org/10.1016/j.jclepro.2017.05.076

McGuirt, J. T., Pitts, S. B. J., Hanson, K. L., DeMarco, M., Seguin, R. A., Kolodinsky, J., Becot, F., & Ammerman, A. S. (2018). A modified choice experiment to examine willingness to participate in a Community Supported Agriculture (CSA) programme among low-income parents. *Renewable Agriculture and Food Systems*, *35*(2), 140–157. https://doi.org/10.1017/s1742170518000364

Muller, A., Schader, C., Scialabba, N. E. H., Brüggemann, J., Isensee, A., Erb, K. H., Smith, P., Klocke, P., Leiber, F., Stolze, M., & Niggli, U. (2017). Strategies for feeding the world more sustainably with organic agriculture. *Nature Communications*, *8*(1). https://doi.org/10.1038/s41467-017-01410-w

Nkang, N. M. (2018). Oil Price Shocks, Agriculture and Household Welfare in Nigeria: Results From an Economy-Wide Model. European Scientific Journal ESJ, 14(31), 158. https://doi.org/10.19044/esj.2018.v14n31p158

Nwite, S. C., C, N. N., Onwe, B. U., J, U. O., & Ogiji, F. O. (2019). Effect of Fiscal Policy on the Real Sector of the Nigerian Economy: A Focus on Government

Capital Expenditure and Agricultural Sector Contribution to GDP. *Journal of Economics and Business*, *2*(3). https://doi.org/10.31014/aior.1992.02.03.133

Obayelu, A. E., Obayelu, O. A., & Tolorunju, E. T. (2020). Rural–Urban Labor Migration and Youth Employment: Investigating the Relevance of Nigeria's Agricultural Sector in Employment Generation. In *Springer eBooks* (pp. 341–365). https://doi.org/10.1007/978-3-030-41513-6_16

Ogbanje, E. C., & Salami, A. O. (2022). Impact of Foreign Direct Investment on Nigeria's Agricultural Sector (1981 to 2019). *International Journal of Environment Agriculture and Biotechnology*, *7*(4), 161–171. https://doi.org/10.22161/ijeab.74.18

Ojeyinka, T. A., & Adegboye, A. A. (2017). Trade liberalization and economic performance in Nigeria: Evidence from agricultural and manufacturing sectors. AFRICAN JOURNAL OF ECONOMIC REVIEW, 5(3), 1–14. https://africaneditors.org/journal/AJER/full-text-pdf/32893-25147

Olaniyi, E. (2017). Back to the Land: The Impact of Financial Inclusion on Agriculture in Nigeria. *Iranian Economic Review*, *21*(4), 885–903. https://doi.org/10.22059/ier.2017.64086

Olomu, M. O., Ekperiware, M. C., & Akinlo, T. (2020). Agricultural sector value chain and government policy in Nigeria: issues, challenges and prospects. *African Journal of Economic and Management Studies*, *11*(3), 525–538. https://doi.org/10.1108/ajems-03-2019-0103

OnyekaEzealaji, N. L. (2019). Infrastructure for Agricultural & Rural Development in Sub Saharan Africa: Need for a Comprehensive programme and Adequate Investment. *Journal of Scientific Research and Reports*, 1–8. https://doi.org/10.9734/jsrr/2019/v23i330120

Ortiz-Bobea, A., Ault, T. R., Carrillo, C. M., Chambers, R. G., & Lobell, D. B. (2021). Anthropogenic climate change has slowed global agricultural productivity growth. *Nature Climate Change*, *11*(4), 306–312. https://doi.org/10.1038/s41558-021-01000-1

Osabohien, R., Osabuohien, E., & Urhie, E. (2018). Food Security, Institutional Framework and Technology: Examining the Nexus in Nigeria Using ARDL Approach. *Current Nutrition & Food Science*, *14*(2), 154–163. https://doi.org/10.2174/1573401313666170525133853

Osabohien, R., Osuagwu, E., Osabuohien, E., Ekhator-Mobayode, U. E., Matthew, O., & Gershon, O. (2020). Household access to agricultural credit and agricultural production in Nigeria: A propensity score matching model. *South African Journal of Economic and Management Sciences*, *23*(1). https://doi.org/10.4102/sajems.v23i1.2688

Osuagwu, E. S. (2020). Empirical Evidence of a Long-Run Relationship Between Agriculture and Manufacturing Industry Output in Nigeria. SAGE Open, 10(1), 215824401989904. https://doi.org/10.1177/2158244019899045

Paul, E. A. (2016). The nature and dynamics of soil organic matter: Plant inputs, microbial transformations, and organic matter stabilization. *Soil Biology and Biochemistry/Soil Biology & Biochemistry*, *98*, 109–126. https://doi.org/10.1016/j.soilbio.2016.04.001

Pawlak, K., & Kołodziejczak, M. (2020). The Role of Agriculture in Ensuring Food Security in Developing Countries: Considerations in the Context of the Problem of Sustainable Food Production. *Sustainability*, *12*(13), 5488. https://doi.org/10.3390/su12135488

Plumecocq, G., Debril, T., Duru, M., Magrini, M. B., Sarthou, J. P., & Therond, O. (2018). The plurality of values in sustainable agriculture models: diverse lock-in and coevolution patterns. *Ecology and Society*, *23*(1). https://doi.org/10.5751/es-09881-230121

Quagrainie, K. K., Flores, R. M. V., Kim, H. J., & McClain, V. (2017). Economic analysis of aquaponics and hydroponics production in the U.S. Midwest. *Journal of Applied Aquaculture*, *30*(1), 1–14. https://doi.org/10.1080/10454438.2017.1414009

Rajeswari, S., Suthendran, K., & Rajakumar, K. (2017). *A smart agricultural model by integrating IoT, mobile and cloud-based big data analytics*. https://doi.org/10.1109/i2c2.2017.8321902

Samberg, L. H., Gerber, J. S., Ramankutty, N., Herrero, M., & West, P. C. (2016). Subnational distribution of average farm size and smallholder contributions to global food production. *Environmental Research Letters*, *11*(12), 124010. https://doi.org/10.1088/1748-9326/11/12/124010

Sane, M., Hajek, M., Phiri, J., Babangida, J. S., & Nwaogu, C. (2022). Application of Decoupling Approach to Evaluate Electricity Consumption, Agriculture, GDP, Crude Oil Production, and CO2 Emission Nexus in Support of Economic Instrument in Nigeria. *Sustainability*, *14*(6), 3226. https://doi.org/10.3390/su14063226

Sarker, T. C., Incerti, G., Spaccini, R., Piccolo, A., Mazzoleni, S., & Bonanomi, G. (2018). Linking organic matter chemistry with soil aggregate stability: Insight from 13C NMR spectroscopy. *Soil Biology and Biochemistry/Soil Biology & Biochemistry*, *117*, 175–184. https://doi.org/10.1016/j.soilbio.2017.11.011

Sertoglu, K., Ugural, S., & Bekun, F. V. (2017). The Contribution of Agricultural Sector on Economic Growth of Nigeria. *International Journal of Economics and Financial Issues*, *7*(1), 547–552. https://www.econjournals.com/index.php/ijefi/article/download/3941/pdf

Shikur, Z. H. (2020). Agricultural policies, agricultural production and rural households' welfare in Ethiopia. *Journal of Economic Structures*, *9*(1). https://doi.org/10.1186/s40008-020-00228-y

Sinha, J. K. (2019). Influence of technologies on the growth rate of GDP from agriculture: A case study of sustaining economic growth of the agriculture sector in Bihar. Statistical Journal of the IAOS, 35(2), 277–287. https://doi.org/10.3233/sji-180436

Smart Agriculture for Developing Nations. (2023). In *Advanced technologies and societal change*. https://doi.org/10.1007/978-981-19-8738-0

Tang, H., Liu, Y., & Huang, G. (2019). Current Status and Development Strategy for Community-Supported Agriculture (CSA) in China. *Sustainability*, *11*(11), 3008. https://doi.org/10.3390/su11113008

Thornton, P. K., Jones, P. G., Alagarswamy, G., Andresen, J., & Herrero, M. (2010). Adapting to climate change: Agricultural system and household impacts in East Africa. *Agricultural Systems*, *103*(2), 73–82. https://doi.org/10.1016/j.agsy.2009.09.003

Tuck, S. L., Winqvist, C., Mota, F., Ahnström, J., Turnbull, L. A., & Bengtsson, J. (2014). Land-use intensity and the effects of organic farming on biodiversity: a hierarchical meta-analysis. *Journal of Applied Ecology*, *51*(3), 746–755. https://doi.org/10.1111/1365-2664.12219

Verdier-Chouchane, A., & Boly, A. (2017). Introduction: Challenges to Africa's Agricultural Transformation. *African Development Review*, *29*(S2), 75–77. https://doi.org/10.1111/1467-8268.12272

Wang, Q., Zhao, M., & Li, R. (2019). Decoupling sectoral economic output from carbon emissions on city level: A comparative study of Beijing and Shanghai, China. *Journal of Cleaner Production*, *209*, 126–133. https://doi.org/10.1016/j.jclepro.2018.10.188

White, C. (2020). Why Regenerative Agriculture? *American Journal of Economics and Sociology*, *79*(3), 799–812. https://doi.org/10.1111/ajes.12334

Yusuff, M., Afolayan, O., & Adamu, A. (2016). Analysis of Foreign Direct Investment on agricultural sector and its contribution to GDP in Nigeria. *Journal of Emerging Trends in Economics and Management Science*, *7*(2), 94–100. https://journals.co.za/content/sl_jetems/7/2/EJC190049

Zaman, S. B., Ishaq, M., & Niazi, M. A. (2021). Contribution of Agriculture Sector in Economic Growth of Pakistan: An Empirical Analysis. *Journal of Applied Economics and Business Studies*, *5*(2), 103–120. https://doi.org/10.34260/jaebs.527

Zhang, Q., Qu, Y., & Zhan, L. (2023). Great transition and new pattern: Agriculture and rural area green development and its coordinated relationship with economic growth in China. Journal of Environmental Management, 344, 118563. https://doi.org/10.1016/j.jenvman.2023.118563

Zhou, Y., Guo, L., & Liu, Y. (2019). Land consolidation boosting poverty alleviation in China: Theory and practice. *Land Use Policy*, *82*, 339–348. https://doi.org/10.1016/j.landusepol.2018.12.024