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NAPReJ is a prime, peer-reviewed, journal of agricultural policy and rural development established for professionals whose research interests are in Sub-Saharan African agriculture. The journal was launched in 2016 by the Agricultural Policy Research Network, *APRNet*, with support from International Food Policy Research Institute, *IFPRI*. This journal is in line with one of the cardinal tasks of APRNet; which includes, but not limited to, research communication and to serve as a network that will engage professionals in conducting quality peer review of agricultural research outputs in Sub-Sahara Africa. It is primarily focused on agricultural and rural development issues, economic policies, livelihood and environmental studies (including climate change and clean energy issues as they relate to sustainable agricultural development), agricultural policy research, analysis and advocacy, science, technology and innovations (STI), social advancement of knowledge via a trans-disciplinary approach that includes, but not restricted to, agricultural sciences, social works, social sciences, environmental sciences, agribusiness and agricultural/development economics. It accepts full length original research articles, short communications and reviews.

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FROM THE EDITORIAL DESK

The Agricultural Policy Research Network (APRNet), publishers of Nigerian Agricultural Policy Research Journal (NAPReJ) and its editorial crew bring its readers special greetings as they launch the journal's first ever *Special Issue* in this edition. This issue is derived from the presentations of transdisciplinary scholars who made policy research inputs and had their research papers reviewed successfully after the epic host of the 1st Annual International Conference and The 7th Agricultural Policy Stakeholders' Forum of the Agricultural Policy Research Network (APRNet) at the Hotel Benizia, Asaba, Delta State, Nigeria from 1st to 4th June, 2022. The joint event was supported by the Job & Wealth Creation Office, Delta State, *Feed The Future* and its Committee of Party to the Nigeria Agriculture Policy Activity (NAPA) - USAID/Michigan State University/IFPRI and PILAF-Nigeria. The event brought together a total of 178 participants from across the world and 51 papers were presented at the parallel sessions. The categories of participants includes members of academia and scientific community, APRNet, Civil Society Organizations, Government Sector (State including Job and Wealth Creation Bureau, Delta State Ministry of Agriculture, Federal Ministry of Agriculture and Rural Development), APRNet Members, International donor community, Farmer organizations, Mainstream media, Agro-entrepreneurs, Civil society organizations and other non-State actors. The occasion, which was declared opened by Nigeria Honourable Minister for Agriculture and Rural Development (FMARD) ended with a communiqué which has been duly disseminated to a wider policy making audience in Nigeria and beyond. The event was motivated by the agrifood systems value chain in Sub Sahara Africa and Nigeria in particular. The sources of the shocks emanate from the Covid-19 pandemic, climate change (flood and extreme weather events), Russian-Ukraine war alongside pockets of violent conflicts in other African countries, volatility in global food prices jeopardizing the attainments of the SDGs 2030 especially, eliminating Poverty (SDG 1), Zero Hunger (SDG 2), creating safe and decent jobs (SDG 8) taking climate action (SDG 13) by 2030 in order to transform the agrifood system to become more efficient, inclusive, resilient, and sustainable systems (in Nigeria and SSA) by 2030. The research papers selected for publications in this special issue all did justice to this important theme respectively and especially to the theme of the year's conference titled**: *Towards a Resilient and Sustainable Agri-Food System by 2025 in Nigeria and Sub-Saharan Africa.*** You are hereby encouraged to read every article in this Special Issue and see how, together, we can build the *Africa that we want* and a world free of hunger and poverty by 2050. Enjoy your reading.

Pius Chinwuba Ike (PhD)
Vice President, APRNet and Managing Editor, NAPReJ

Special Appreciation

The production and publication of this *Special Issue* of Nigerian Agricultural Policy Research Journal (NAPReJ) was done with funding support from Delta State Job and Wealth Creation Bureau which also cosponsored the 1st Annual International Conference and The 7th Agricultural Policy Stakeholders' Forum of the Agricultural Policy Research Network (APRNet) which held at the Hotel Benizia, Asaba, Delta State, Nigeria from 1st to 4th June, 2022.

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GUEST ARTICLE

Youth Employment and Wealth Creation through Agricultural Entrepreneurship: The Delta State Model as Evidential Case for Paradigm Shift

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ABSTRACT

This paper demonstrates with live evidence from Delta State, Nigeria, that conventional theorems indicating youths are not interested in agricultural occupation is yielding to the paradigm shift towards youth agricultural entrepreneurship models underpinned by key enablers and drivers. The paper gives extensive review of anecdotal literature and empirical research about the necessity, relevance, approaches and potential impacts of mainstreaming and targeting youths in agricultural policy and programme design. The paradigm shift is corroborated by field evidence from the Delta State Youth Agricultural Entrepreneurship Programme (YAGEP) which gives empirical proof of critical enablers and drivers of youth agricultural entrepreneurship. An array of factors comprising holistic training, branding and mentoring, start-up support, sustainable cost-subsidized access to technologies, inputs, finance and information in tandem with market guarantee and risk mitigation work to ensure the survival, profitability and sustainability of the agricultural enterprise. By its successes, lessons and insights, YAGEP typifiesa role model in the deployment of youth agricultural entrepreneurship for curbing youth unemployment, developing the agricultural value chain and promoting economic diversification.

1.0 INTRODUCTION

Agriculture and agribusiness constitute huge opportunities for profitable youth employment, economic diversification and inclusive growth in Nigeria. However, youth participation in the Nigeria's agricultural value chain is much below potential, like many countries in Sub-Saharan African (Yeboah and Jayne, 2016). Meanwhile, Nigeria's agricultural population, particularly the farming segment of the value chain, whose average age is estimated at 60 years, is ageing at a faster rate relative to the rate of youth entry (Adesugba and Mavrotas, 2016).Insufficient youth participation in agriculture implies that the agricultural economy misses thetransforming impacts of perhaps the most energetic, most productive, most innovative, most entrepreneurial and most physically and mentally vibrant segment of a country's labour force (Naamwintome and Bagson, 2013).

In Nigeria, the problem of low youth participation in agricultural labour is clearly evident. One study put the pooled national estimate at 27.1% and ranging from 17.8% in Southern Nigeria to 36.5% in Northern Nigeria (Ameyawand Maiga, 2015). This situation is clearly ironic considering that Nigeria is endowed with large youth population, estimated at 60% of the country's population and youth (15-34 years) labour force accounts for 51% of the country's labour force.

Given this scenario, Nigeria is confronted with a development paradox that despite the tremendous employment opportunities in agriculture and agribusiness, unemployment rate among youth (15-34 years) is estimated at 34.9%, accounting for 61% of total unemployment in the country (NBS, 2020). With an additional youth underemployment rate estimated at 28.2%, the total number of Nigerian youths that are either unemployed or underemployed as at 2nd Quarter of 2020 is estimated at 25,277,736, more than the populations of Senegal and Sierra Leone combined.

The paradoxical coexistence of humongous but untapped agricultural employment opportunities alongside mounting youth unemployment signifies a real national development dilemma. Underlying this dilemma is the two-pronged policy challenge. One side of the policy challenge is to use youth entrepreneurship energies to modernize, transform and develop the agricultural value chain. The other side is to use the agricultural value chain as a strategic economic platform for growing youth entrepreneurship for food security, job creation and inclusive growth.

2.0 A REVIEW OF THE LITERATURE

Conceptual literature on entrepreneurship is dominated by the descriptive approach, rather than definitional. From the descriptive perspective, entrepreneurship is conceptualized in terms of aptitude (skills), attitude (behaviour) and action-ability (capability) of a person. While the 'skills' element refers to ability to start and run an enterprise

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profitably, attitude infers being innovative, creative, competitive, risk-taker, proactive in seeking, finding and utilizing economic opportunities.

Youth is a socio-demographic concept, basically defined in terms of age. However, the age classification of youth varies across climes and contexts. The African Youth Charter 2006 defines youth as people between the ages of 15-35 years while Nigeria's 2009 National Youth Policy defines youth as persons aged 18 to 35 years. However, the National Youth Policy 2019-2023 defines youth as persons between the ages of 15 to 29. The definition of youth has a social dimension which alludes to distinctive youth attributes, peculiarities, developmental needs and opportunities for economic participation (MYSD, 2019). In this regard, National Youth Policy 2019-2023 adopts strategic thrusts and thematic priorities which include sustainable economicengagement of youths, employment creation through youth entrepreneurship, youth involvement in agriculture for national food security and economic diversification as well as the use of information and communication technologies (ICTs)for youth creativity, productive innovation and job creation (MYSD, 2019).

In recent years, the mounting necessity to curb youth unemployment through the agricultural economy has elicited increased debate on and research attention to the factors that influence youth participation in agriculture and agribusiness. On the one hand, there is the traditional notion that agriculture is innately unattractive and unrewarding to youths, that is, youths do not like agriculture and are not interested in farming. On the other hand, modernist models of youth employment posit that interest and participation of youths in agriculture and agribusiness can be cultivated through deliberately targeted and tailored policies and programmes underpinned by "enablers and drivers" of youth employment along the agricultural value chain.

In the literature, 'enablers' imply production infrastructure, technology and facilities that enhance the economic competitiveness, productivity and profitability of agriculture and agribusiness. In a similar vein, 'drivers' include policy framework, programme model, organizational approach, institutional services (such as finance, training, mentorship, access to production inputs, market linkage) and elements of the agribusiness environment which together provide a conducive setting for profitable and sustainable youth participation in agriculture.

Several literatures on youth involvement in agricultural value chain give similar narratives of the interplay and potency of these enablers and drivers. Based on project experience in Senegal, IYF (2014) identifies best practices for promoting youth agricultural entrepreneurship. They include holistic approach to training (life skills together with agricultural skills and entrepreneurial skills), networking, linkages, innovation labs and mentorship, value chain approach to interventions that elicit both farm and off-farm business opportunities, access to financing and capital, access to market and an integrated package of support that fits youth populations and local contexts. Foodtank (2014) observes that greater policy attention to economic, social and institutional factors that deter youths from agriculture is critical to reversing the trend. Ogunsanmi (2014) reports the experiential insights and lessons from youth-focused agricultural programming by 2SCALEin Benin, Ethiopia, Ghana, Ivory Coast, Kenya, Mali, Mozambique, Nigeria and Uganda. The key lessons include (i) the fundamental need to tackle structural constraints - infrastructural, institutional and technological (ii) the significance of modernizing, professionalizing and dignifying agricultural and agribusiness activities and (iii) deploying youth agricultural entrepreneurship for service delivery and gap-filling along the value chain.

Based on insights and perceptions from a qualitative survey about what works best for supporting youth entrepreneurship, CAD (2018) underscores the importance of programme elements including beneficiary profiling for proper selection and targeting, training modules that incorporate life skills, entrepreneurship and business skills and access to financial and investment support. Others are access to markets, networking and links to the local business environment, service delivery feedback for organizational learning and continuous programme adaptation as well as monitoring, mentoring and aftercare services.Fox and Filmer (2014) criticizes the "myth" that agriculture offers no hope for youth, stressing that despite current low levels of productivity and earnings, Africa agriculture offers economic and business opportunities for young people. With the right policies and measures that guarantee access to land, inputs, know-how, markets and finance, youth entrepreneurship can bring about agriculture renaissance.

From a case study of the nexus of youth, information & communication technology (ICT) and agriculture, Brand and Galdava (2019) deduces that youth populations possess the entrepreneurial drive, innovative energies and greater disposition to master and apply new technologies to agriculture to increase productivity, profitability and viability. ICTs, such as mobile phones, internet and communications platforms like television and radio, can be deployed for reducing traditional drudgery of agriculture activities, instructing the right choice of enterprises and production

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practices, tracking and responding to weather conditions, giving timely and beneficial access to markets, enhancing productivity and profitability - all of which contribute to making agriculture more attractive and desirable to youths.

An analysis of current literature (for example, Cassinath and Mercer, 2016; Weidinger, Mwaura and Quaye, 2015; Ssendiwala and Nzioki, 2015) on public policy intervention models for promoting youth involvement along the agricultural value chains reveals that governments often use one or a combination of three programme approaches or designs. 1. Deliberate mainstreaming of youth in general agricultural programmes, meaning setting minimum levels of consideration, for example, quota for youth participation to practically embed youth as a crosscutting element in programme design 2. Agricultural programmes that are neutral or blind to youth participation, that is, youth involvement is not specifically distinguished or embedded in the programme design, rather all conditions, benefits and services generally apply regardless of the demographics of participant. 3.Youth-targeted or youth-centric agricultural programme models which are consciously and strategically structured, adapted and responsive to the participation preferences, needs, peculiarities, constraints and opportunities of youth.

In a case study of the opportunities for youth in agriculture value chain activities based on programme experiences in four countries – Liberia, Uganda, Nepal and Guatemala (Cassinath and Mercer, 2016), several success factors, desirable pathways, empirical challenges and mitigatory measureswere identified. One key message is the necessity for a multi-layer strategy or mixed portfolio that synergistically combines elements of youth-mainstreaming and youth-targeted policy/programme models. While youth-focused agricultural programming may be desirable, its impact would be negligible unless it issituated within the broader context of a competitive agricultural economy. Hence, the development of more competitive, inclusiveand resilient market systems that can sustain demand, supportmore actors and absorb the youth bulge, and catalyse economic activity in a variety of interconnected systems that offer arange of opportunities for youth.

Likewise, notwithstanding the higher-level sector wide efforts, it remains important to undertake youth-targeted approaches/measures that facilitate market linkages, identify and harness mid-chain or off-farm opportunities for youth, create real pathways to profitable agricultural enterprise, promote economies of scale for youth in agriculture and engender climate-smart agriculture among youth. Another major lesson is the need for youth-focused programmes to clearly identify, practically demonstrate and operationalize value chain entry points for youth, such as on-farm services, farm tools production, construction of agricultural structures and sheds, post-harvest handling (aggregation), agro-processing, agro-dealership, extension and information services, transport, storage, market brokerage and retail services.

Underscoring this perspective, Weidinger, Youdeowei, Mwaura and Quaye, (2015) alludes to business opportunity spaces along the agricultural value chain including input supply, production, processing, storage, wholesale and retail, as well as consumption, as well as support services such as transport, brokering, and service processing. In this regard, agribusiness opportunities for youth entrepreneurship along the agricultural value chain is distinguishable into three aspects. One, upgrading value chains, which involves moving value chains in a different direction, such as towards new customers, adding operations, using better technologies, increasing efficiency. Two, deepening the value chains by addressing unmet market demands or seeking opportunities for vertical and horizontal integration, greater specialization and expansion of services. Three, expanding the value chains, which involve the growth of national and regional trade in agrifood products for the urban retail and supermarket chains, establishing joint ventures that share risk and investing in commodity exchanges. Regardless of the entry point along the value chain, the underlying factor that for entrepreneurship to bring about economic independence and sustainable youth employment, it must generate sufficient income in the present and show progression of income growth into the future (Brooks, Zorya, Gautamand Goyal, 2013).

Country case studies reported in Cassinath and Mercer (2016) also commonly instruct that it pays for programme models to adopt deliberate approaches and measures that make business enterprises and employment along agricultural value chain profitable, appealing and attractive to youth, thereby changing the cynical mindsets of youth towards agriculture. Such youth-friendly factors include tailored agricultural skills training and experiential learning, better technologies, better and more efficient inputs and tools, appropriate mechanization, management of agricultural risks, enterprise mixes and modern agricultural practices which together combine to enhance enterprise productivity, income stability, economic security and sustainability of business growth. These outcomes will collectively erode the negative social image, unpleasant technological anecdote and adverse occupational stereotypes traditionally associated with youth involvement in agriculture.

In addition to anecdotal literature and qualitative research which substantiate the thesis of ‘enablers-cum-drivers’ of youth participation and entrepreneurship in agricultural value chains, several quantitative research and agricultural

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surveys have reached similar conclusions. In particular, empirical research give quantitative estimates of the joint and relative effects of social, institutional, economic and technological factors on youth participation in agriculture. The factors that influence youth participation in agricultural value chains are many, interrelated and interspersed in multiple agricultural research and surveys across developing countries. The more significant factors are the nature and adequacy of training, knowledge, technology, market access and agricultural extension (Thomas and Eforuoku, 2014; Sakiluzzaman, Sarker, Rahman, Hasan, Lei and Mukta, 2018; Adeyanju, Mburu and Mignouna, 2020) and access to land, inputs and finance (Kimaro, Towo and Moshi,2015). Others are education, personality traits, perception about and attitude towards agricultural occupation (Okoche, Age and Alegwu, 2012; Kimaro, Towo and Moshi,2015; Sakiluzzaman, Sarker, Rahman, Hasan, Lei and Mukta, 2018; Twumasi, Jiang and Acheampong,2019) as well as costs, risks, profit and drudgery (Suhana, Sivapalan, Mohd, Nur and Nur, 2016).

3.0 THE METHODOLOGY

3.1 The Agro-Ecological and Socio-Economic Setting

Delta State lies within longitudes 50 00'E and 60 45'E and latitudes 50 00'N and 60 30'N. This location is in the oil-rich Niger Delta region of Nigeria, which endows the state as contributing about 35-40% of Nigeria's oil and gas output. It has an estimated land area of 18,050 square kilometres with an Atlantic Ocean coastline of about 163 kilometres in the south. Corresponding to the estimated annual rainfall of 1,910 mm in the northern area to 2,670 mm in the southern area, the vegetation ranges from mainly mangrove swamp in the southern coastal area to mostly rain forest in the central part and a mix of secondary forest and derived savanna in the northern part (DS-MEP, 2010; DS-MEP, 2016).

Like other states in Nigeria, Delta State enjoys a demographic dividend of large youth population [persons aged 15-39 years total 2,599,200 which is 43% of the 2020 population estimated at 6,050,117. The estimated 2020 labour force [20-59 years] is 2,736,861 out of which youth population aged 20-39 years is 1,905,728, that is, 69% (DS-MEP, 2021). The Labour Force Survey - Unemployment and Underemployment Report Q 2020 - published by National Bureau of Statistics (NBS) in March 2021 gives the national unemployment and underemployment rates as 33.3% and 22.8% respectively (NBS, 2021). Specifically, the same survey reported that Delta State had unemployment and underemployment rates of 31.14% and 24.01% respectively.

While the state's oil and gas resources account for the bulk of statutory revenues, the employment and livelihoods of the people are derived mainly from agriculture and informal sector (trade and services). As at 2020, estimated Gross Domestic Product [GDP] of Delta State was estimated at ₦4.43 trillion [about USD 12.3 billion], making it the 3rd largest state economy in Nigeria, after Lagos and Rivers States. Furthermore, the GDP per capita was estimated at ₦731,396.09 (USD2,041.24) in 2020 (DS-MEP, 2020).

The state's economy is composed of oil sector 47.54% and non-oil sector 52.46%. Disaggregated 2019 GDP analysis also shows that, overall, natural minerals subsector (crude oil, natural gas, mining and quarrying) contributes 47.54%, followed by services 34.22%, agriculture 13.22% and manufacturing 5.02% (DS-MEP, 2020). In nominal value, the state's agricultural sector is estimated at ₦584.333 billion, comprising crop production 79%, livestock 10%, fish production 8% and forestry 3% (DS-MEP, 2020). The range of agroecological and natural resource conditions bestow comparative advantages in the production of crops including cassava, yam,rice, oil palm, tomato/vegetables, sweet potato and okra. Other major agricultural commodities include aquaculture and livestock (poultry and piggery).

3.2 The Study Approach

The study approach involves analysis and interpretation of field evidence as factual basis to support the hypothesis about enablers and drivers of youth participation in agriculture, in other words, to refute the traditional notion that youth are not interested in or attracted to agriculture. The evidence consists of data and statistics from the ongoing implementation of Youth Agricultural Entrepreneurship Programme (YAGEP) in Delta State, Nigeria. YAGEP was established by the Delta State Government in June 2015 as an integral component of overall strategy to solve youth unemployment, modernize agriculture, diversify the economy and promote inclusive growth through youth agricultural entrepreneurship.

3.3 Exploratory Survey of Youth Employment in Agriculture

A background assessment was carried out to characterize the features and patterns of youth employment in the state. The aim was to find out the characteristics, preferences, circumstances and challenges of youth owners of agricultural enterprises, towards clear understanding of youth employment in agriculture. The assessment is based on a 2019 survey of youth agricultural entrepreneurs across the 25 local government areas, selected through gender-stratified

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random sampling of registered youth agricultural entrepreneurs in each local government area. In all, one thousand three hundred and seven (1,307) youth agricultural entrepreneurs were interviewed. The survey instrument sought personal and agribusiness information including biodata, educational qualification, type of agricultural enterprise, location of agricultural enterprise, size of agricultural enterprise, age of agricultural enterprise, condition of agricultural enterprise. Other information elicited are problems and challenges facing the agricultural enterprise, critical intervention needs regarding training and enterprise support.

4.0 FINDINGS, EVIDENCEAND INSIGHTS

4.1 Background Assessment of Youth Agriculture in Delta State

The exploratory survey shows that youth entrepreneurship in agriculture is dominated by age 31-40 years (51%), followed by age 21-30 years (34.7%). Youth with educational level - West African School Certificate – constitute the largest single majority (46.0%), followed by Bachelor's Degree or HND (27.3%). Male youth agricultural entrepreneurs constitute 66.5% while female youth constitute 33.5%.The agricultural enterprises owned and operated by the youths include fish farming 29.9%, followed by poultry 22.7%, cassava farming 16.1%, plantain cultivation 5.5% and piggery 5.2%.Moreover, other youths own and operate different combinations of separate or co-located crop-crop, crop-livestock and livestock-livestock enterprises such as cassava/yam/maize, cassava/vegetables, oil palm/cassava, fish farming/fish processing, fish farming/snailery, fish farming/vegetables and poultry/cassava.

The challenges expressed by youth agricultural entrepreneurs include high and rising cost of farm inputs particularly fertilizer, poultry and fish feeds coupled with unreliable quality of purchased farm inputs including fertilizer, poultry and fish feeds. Other major challenges identified include weak links to the market, lack of access to suitable land for crop farming, poor information-cum-training on better production techniques and practices, lack of post-harvest processing and storage infrastructure (e.g., poultry and fish processing/preservation stations), natural events, particularly flooding of fish and rice farms coupled with lack of insurance cover against production risks. On the other hand, youth agricultural entrepreneurs were found as very weak in farm business planning and in keeping farm records and accounts coupled with generally low farm business discipline.

4.2 Programme Design and Implementation

4.2.1 Design Elements

The design of Youth Agricultural Entrepreneurs Programme (YAGEP) is instructed by the preceding situation assessment (SWOT Analysis) and clear understanding of youth participation in agriculture in Delta State. The programme aims to reduce youth unemployment through youth agricultural training and entrepreneurship. The strategy involves developing a critical mass of skilled and business-minded youth entrepreneurs actively generating economic goods and services to reap profits along the agricultural value chain on a sustainable basis. The YAGEP approach is to mobilize, reorientate, train, equip, start-up, mentor and support youths in their choice agricultural enterprises.

Under YAGEP, unemployed youths aged 18-35 years are trained and started up in their chosen agricultural enterprises, including poultry, piggery, fishery, crop production, agro-processing and agribusiness. There are two categories of YAGEP participants: Green YAGEP and Brown YAGEP. Green YAGEP include YAGEP candidates who are freshers/newcomers to agricultural skills and need to be trained from afresh and thereafter provided with starter packs to set up and run own enterprises. Brown-support YAGEP include YAGEP candidates who already own and operate their agricultural enterprises but need support packages to become viable, survive and scale up.

After rigorous planning and design, YAGEP was started in August 2015. The design can be simplified into three main sequential components, namely, all-round training, enterprise start-up support and post start-up support. The process flow of the programme is illustrated as follows:

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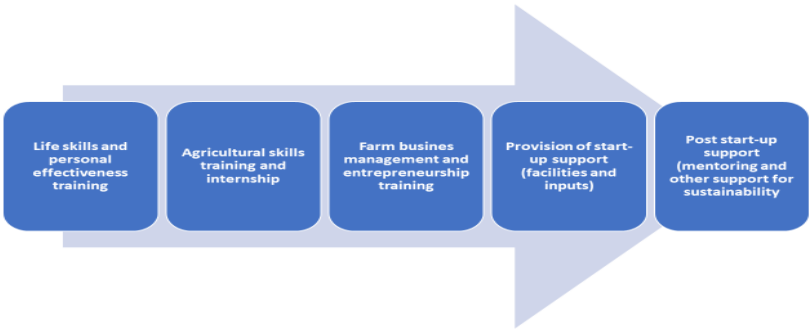

Figure 1. YAGEP Process Flow

Life skills and personal effectiveness training: This is the beginning phase of the training cycle. The objects of the training are mindset reorientation, character-building and self-actualization. The training involves on-boarding orientation and impartation of the right mindset from job-seeking towards self-employment. The training lasts one week and covers topics such as personal management, critical success drivers, interpersonal relations, personal visioning and self-planning, leadership virtues, self-discipline, motivation and confidence, self-discovery and actualization. Other topics are effective management of time, effort and resources, teamwork and partnering, problem solving, peer networking, personal attitudes to risks and uncertainties, identifying opportunities, managing successes and coping with failures.

Agricultural skills training (instruction and field-based): This training phase involves the deployment of participants to class instruction in preferred agricultural skills (including crops, livestock and aquaculture, agro-processing). The class instruction is followed with practical skills transmission and field-based training in accredited live agricultural enterprises. The practical field-based training lasts 3-6 months, depending on the agricultural enterprise. During this period, participants are impacted real-life crop, livestock and fishery production skills and agricultural enterprise management knowledge.

Farm business management and entrepreneurship training: This final phase of training aims to inculcate farm business management and entrepreneurship skills and competencies to complement the agricultural skills. The training module covers a host of "how to" topics including how to translate acquired agricultural skills to a farm business enterprise, how to start an agricultural enterprise, how to prepare and use a business plan, how to finance the enterprise, how to grow the enterprise, how to market the product/service, how to communicate the product, how to cooperate/partner with business peers, how to manage the enterprise, how to cope with risks and business competition and how to keep, analyze and use farm records and financial accounts.

Provision of start-up support (facilities and inputs): Participants who successfully complete the three phases of training are provided start-up support to own and run an agricultural enterprise. Green YAGEP starter packs comprise critical start-up items, production inputs and farm management advisory, according to agricultural enterprise. Candidates for Green YAGEP must show proof of own or secured location for the agricultural enterprise. Trainees are wholly responsible for finding and securing suitable locations for their enterprise as well as have own supplies of water and energy. The location must be physically verified as suitable prior to providing the starter pack items. Brown YAGEP support packs comprise the critical production inputs and farm management advisory, according to agricultural enterprise. Candidates for Brown YAGEP must own and show the live farm enterprise for which support is needed. The live farm enterprise must be physically verified as owned by the candidate, prior to giving the support pack items.

Upon completion of training, participants are given critical support necessary and sufficient to enable successful take-off and growth of the agricultural enterprise. The support is entirely grant to the participant, in addition, income from the agricultural enterprise is owned and appropriated by the participant. Moreover, the participants are exposed and facilitated to access complementary resource augmentation opportunities. They include Central Bank of Nigeria (CBN)'s Agribusiness, Small and Medium Enterprises Investment Scheme (AGSMEIS), Anchor Borrowers' Programme (ABP) and Accelerated Agricultural Development Scheme (AADS) as well as Bank of Industry (BOI)'s Youth Entrepreneurship Support (YES) Programme and Graduate Entrepreneurship Fund (GEF).

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4.2.2 YAGEP Crop and Livestock Outputs

YAGEP agricultural outputs are estimated based on farm enterprise data generated through a combination of data collection methods, namely physical measurement of farm enterprise outputs and sample survey of programme beneficiaries.

Estimates show that, from 2015-2021, YAGEP beneficiaries have produced 2,298.47 Metric Tonnes (MT) of poultry, 72,280,767 eggs and 6,682.91MT of fish. In addition, the outputs include 2,342.24MT of pig, 3,084.40MT of cassava roots, 1,572.79MT of grains, 862.16MT of plantain and 2,235.66MT of vegetables namely tomatoes, watermelon and cucumber.

The breakdown of agricultural outputs under YAGEP is given as follows:

Table 1. Summary of agricultural outputs of YAGEP beneficiaries 2015-2021

PROGRAMME:	POULTRY ENTERPRISE		FISH PRODUCTION ENTERPRISE	PIG PRODUCTION ENTERPRISE	CROP PRODUCTION ENTERPRISE (MT)			
					Staples		Fruit	
CYCLE	Meat (MT)	Egg (Nos.)	(MT)	(PORK)	Cassava	Grains	(Plantain)	Vegetable
2015/2016	322.32	13,708,800	295.20	296.88	20.00	-	60.00	66.00
2016/2017	283.64	12,063,744	1,094.98	273.13	16.00	444.00	48.00	382.80
2017/2018	249.60	10,616,095	1,388.38	251.28	12.80	487.20	38.40	478.80
2018/2019	335.57	11,458,963	1,376.57	275.71	170.24	206.88	75.72	419.04
2019/2020	438.91	12,188,592	1,274.67	609.91	890.19	201.50	255.58	407.23
2020/2021	668.42	12,244,573	1,253.11	635.34	1,975.17	233.20	384.46	481.79
TOTAL	2,298.47	72,280,767.05	6,682.91	2,342.24	3,084.40	1,572.79	862.16	2,235.66

4.2.3 Further Evidence of YAGEP Impacts on the Agricultural Economy

Accelerated Growth of the Agricultural Sector: The Youth Agricultural Entrepreneurs Programme (YAGEP) and other agricultural sector interventions of the state government have had significant impact on the state economy. Data generated by National Bureau of Statistics (NBS) and published in August 2018 show that the state's agricultural sector grew at an accelerated rate from 2015-2017, compared to the period before 2015. It grew by annual average of 8.6% from 2013-2015 but accelerated to annual average of 13.3% from 2015-2017. This is clear evidence of incremental impacts of YAGEP, PPSP and other agricultural sector interventions of Governor Okowa, since 2015.

Transformation of the Agricultural Landscape: Specifically, the development of farm enterprise clusters, owned and managed by the youths, is transforming the state's agricultural landscape and having a demonstration effect on agricultural modernization. Currently, there are twenty (20) YAGEP farm enterprise clusters with varying combinations of enterprises including poultry, piggery, fishery, rice and tomato production. The cluster model of youth agricultural employment has restored previously idle agricultural resources to economic use and boosted agricultural productivity and wealth generation in the state.

Development of the Rice Value Chain: One distinctive landmark of YAGEP is the development of the rice value chain through youth agricultural entrepreneurship. The rice value chain initiative involves instructional and field-based training, farm enterprise incubation and establishment of youths through the entire process of rice production, processing, packaging, branding and marketing.

The YAGEP rice initiative started in 2017 with the cultivation of 74 hectares at Ugili-Amai, Ndokwa West Local Government Area. Subsequently in 2018, the initiative involved the cultivation of 42 hectares of rice at Deghele, Sapele Local Government Area and 54 hectares at Mbiri, IkaNorth East Local Government Area. During the 2018 production year, the process involved 48 youth trainees working under close tutorials, facilitation and guidance of the Office of the Chief Job Creation Officer through knowledgeable and experienced resource persons from within and outside the state.

The programme activities include soil tests and site selection, land preparation (clearing, ploughing and harrowing), seed treatment and planting, soil treatment, weeds prevention and control, fertilizer application, prevention and control of pests and diseases and birds scaring. Other operations include harvesting (cutting and packing), threshing, drying, winnowing, washing/parboiling, milling, destoning and packaging/bagging. The cultivation, harvesting, threshing, drying, parboiling, milling, destoning and bagging operations were carried out together with hands-on training and participation of the YAGEPreneurs. All the inputs, technologies and materials used in the rice

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production and processing and packaging operations were provided by the Office of the Chief Job Creation Officer. The YAGEP project on rice resulted in paddy production and processing into YAGEP milled rice (10kg pack).

4.3 Success Rates among YAGEP Beneficiaries: Results of Tracer Studies

The performance and impact of STEP & YAGEP have been assessed through tracer studies of beneficiaries. Tracer study is an Outcome Assessment Methodology which tracks programme beneficiaries in order to ascertain if they bear the results and outcomes anticipated by the programme.

Since inception in 2015, two consecutive tracer surveys have been carried out. The first was conducted by Office of the Chief Job Creation Officer with professional facilitation by experts at Lagos Business School/Pan Atlantic University, from 9-31 August 2018. The field verification covered a total of 2,242 beneficiaries from 2015/16-2016/17 plus Brown STEP 2017/18. The second tracer survey was conducted by Directorate of Youth Monitoring and Mentoring (DYMM) in conjunction with Office of the Chief Job Creation Officer, from 11-21 February 2020. It covered a total of beneficiaries from 2015/16 to 2018/19.

Results of the two consecutive tracer surveys, summarized in the table above, show that the success rates have generally improved over time. From 2015 to 2019, the beneficiary success rates have improved from 66% to 77% for YAGEP. The improvement in success rate is the outcome of cumulative programme reforms including beneficiary targeting, quality control in training content and methodologies and realignment of enterprise combinations.

Latest field verification of YAGEP farm enterprises, carried in from 2021-2022, using geographic positioning system (GPS)-based survey and digital mapping methodology show beneficiary retention rate of 70%. The decrease of retention rate from 77% in 2019 to 70% in 2021 is attributable to the economic shocks associated with the COVID-19 pandemic and related production challenges.

5.0 CRITICAL SUCCESS FACTORS: LESSONS AND INSIGHTS FROM YAGEP

The design, implementation and performance of YAGEP have revealed the critical success factors for effective and sustainable programming of youth agricultural entrepreneurship. Around the achievements, experiences and challenges in the implementation of YAGEP are interwoven enablers and drivers (must do's) that are fundamental to the sustainable participation of youths in agricultural entrepreneurship. They are as follows:

i. Admission of beneficiaries must be rigorously conducted to avoid wrongful selection leading to moral hazards. The selection process must be able to separate those genuinely interested from those who are pretending to be interested.

ii. Admitted youths must be trained and established in their preferred agricultural enterprises, not the enterprises pre-determined for them.

iii. There must be agricultural technologies and production systems to curtail drudgery and physical effort of agricultural operations so that agriculture can be more attractive to youths.

iv. Youth agriculturists must be subjected to adequate good-quality instructional training and hands-on practical exposure.

v. The establishment start-up support must incorporate unfettered secure access to suitable land coupled with appropriate land development and provision of crucial production infrastructure.

vi. The startup support must also incorporate access to adequate amounts of high-quality efficient production inputs in a timely manner.

vii. Cluster approach to establishment of youth agricultural enterprises, that is, co-location of youth agricultural entrepreneurs, can only be effective and sustainable if the enabling conditions are in place.

viii. Agricultural enterprises must be sufficiently profitable and viable in order to attract and retain youths in agriculture relative to other competing sectors.

ix. Youth participants must be subjected to high standards of programme discipline through admission-point signing on to applicable codes of conduct for participants and personal guarantees of individual participants by respective community and social leaders.

x. There must be continuous and sustained follow-through and mentoring of newly established youths in agriculture.

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xi. Youth agriculturists must be branded and promoted as entrepreneurs and business owners, in such a manner that is professionally dignifying and appealing.

xii. Youth agricultural enterprises should have adequate insurance cover in order to mitigate peculiar agricultural risks and inspire confidence in enterprise owners and agricultural lenders.

xiii. The design and implementation of youth agricultural entrepreneurship programmes must be underpinned by strong and unwavering political will to succeed. Real evidence of political will is to allow programme managers run the programmes in a professional manner.

6.0 CONCLUSION

This paper has argued, based on theoretical postulates and live empirical evidence, that entrepreneurial opportunities along the agricultural value chain can be attractive, dignifying, profitable and viable to youth if the conditions are both enabling and instrumental.

The conventional view that youth are not interested in agriculture or that agriculture is not attractive (dignifying) to youths is overtaken by insights from anecdotal experiences and research findings which together expound programme models, approaches and practices that work for youth employment along the agricultural value chains. The example provided by the success story of the YAGEP experiment, clearly demonstrates that, with the right mix of conditions, factors and processes, youth entrepreneurship along the agricultural value chains, is decisive in alleviating high and rising rates of youth unemployment in the country.

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Cassava Seed Entrepreneur Model: A Strategy for Youth Empowerment among Selected Value Chain Development Project (VCDP) States in Nigeria

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A R T I C L E I NFO

Key words:

Youth,

cassava,

stem,

entrepreneur,

seed,

empowerment

ABSTRACT

One hundred and twenty (120) randomly selected youths from Nine (9) states of Nigeria which include Anambra, Ebonyi, Enugu, Kogi, Nasarawa, Niger, Benue, Taraba and Ogun, under the Federal Government of Nigeria (FGN) and International Fund for Agricultural Development (IFAD) sponsored Value Chain Development Programme (VCDP) in collaboration with Building An Economically Sustainable and Integrated Cassava Seed System (BASICS 11 project)were on boarded into the Cassava Seed Entrepreneur programme and trained on good Agronomic Practices (GAP), enterprise development, marketing and business opportunities in the cassava seed system of Nigeria. Baseline information on the socioeconomic characteristics of the trainees, assessment of their cassava varietal preferences as well as the strengths, weaknesses, opportunities and threats to cassava seed entrepreneurship among the youths were obtained through the use of a well-structured questionnaire. Data generated were analyzed using descriptive statistics. Results obtained show that majority of the youths were males (over 60%), belonging to cooperative societies and well educated. Most of them preferred TME 419 variety and among the threats to a successful cassava seed entrepreneurship is the non-involvement of National Agricultural Seed Council. It is therefore recommended that the youths be more engaged in cassava seed business as a means of improving their livelihoods.

1.0 Introduction

Nigeria leads the world in cassava production (Olutosin and Sawicka, 2019), with about 59 million tonnes in 2017 (FAO, 2019), contributed up to 21.5% of Africa's cassava production (FAOSTAT, 2020). The desire to sustainably increase production, improve food security, while also providing nonfood products from cassava spurred many countries to explore innovative processes within their agricultural systems (Adeyemo *et al*, 2019).

Since its emergence in Africa in the 16th and 17th centuries, the crop has replaced several traditional staples and has been successfully incorporated into many farming and food systems in the continent. About 90% of this is however consumed as food in form of *gari*, l*afun* and *fufu* and also 70% of cassava produced in Nigeria is processed into gari (Onabalu, 1997). The potential of the crop is large because it offers the cheap source of food calories and the highest yield per unit area. It also has multiple roles as famine reserve, food and cash crop, industrial raw material and livestock feed (Ospira-Patino and Ezedinma, 2015). As a cash crop, cassava generates cash income for the largest number of households, in comparison with other staples, contributing positively to poverty alleviation (Obisesan, 2012 and Ezeibe, *et al.,* 2015).

However, Nigeria has not been producing cassava output that would be relatively enough for export simply due to a number of factors which include small scale farming (on plot that are usually less than 1 hectare), manual operation, little or no use of agro-chemicals and limited knowledge in the use of high yielding roots, disease and pest resistance, and environmentally friendly varieties (Olomola, 2007). Cassava stem is gradually becoming relevant in the agribusiness sector due to the rising need to plant

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improved varieties that are early maturing high yielding and disease resistant.

In Nigeria, the seed industry is rapidly developing especially for crops like cassava whose botanical seeds are not consumed or popularly used for planting. Private seed companies are now becoming interested in multiplication, distribution and marketing of cassava seed. With improved technology, cassava seed can now be multiplied within a very short period of time. Seeds are the foundation of agriculture and the most important input (Onunka *et al* 2016) in the production process of most crops especially root and tuber crops. Clean cassava seeds of high quality needed for planting are often in short supply.

Cassava stem production has been found to be a profitable venture but requires compromising the root yields by reducing the planting distance to as low as 1m x 0.5m inter and intra row spacing instead of the normal 1m x 1m spacing. By this arrangement, the plant population of about 20,000/ha is expected. This will translate to about 400-500 bundles of cassava stem at first ratoon depending on variety. The success of cassava seed multiplication and sales depends on the quality of planting material. Quality should actually separate the local and improved varieties. The criteria used in determining quality of planting materials of cassava are generally based on the threshold levels of infestation of diseases and pests.

Figure 1: Improved cassava seed multiplication farm

Improving access to quality seeds and transiting from subsistence to commercial production requires an integrated seed system, where certified cassava stems are available and accessible from formal (seed companies, NGOs and research institutes) and informal sources (Cassava Matters, 2017). However, government monopoly in the seed industry of Nigeria has caused undue delays in distributing approved planting materials to farmers. There is the need to establish a formal seed distribution system that will involve multi stakeholder participation in the cassava seed multiplication and distribution system.

The cassava seed entrepreneurship model emphasizes the production and distribution of certified cassava seed with the approval of National Agricultural Seed Council of Nigeria (NASC). Certified seed is the progeny of foundation seed and its production is supervised and approved by certification agency. This is the commercial seed which is available to the farmers. It is produced through the multiplication of basic/foundation seed. Here, production, fields are managed by small-scale farmers and NGOs, but under the supervision of a certification scheme. Crop fields which fall within the acceptable score range of quality standards qualify as good planting materials, while those outside the range are rejected. The certified seed producers are the cassava seed entrepreneurs who are trained and have the capacity to undertake seed production and distribution as a business. They will ensure that preferred improved clean planting materials are available in the right quantities and time to the local cassava farmers. By this Entrepreneurship-based model, the problem of variety mixture, distribution of infested materials, and damage to stems on transit are avoided.

Development of an efficient and formal cassava seed production and distribution system will:

- ✓ Encourage entrepreneurship in the multiplication and distribution of cassava seed
- ✓ Guarantee knowledge of source of planting material and varieties
- ✓ Provide an affordable and timely means to deliver Clean and quality planting materials to cassava farmers in Nigeria
- ✓ Enable more efficient dissemination and adoption of new cassava varieties of cassava
- ✓ Increase stakeholder synergy and networking along the cassava value chain
- ✓ Enhance business capacities of cassava farmers and processors
- ✓ Encourage gender participation and youth involvement in cassava seed multiplication and distribution
- ✓ Enhance availability and accessibility of true-type and clean planting materials to cassava farmers
- ✓ Boost export and Quality control
- ✓ Efficient Cassava pests and diseases management
- ✓ Encourage seed companies to venture into vegetative seed marketing
- ✓ Increase cassava yield

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To achieve these, individuals who are already cassava farmers that have the capacity and show interest to drive this agenda of cassava seed multiplication and marketing as a business are encourage to become entrepreneurs in the cassava seed business.

The term 'entrepreneur' has been said to derive from the French word 'entreprende' which means to 'begin something' or to 'undertake'. Hence, at its simplest, an entrepreneur can be said to be someone who begins something. However, the term is normally associated with those starting up a business but is more than simply "starting a business." It is a process through which individuals identify opportunities, allocate resources, and create value. This creation of value is often through the identification of unmet needs or through the identification of opportunities for change" (Chidiebere *et. al.,* 2014). Njoku *et al*. (2014) sees an entrepreneur as a person who brings in overall change through innovation for the maximum social good. Human values remain sacred and inspire him to serve the society. He has firm belief in social betterment and he carries out this responsibility with conviction. In this process, he accelerates personal, economic as well as human development. The entrepreneur is a visionary and an integrated man with outstanding leadership qualities. With a desire to excel, he gives top priority to Research and Development. He always works for the well-being of the society. More importantly, entrepreneurial activities encompass all fields/sectors and foster a spirit of enterprise for the welfare of mankind.

The core mission of Building a Sustainable and Integrated Cassava Seed System (BASICS) is a fundamental overhaul of the cassava seed sector into a responsive, sustainable and integrated value chain that has the potential to significantly raise the cassava productivity in Nigeria. To achieve this, the project in partnership with major stake holders in Cassava such as International Institute for tropical Agriculture (IITA) and National Root Crops Research Institute (NRCRI) developed the Cassava Seed Entrepreneurs Model. The model seeks to identify, onboard and encourage already existing cassava farmers, who have the capacity and willingness to undertake cassava seed production and marketing as a business. The most visible aspect of this encouragement is by training and retraining of the cassava seed farmers on Good Agronomic practices, pests and disease control, business and marketing strategies among others.

With an estimated 70% of the total population of Nigeria living in rural areas, agriculture is the mainstay of economic activity. The livelihood of smallholder farmers has been constrained by a host of challenges: low productivity; paucity of opportunities for value addition; environmental degradation; limited access to productive assets and inputs; inadequate support services; limited access to rural financial services; inadequate market and rural infrastructure; post-harvest losses and a constrained enabling environment. To address these challenges, the VCDP aims to enhance productivity, promote agro-processing, access to markets opportunities, facilitate engagement of the private sectors and farmers' organizations in the developmental efforts.

National Root Crops Research Institute, Umudike in collaboration with FGN/IFAD Assisted Value Chain Development Programme conducted a 2-week training for 120 youth Cassava farmers from 9 states of Nigeria (Anambra, Ebonyi, Enugu, Kogi, Nasarawa, Niger, Benue, Taraba and Ogun), to onboard them into Cassava seed entrepreneurship after the training on Good Agronomic practices, pest and disease management, business and enterprise development strategies, as well as, seed certification, seed tracking, nutritional perspectives and benefits of producing Pro-vitamin A cassava as keys in ensuring cassava production and food security in Nigeria. This paper therefore examined the socioeconomic characteristics of the youth participants in the FGN/IFAD VCDP, assess cassava varietal preferences among the youths as well as identify the strengths, weaknesses, opportunities and threats to cassava seed entrepreneurship in the states.

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NRCRI Umudike Management Team flanked by the 120 youths from 1st and 2nd cycle

Cassava seed certification

Seed certification is a process designed to maintain and make available to the general public continuous supply of high-quality seeds and propagating materials of notified kinds and varieties of crops, so grown and distributed to ensure physical identity and genetic purity (www.vikaspedia.in/agriculture). Seed certification is a legally sanctioned system for quality control of seed multiplication and production. The main objective of the Seed Certification is to ensure the acceptable standards of seed viability, vigour, purity and seed health. A well-organized seed certification should help in accomplishing the following three primary objectives.

- The systematic increase of superior varieties;
- The identification of new varieties and their rapid increase under appropriate and generally accepted names.
- Provision for continuous supply of comparable material by careful maintenance.

Cassava seed certification therefore implies a continuous process of quality control that ensures compliance to specific guidelines in the production of cassava seed and supervised by the agency approved by law to carry out such supervision. In Nigeria, the National Agricultural Seed Council has the responsibility to supervise and approve cassava seed farms for certification based on established laws of the country. The agency is also empowered to prosecute offenders to the seed Law.

Procedure of certification

The process of cassava seed certification begins with field preparation until harvesting. The following procedure is recommended:

- Verification of seed source, class and other requirements of the seed used for raising the seed crop.
- Inspection of the seed crop in the field (minimum of 3 visits) to verify its conformity to the prescribed field standards. (Ensure that variety planted is true to type, no crop mixtures, minimum protection distance and disease-free crops)
- Supervision at post-harvest stages including processing and packing.
- Drawing of samples and arranging for analysis to verify conformity to the seed standards; and
- Grant of certificate, issue of certification tags, labeling, sealing etc.

However, certification is field specific, attracts a fee and done annually.

Farmers' perception to the use improved cassava varieties

Cassava production is essentially an age long activity in most communities in southern and middle belt areas of Nigeria. Its seed production and distribution pattern are largely informal and the farmers tend to hold on to their production system tenaciously, believing that the routine practice of sharing and using available planting material does not affect output. In describing market imperfections associated with vegetatively propagated crops (VPC) in Nigeria, Wossen et al (2020) stated that Cassava in Nigeria offers a useful contrast to the prevailing narratives on cereal seed systems in Africa not least because Nigeria is host to a poorly functional VPC seed system within an economy that is significantly fuelled by cassava, and is in search of new and innovative solutions to problems facing the crop's cultivation and use.

Improved cassava seed use and distribution is a new concept driven by the need to improve yield and income to the farmers. Since the commencement of a project named Building an Integrated and Sustainable Cassava Seed System in 2016, a concise effort is being made to change the narrative in cassava seed system and get the farmers to adopt and use improved cassava varieties through the network of seed entrepreneurs in the rural cassava growing communities of Nigeria. BASICS project has really reoriented farmers' perception in the use of improved varieties. Most farmers in the pilot states of South east and south-south have adopted improved varieties of cassava.

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Methodology

120 youths were randomly selected from nine states (Anambra, Ebonyi, Enugu, Kogi, Nasarawa, Niger, Benue, Taraba and Ogun) for the study. The distribution of participants by states and Local government Area are shown in table 1 below.

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Table 1: Distribution of participants across states and Local Government Areas

States	Number of LGAs	Number of Representatives
Kogi	4	20
Nassarawa	5	20
Enugu	3	20
Anambra	3	9
Benue	3	9
Ebonyi	3	9
Niger	3	9
Ogun	5	15
Taraba	3	9
Total	32	120

A well-structured questionnaire was used to elicit information on the socioeconomic characteristics, production status and varietal preferences of the VCDP youths in the selected states. Data collected were analyzed using descriptive statistics and likert scale. Results are presented in tables, frequency distribution and percentages.

Results and discussion

Socioeconomic characteristics of the VCDP youths
The descriptive statistics obtained from SPSS was used to determine the socioeconomic characteristics of the youths (trainees) who were trained on cassava seed production and marketing. Table 2 presents the socioeconomic profile of the trainees. The Table indicates that the majority (66.7%) of the trainees were males with relatively small farms.They are experienced in cassava production; however, most of them had no formal training on agronomic practices of cassava seed production. Although, a vast majority of the youths (98.3%) are members of cooperative societies, they had limited access to credit. Table 3 displays the distribution of the socioeconomic characteristics of the trainees. It reveals that most of the youths were farmers who had tertiary education. On average, 79.5% of them were farmers while 70.7% had tertiary education. They were previously involved in cassava stem commercialization (marketing of uncertified stems) in Nigeria. About 99% of the youths indicated that their clients usually pay cash at the point of sale of stems ('cash and carry' basis. Nevertheless, some of them (9.4%) pre-order stems. Purchases are made regularly as indicated by the youths (88.70%)

Table 2: Socioeconomic profile of the trainees

Variables	Trainees
Gender (% male farmers)	66.7
Membership of cooperative society	98.3
Engagement in thrift	33.3
Access to loan	23.9
Average household size	6.0
Average farm size(ha)	1.62
Farming experience(yrs)	8.6
Training on agronomic practices	33.3

Source: Field survey, 2021

3. Distribution of socioeconomic characteristics

Variables	Farmers (%)
Education	
No formal education	
Primary	4.3
Secondary	24.1
Tertiary	70.7
Total	100.0
Primary Occupation	
Farmer	79.5
Civil Servant	8.9
Others	11.6
Total	100
Marital Status	
Single	49.6
Married	50.4
Total	100.0
Frequency of purchase	
Rarely	11.3
Often	44.4
Most often	44.3
Total	100
Order of cassava seed	
Cash and carry	98.9
Pre order	9.4
Total	108.3

Source: Field survey, 2021
Note: Percentage could exceed 100% because of multiple responses

Previous involvement of VCDP youths in cassava value chain
The trained youths were previously engaged in informal cassava stem marketing, although commercialization of cassava stem is not popular in most parts of Nigeria. Selection of youths who were previously engaged in cassava stem production is an indication of commitment (on the side of the trainees) and success in the cassava seed system. Table 4 shows

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production and marketing of cassava stems by trainees in Nigeria. The Table indicates that youths are expanding area under cassava stem production. This could be due to the profitability of the business. Although there was an increase in the area cultivated, quantity of stem produced declined from 180 bundles in 2020 to 115.7 bundles in 2021. The quantity of stem marketed also decreased from 120.4 - 86.3 bundles in 2020 and 2021 respectively. The decline in the quantity of marketed cassava stem could be on one hand, due to buyers' dissatisfaction in the quality of cassava stems purchased and on the other hand, could be due to the recycling of cassava stems by the buyers. Continuous use of cassava cuttings from previous harvest (the common practice in Nigeria) should be discouraged. Cassava is propagated vegetatively; the cuttings accumulate pathogens over time if repeatedly used. Pathogens that affected the parent are transmitted to the newly established plant through the cuttings (Legg et al., 2022). Also, poor knowledge of the agronomic practices of stem production, hence the need to train farmers on agronomic practices of cassava stem production.

Table 4: Production and marketing of cassava stems by the trainees

Farm size 2020	Farm size 2021 (ha)	Quantity of stem produce2020 (bundle)	Quantity of stem produce 2021 (bundle)	Quantity of stem sold 2020 (bundles)	Quantity of stem sold 2021 (bundles)
1.35	1.62	180.04	115.7	120.4	86.28

Source: Field survey, 2021

Cassava varieties and their prices in the VCDP States Nigeria

This investigation reveals that a vast majority of VCDP youths plant improved varieties. Table 5 displays the cassava varieties under production in Nigeria. It reveals that most of the youths (86.3 %) planted TME 419, followed by Yellow Root (29.9%), then TMS 0505 (17.9%). Insignificant parentage of the trainees (6%) planted local varieties. Table 6 shows cassava varieties and preferred stem prices. The Table indicates that youths were willing to pay more for TMS 0505 (N1541.67/bundle) and yellow root (N1228.37/bundle). Tabe 7 presents the ranking of cassava varieties according to preference. It shows that TME 419 is the most preferred variety, followed by Yellow Root, then TMS 0581 (Dixon) among others. TME 419 and TMS 0581 were preferred possibly because of their high yield and dry matter content while the choice of yellow root may be due to its nutritional value.

Table 5: Cassava varieties under production in Nigeria

Varieties	*Farmers (%)
TME 419	86.3
Yellow root	29.9
TMS 0505 (fine face)	17.9
TMS 0581 (Dixon)	9.4
TMS30572	15.8
Local varieties	6.0
NR 8082	0.9
TMS 4(2)1425	4.3

Source: Field survey, 2021
Note:* Percentage could exceed 100% because of multiple responses

Table 6:. Cassava varieties and preferred stem prices

Varieties	TME 419	Yellow root	TMS 0505	TMS 0581	TMS 30572	Local variety
Preferred price (₦/bundle)	1141.33	1228.57	1541.67	1035	1100	1125

Source: Survey 2021

Table 7. Ranking of cassava varieties according to preference

Varieties	4	3	2	1	Weighted average	Ranking
TME 419	82.9	6.8	1.7	0	35.54	1
Yellow root	2.6	20.5	7.7	0.9	8.82	2
TMS 0581 (Dixon)	3.4	13.7	8.5	4.3	7.6	3
TMS 0505(fine face)	2.6	12	6	1.7	6.01	4
Local varieties	1.7	2.6	0.9	0.9	1.73	5
4(2)1425	0	0	0	0.9	0.09	6

Source: field data, 2021
Note: 1- 4 denote scores in increasing order of magnitude; the most important was ranked 1. These variables did not add up to one hundred because zero percent was excluded from the estimation

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Strengths, Weaknesses, Opportunities and Threats (SWOT) of cassava seed business in the VCDP state

Strengths	**Weaknesses**
✓ New and improved cassava varieties available ✓ NRCRI/IITA developing farmer preferred varieties ✓ Network of trained CSEs and farmers ✓ CSEs already in Agribusiness	• Poor synergy among VCDP States • High transportation cost • Stem buying behaviour of small holder farmers • Existence of older varieties with farmers
Opportunities	**Threats**
➢ High demand for Cassava products ➢ Availability of numerous small holder cassava farmers in the VCDP network ➢ Expanding markets for improved cassava seed ➢ Partnership between IFAD and NASC in Third Party Certification	❖ Non certification of improved cassava stem **(may be a killer threat)** ❖ Quality of cassava seed sold is not guaranteed ❖ Varietal mix up could lead to loss of traceability

Conclusion

Production and marketing of cassava seed is one way of ensuring that only certified quality seeds are in circulation, increasing incomes to youth cassava farmers and reducing unemployment in Nigeria. The VCDP youths have the capacity and are willing to undertake cassava seed entrepreneurship as a veritable source of income and livelihood improvement. It requires stakeholders' synergy to be efficient. The IITA/NRCRI BASICS 11 project has provided the platform for this to happen by on boarding the 120 youths from nine States to propagate this initiative. NASC involvement is paramount to the success of this activity.

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Climate Change Implications on Oil Palm Production Trends in Nigeria

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A R T I C L E I NFO

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VECM

ABSTRACT

Climate change had become a focal global environmental concern. Studies on various crops had proved that adverse effects accrue to crop plants from climatic factors variability. This could be in form of increase in temperature, draught, flood or disease epidemics. This study therefore estimated the climate change implications on oil palm production trends in Nigeria from 1981 to 2020 using Johansen cointegration and VECM model. The analysis revealed that ADF shows that at the level all the series data were non-stationary (p-value > 0.05), while at first difference, all variables were all significant at 1% level. AIC and HQC were significant at 5% at an optimal lag three in the model. Johansen cointegration test reveals that Trace test and Lmax test indicates there is only one cointegrating model at the 5% significance level with eigenvalue (0.73); which implies that there is a long-run relationship between Nigeria oil palm production and its climatic factor determinants. The VECM was used to estimates the error correction (EC) which was significant at 1% and 5% respectively in different equations; shows long-run relationships in oil palm production with area of farm, temperature and rainfall. Residuals diagnostics of the estimated VECM using ARCH and autocorrelation indicates that the residuals are homoskedasticity and residuals in the function are not correlated with one another. The study therefore recommended increase in oil palm tree planting; and the trends of climate change and production should be related to stakeholder in oil palm industry.

1.0 Introduction

Agricultural practice globally is the major vulnerable sector to the hazards and effects of international climate change, regardless of the advancements in technology and Green Revolution; weather and climatic factors remain the source and crucial dynamics in determining the level of agricultural productivity in almost regions globally. Temperature and rainfall patterns change with their related effects on availability of water, pests and diseases, and severe weather actions all to a large extent affect the prospective of agricultural production (Sarkar, Begum & Pereira, 2020). Although, the impacts of climate change are not equally experienced globally due to its unpredictability spatial level. The impact of climate change varies in several continents, countries, and regions of the world. Definitely some countries may be prone to more adverse impacts than others, whereas some other countries may likely benefit from the impact of climate change (Environmental Protection Agency EPA, 2016). Hence, climate change can have positive and negative impacts on geographical related area of agricultural production. However, several studies indicated that the negative effects of climate change could be higher than the positive impacts (Intergovernmental panel on Climate Change 2012 as cited in Sarkar *et al,* 2020).

The implications of climate change on agricultural productivity can be difference among crops and regions. The rate of recurrence and gravity of extreme weather events rises because of change in climatic factors, which affect agricultural productivity to a great extent. According to Calzadilla, Rehdanz, Betts, Fallons, Wiltshire and Tol (2013) as cited in Sarkar *et*

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al, (2020) crop production is capable of reducing more or lesser in all regions of the world, excluding Australia and New Zealand because of rise in temperature. Sub-Saharan Africa countries would experience crop production losses (like rice, wheat, fruits, nuts, oil seeds, oil palm etc) of about 10.91% and 25.40% with +2^{o}C and +4^{o}C increase in temperature respectively.

Nigeria was the highest oil palm producer globally in early 1960s with about 43% market share globally. Currently, Nigeria is the fifth largest oil palm producer with less than 2% of the aggregate world market production of about 74.08 million metric tonnes MMT (Prince water house Coopers Limited PwC, 2019). Malaysia and Indonesia improved and exceeded Nigeria as the highest global in oil palm production in 1966. Ever since then, Malaysia and Indonesia collectively produce about 80% of the aggregate world oil palm output, with Indonesia alone produced more than 53.3% of world output. According to the Central Bank of Nigeria (CBN) as cited in PwC (2019), if Nigeria had continued and sustained its market largest globally in oil palm production, Nigeria would have been receiving income of about $20 billion per annul from growing and processing of oil palm currently. According to United States Department of Agriculture (USDA) as cited in PwC (2019) Nigeria is presently the fifth highest oil palm producing nation, with about 1.5% that's about 1.03MMT of the global aggregate output. This could be as a result of extreme climatic factors variations.

Nigeria utilized (that's both domestic and industrial used) about 6.6 million tonnes MT of oil palm produced from 2014 t0 2018. Out of the aggregate consumption, 75% which was about 4.93MT was locally produced, thus relying on importation for the deficit of about 25% which was about 1.67MT, which amount to about 350,000MT or $223.63 million in 2018. From 2014 to 2018, Nigeria imported palm oil of about 1.7MMT which was about $1.28 billion (PwC, 2019). From being one of the key and foremost oil palm in the 1960s, Nigeria is presently one of the net importers of oil palm produce. In a bid to meet up and closed the gap in knowledge and encourage local oil palm producers this study examined climate change implication on oil palm production and utilisation trends in Nigeria. The remaining part of this article is divided into literature, methodology, results and discussion, and conclusion and policy recommendation. The specific objective of this study was to estimate the temperature and rainfall trends on oil palm production in Nigeria from 1981 to 2020.

1.1 Implications of oil palm farming on climate change

Dislich, Keyel, Salecker, Kisel, Meyer, Auliya, Wiegand (2017) noted that 11 out of 14 ecosystem functions reduced oil palm plantations and green house gasses GHGs contributes to climate change processes. Koh and Wilcove (2008) as cited in Murphy, Goggin and Paterson (2021) stated that expansion of oil palm plantation emerges at the expense of natural forests acting as carbon sinks. The conversion of natural tropical rainforests into oil palm plantations is the main and crucial ecological implication of the oil palm industry (Paterson & Lima, 2018), forested areas are converted for the development and growth of oil palm plantations where the emissions from the used surpassed the possibility of carbon fixing ability of oil palm.

Oil palm production entails deforestation releasing global anthropogenetic emissions of between 6-17% of CO_2 (Murphy *et al,* 2021). Brazil, Indonesia and Malaysia with values of 340, 105 and 41 (Teragrams C/year) respectively are the nations with utmost carbon emissions from there forest shield loss. Indonesia and Malaysia recorded highest carbon emissions due to deforestation as they are the first and second largest country oil palm producers; moreover considerable oil palm production is also carried out in Columbia and Nigeria (Paterson, Kumar, Shabani & Lima, 2017). Huge decreases in GHGs emission and climate guideline adaptation act occur owing to the conversion of natural forest into oil palm plantations. Additional GHGs and volatile organic compounds (VOCs), which occur as antecedents to troposphere zone are produced from oil palm plantations. GHGs released from farm land preparations, burning, and establishment of oil palm plantations are to a greater extent larger than carbon sequestered by oil palm. GHGs, VOCs and aerosol element emissions in the course of burning result directly and indirectly variations in solar irradiation while uninterrupted forests provide lesser air and soil temperature with higher atmosphere humidity microclimates in contrasts to oil palm plantations (Dislich *et al*, 2017).

The prevalent and major compound causal of the GHG from oil palm plantations is CO_2, while nitrous oxide and methane are at abridged intensities, even though with larger consequence per molecule. Greater emissions of CO_2 from land preparation burning operation happen, predominantly on peat. Farm land burning indirectly heightens emissions through increasing peat breakdowns and decomposition. Drainage of peat from farm soil emits substantial concentrations of CO_2 to establish oil palm plantations through oxidation, breakdowns and decomposition; break up and liquefied organic matter

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is detached from peat farm soils in the course of drainage, which decays, circulates and emits extra CO_2 (Murphy *et al,* 2021). The actual climax oil palm fruit production tolerates higher absorption and acclimatization of CO_2 and generates more biomass than natural forests. This huge level of carbon uptake does not counterbalance for that emitted during forests clearing for oil palm plantations, as natural forests have additional biomass than oil palm plantations except extremely long timelines of about hundreds of years are taken into account deliberately (Paterson *et al,* 2017). Burning adds black carbon, which also increases warming globally and oil palm plantations emit additional nitrous oxide (N_2O) into the air and environment than forests, majorly from fertilizer utilized.

1.2 Implications of climate change on oil palm farming

Generally, climate change is prone to have an effect on continual oil palm productivity as climatic factor appropriateness will reduce, with concurrent rises in economic and social difficulty in oil palm producing regions. According to Paterson *et al,* (2017) oil palm varieties may response differently under climate change to the negative effect on the accuracy and correctness of future climates on oil palm production at global position. Moreover, oil palm production generates climate change as discussed above, and this will have implication on the capacity to grow, maintain and distribution of oil palm. By 2100, higher oil palm plantation mortalities were ascertained globally excluding Paraguay which happened to be almost immune to the impacts of climate change in future. Extreme high oil palm mortality was ascertained for Nigeria and Ghana in Sub-Saharan Africa, while Cameroon will experience low levels, particularly by 2100 (Paterson, 2021). Hence, this forecasting is capable of making oil palm production unsustainable, if accurate measures are not put in place. Therefore, the implications of climate change on oil palm productivity can be colossal owing to the severity, concentration and intensity of climate change: the oil palm plantation land could be dehydrated and degraded; and also the oil palm plantation could be vulnerable to fungus, diseases, and pest infestations because of increase in temperature. Hence, this study attempts to examine the relationship between climate change and oil palm production in Nigeria using time series data.

2.0 Methodology

To examine the implication relationship between climate change and oil palm production and utilization, this study used secondary data related to oil palm production area, oil palm production, annual mean temperature and annual mean rainfall in Nigeria. Oil palm production (area harvested) in thousand hectares (ha), oil palm production and consumption in thousand metric tonnes (MT) are extracted from United States Department of Agriculture USDA from 1981 to 2020, while population, annual mean temperature in (^oC) and annual mean rainfall in (mm) from Nigerian Meteorological Agency and World Development Indicator (WDI) the primary World Bank collection of development indicators from 1981 to 2020.

According to Engle and Granger (1987 as cited in Songsiengchai, Sidique, Djama and Azman-Saini, 2018), two or more sequences of non-stationary data possibly will be present as a stationary linear model combination, if they are cointegrated. Thus, the linear model combination can be expressed as:

$$\mu_t = y_t - \beta_0 - \alpha_i x_i \quad (1)$$

Where;

μ_t = Stationary

y_t and x_i = set of non-stationary data

This model combination represents the relation of long-run stability in the midst of variables. In order to estimate the long-run relationship of the equation (1), Hoffman and Rasche (1996 as cited in Songsiengchai *et al,* 2018) recommended vector error correction model (VECM) that proffers a long-run relationship and efficient coefficient estimation. The processes of estimating VECM are; first, assess the unit root tests. The unit root test is required before proceeding to analyse cointegration; to check the stationary and integration properties of the data. Augmented Dickey-Fuller (ADF) which is widely in testing unit root tests is applied in this study. Secondly, identify and estimate a vector autoregressive (VAR) model of the integrated series. Then, use suitable lag order of VAR model criteria like Sequential Likelihood Ratio (LR), Akaike Information Criterion (AIC), Hannan-Quinn Criterion (HQC) and Schwarz Information Criterion (SIC). Lastly, utilize Johansen (1988 as used and cited in Songsiengchai *et al,* 2018). The VECM model can be expressed as:

$$\Delta y_t = \pi y_{t-1} + \sum_{i=1}^{k-1} \tau_i \Delta y_{t-i} + \mu + \epsilon_t \quad (2)$$

Where;

y_t = (n x 1) vector of the n variables

Δ = First difference operator

π = (n x n) coefficient matrix

τ = (n x (k-1)) matrix of short-run coefficients

μ = error term

ϵ_t = (n x 1) vector of white noise disturbances

The production model as the following will be estimated:

$$Prod_t = f(ProdAr_t, Temp_t, Rain_t) \quad (3)$$

Where;

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$Prod_t$ = oil palm production (in 1000 MT)
$ProdAr_t$ = oil palm production area (in 1000ha)
$Temp_t$ = annual mean temperature (in ^oC)
$Rain_t$ = annual mean rainfall (in mm)

3.0 Results and Discussion

Table 1: Summary statistics of Nigeria oil palm production and its determinants

	Prod (1000 MT)	ProdAr (1000 ha)	Temp (^oC)	Rain (mm)
Mean	767.52	2226.9	27.17	1137.1
Median	760	2500	27.19	1139
Minimum	500	1.00	26.32	872.04
Maximum	1275	2800	27.81	1269.2
Std. Dev.	191.4	636.71	0.32	82.15
Skewness	0.66	-2.50	-0.32	-0.79
Kurtosis	-0.24	5.64	0.16	0.92
Jarque-Bera	3.03	94.82***	0.72	5.56*
Doornik-Hansen	5.12*	100.21***	1.44	4.67*

Source: Authors computation, 2022

Table 1 illustrates the summary statistics for the Nigeria oil palm production and its determinants. During the period of 1981 to 2020, mean oil palm output was 767.52 thousand MT at about 2226.9 thousand MT ha at 27.17 ^oC temperature and rainfall at 1137.1 mm. production area (size of farm), temperature and rainfall were negatively skewed, while production output was positively skewed. Jarque-Bera test statistics result affirmed oil palm production area of land covered was not normally distributed. Doornik-Hansen test was used to test the normality of the residuals (Ali, 2015), oil palm production (5.12) and climatic factors that's temperature (1.44) and rainfall (4.67) supported the null hypothesis of the normality of residuals. Several studies have reported similar trends. For instance, Bindoff *et al* (2013) noted that global weather trends and water levels are gradually altering because of elevated temperatures caused by human activities releasing greenhouse gases into the atmosphere. One major cause of global warming is Carbon-dioxide., mainly released into the atmosphere from burning and consumption of fossil fuels as well as variation in land use patterns such as deforestation, although other greenhouse gases such as methane are also key contributors (IPCC 2013). Greenhouse gas emissions and temperatures will continue to increase throughout the 21st century. This will cause a higher frequency and intensity of extreme weather events such as heat waves, drought, and sudden heavy rainfall. Sea levels are also continually rising with temperature increase.

Table 2: ADF unit tests results of oil palm production

Variables	Level		First Difference	
	t-value	*p*-value	*t*-value	*p*-value
Intercept:				
LProd	1.6870	0.9997	-5.4019	0.0000
LProdAr	-2.9021	0.0551	-23.1879	0.0000
LTemp	-1.4205	0.5739	-8.6122	0.0000
LRain	-2.4984	0.1158	-8.8805	0.0000
Intercept and trend:				
LProd	-1.1971	0.8972	-5.4858	0.0000
LProdAr	-1.9578	0.6237	-21.1167	0.0000
LTemp	-4.8779	0.9998	-8.4828	0.0000
LRain	-3.0657	0.1146	-8.7739	0.0000

Source: Authors computation, 2022

Table2 above shows the unit root test at a level and first difference. Augmented Dickey-Fuller (ADF) unit root tests were conducted for stationary test. The ADF shows that at the level all the series data were non-stationary (p-value > 0.05). This means that all the variables are not *I(0)*. At first difference, all variables were all significant at 1% level (P-value < 0.01). This signifies that all the variables considered are integrated of order *I(1)*. This finding agrees with Songsiengchai *et al,* (2018) in their study of crude palm oil price in Thailand. The trend of oil palm production and climate factors in Nigeria is provided in Appendix.

Table 3: VAR lag order selection criteria

Lag	LogL	LR	AIC	BIC	HQC
1	257.72856	NA	-12.5405	-11.1329*	-12.0492
2	284.0765	0.00001	-13.1154	-11.0040	-12.3784
3	310.1977	0.00001	-13.6776*	-10.8625	-12.6951*

Source: Authors computation, 2022

Table 3 above shows the assessment results of the VAR model for decisive optimal lag orders. The asterisks (*) above indicate the best values of the respective information criteria at 5% level significance. Akaike Information Criterion (AIC) and Hannan-Quinn Criterion (HQC) called for three (3) lags, excluding Bayesian Information Criterion (BIC) that called for one lag. Hence, this study decisively chooses three lags as an optimal lag in the model.

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Table 4: Johansen cointegration test of oil palm production

H_0: rank = r	Eigen value	Trace test	*P-value*	Lmax test	*P-value*
r = 0*	0.7265	82.974	0.0000	49.260	0.0000
r ≤ 1*	0.3575	33.713	0.0404	16.812	0.2538
r ≤ 2	0.2299	16.902	0.1378	9.9261	0.3527
r ≤ 3	0.1677	6.975	0.1311	6.9754	0.1310

Note: * implies rejection of the hypothesis at 5% level
Source: Authors computation, 2022

Table 4 shows that both trace and Lmax tests accept the null hypothesis that the smallest eigenvalues is zero (0) as seen in the last row of the table. This implies that the series are in fact non-stationary. However, some linear combination may be *I(0)*. Since, all the variables in the model were integrated of order one, the Johansen cointegration test was chosen to discover long-run relationships. Supposing there is no deterministic trend in the data, no constant or trend in the cointegration model, the finding of Trace test and Lmax test indicates there is only one cointegrating model at the 5% significance level. This implies that there is a long-run relationship between Nigeria oil palm production and its climatic factor determinants. According to Baiyewu-Teru (2017), Oil palm crop production is confronted with many past, present and future setbacks, including emerging threats from climate change and pests and diseases. In a similar view, Merem (2020), noted that the inevitability of climate change requires more effective international synergy for its reduction as it has brought much greater negative effects on oil palm production and utilization efforts. Amidst rising environmental impacts made up of deforestation, biodiversity loss, land grabbing standoff, rural urban migration as well as dislocation and resettlement of rural dwellers due to rising communal conflicts and general insecurity.

Table 5: Cointegrating Beta and Adjustment Alpha Vectors

Variables	Coefficient *β Matrix*				*α Matrix*			
	1st equation	2nd equation	3rd equation	4th equation				
***β* cointegrating vectors**					***α* adjustment vectors**			
Prod	-0.0038	-0.0075	-0.0006	0.0002	-4.2438	-4.8292	-23.032	0.2219
ProdAr	0.0024	-0.0003	-0.0002	-0.0001	-411.29	-35.400	41.493	-21.008
Temp	0.3198	5.2622	-0.5597	-3.1677	0.0002	-0.0923	-0.0345	0.0778
Rain	-0.0003	0.0127	-0.0090	0.0123	26.935	-25.594	0.7398	-21.744
Const	-11.186	-151.32	25.361	71.968				
Renormalized *β*					**Renormalized *α***			
Prod	1.0000	24.369	0.0010	0.0191	0.0163	0.0015	12.891	0.0027
ProdAr	-0.6256	1.0000	0.0004	-0.0076	1.5819	0.0109	-23.224	-0.2562
Temp	-83.153	-17132	1.0000	-259.70	-8.7e-7	2.8e-5	0.0193	0.0009
Rain	0.0667	-41.472	0.0160	1.0000	-0.1036	0.0079	-0.4141	-0.2652
Const	2908.4	4.9e+5	-45.310	5900.3				
Long Run *π (αβ')* Matrix								
Equation	Prod	ProdAr	Temp	Rain	const			
Prod	0.0652	-0.0041	-14.581	0.1486	210.10			
ProdAr	1.8190	-0.9851	-274.50	-0.9734	9498.0			
Temp	0.0007	2.8e-5	-0.7128	8.2e-5	18.689			
Rain	0.0824	0.0745	-57.601	-0.6048	2025.5			
Eigenvalue	0.7265	0.3575	0.2299	0.1677				

Source: Authors computation, 2022

The Johansen cointegrating beta (β) and adjustment alpha (α) vectors test presented in Table 5 above. It shows that one (0.73) of the eigenvalues is larger in comparison to other eigenvalues. This indicates that there is at least one cointegrating long-run relationship. Therefore, the succeeding column vector to this eigenvalue (0.73) (oil palm production) consequently form the constructive and useful relationship. The coefficient of Temp (0.32) in the first equation is close to one in the eigenvector matching to the highest eigenvalue. This indicates that Temp as variable may likely be in the last order of influence in that vector. Hence, Temp equation

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signifies a very vital long term functional and useful relationship.

Table 5 above also shows the model output, where beta signifies the long-term implications, while alpha signifies the degree and dimension of the adjustment of the cointegration vector when the correlation is diverging from the long-term relationship procedure. The ith column of the beta matrix represents the coefficients of each of the variables under consideration in the ith variable equation (that's ith cointegration relationship). Whereas, the ith row signifies the influence of the ith variable to each of the dealings. In the same way, the ith vector of alpha matrix indicates the rate of adjustment of each relationship to be volatile and unstable in ith relation, whereas the row vector indicates the adjustment rates of the ith relation to each of the unstable in relationships.

3.1 Vector Error Correction Model (VECM) Output

VECM is the short-run deviations development of the functional model. It is used to determine the extent of the error correction coefficient. Hence, the VECM analyses the socks in the model, at the same time estimating the functional model of the time series data. Error correction term (EC) is to correct (in percentage) the error in the next period in uniting to the long-run relationship (Ali, 2015). Johansen test specified two rank order of the impact matrix; this study used this order for the VECM estimation.

Table 6: Equation 1: d_Prod1000MT

Variable	Coefficient	Std. Error	*t-ratio*	*p-value*	Indicator of low p-value
Const	−80.0433	3985.09	−0.02009	0.9841	
d_Prod1000MT_1	−0.0196	0.2409	−0.0813	0.9358	
d_ProdAr1000ha_1	−0.0271	0.0169	−1.603	0.1197	
d_Temp_1	25.3878	32.8137	0.7737	0.4454	
d_Rain_1	−0.0504	0.1136	−0.4441	0.6603	
EC1	−0.0028	0.0605	−0.0464	0.9633	
EC2	0.0005	0.0195	0.0247	0.9805	
R^2	0.1289		Adjusted R^2	-0.1122	
Rho	0.0886		Durbin-Watson	1.65	
Production vector		*B*			*A*
d_Prod1000MT_1	1.0000	0.0000		-0.0028	0.0005
d_ProdAr1000ha_1	1.0000	0.0000		2.5267	-0.9724
d_Temp_1	1365.7	325.40		-0.0005	0.0000
d_Rain_1	3.8185	1.0897		-0.2512	0.0618
Trend	21.763	9.9e+7			

Note: d is used to specify a differenced variable, such as d_Prod1000MT, while d_Prod1000MT_1, d_ProdAr1000ha_1, d_Temp_1, and d_Rain_1 indicate lagged differenced variables. The greater the number of asterisks (*), the smaller the *p-value* to indicate the significance level of the variable. ***, **, and *are significant at 1%, 5% and 10% respectively.
Source: Authors computation, 2022

From Table 6 only d_Temp_1 coefficient is positive all other variables were negative. This implies that Temp is directly related to Prod while other variables were inversely related to the differenced Prod. The sign of EC1 is negative though not significant, which is logical, whereas EC2 is statistically zero. The Rho (0.1) coefficient is small; denote weaker relationships in the function. Durbin-Watson (1.7) is within acceptable region of the model, this implies that there is positive correlation. These realities were further established in Okolo *et al,* (2019) survey which found a significant relationship between annual average temperature and oil palm production in Nigeria.

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Table 7: Equation 2: d_ProdAr1000ha

Variable	Coefficient	Std. Error	*t-ratio*	*p-value*	Indicator of low p-value
Const	−94684.3	24209.5	−3.911	0.0005	***
d_Prod1000MT_1	−2.45054	1.4633	−1.675	0.1047	
d_ProdAr1000ha_1	0.2505	0.1025	2.443	0.0209	**
d_Temp_1	−0.0544	199.344	2.174	0.0380	**
d_Rain_1	−0.0544	0.6900	−0.0788	0.9377	
EC1	2.5267	0.3678	6.870	0.0000	***
EC2	-0.9724	0.1188	-8.188	0.0000	***
R^2	0.7297		Adjusted R^2	0.6552	
Rho	0.0526		Durbin-Watson	1.87	

Note: d is used to specify a differenced variable, such as d_Prod1000MT, while d_Prod1000MT_1, d_ProdAr1000ha_1, d_Temp_1, and d_Rain_1 indicate lagged differenced variables. The greater the number of asterisks (*), the smaller the *p-value* to indicate the significance level of the variable. ***, **, and *are significant at 1%, 5% and 10% respectively.
Source: Authors computation, 2022

From Table 7, the production area (1000 ha) equation, constant and coefficients of lagged differenced of ProdAr and Temp were found to be significantly affecting oil palm production in Nigeria. The EC1 and EC2 was both significant. EC2 is negative, which is logical. This implies that 97 percent of the error will be corrected in the next period concerning the long-run relationship, as well as inversely related to differenced production of oil palm in Nigeria. Rho (0.1) was also weak and Durbin-Watson (1.9) is positively autocorrelated, with high determinant R^2 of 73%, which implies that the model is a good fit.

Table 8: Equation 3: d_Temp

Variable	Coefficient	Std. Error	*t-ratio*	*p-value*	Indicator of low p-value
Const	−48.3884	19.7286	-2.453	0.0204	**
d_Prod1000MT_1	0.0003	0.0012	0.2516	0.8031	
d_ProdAr1000ha_1	-0.0001	8.3e-5	-1.793	0.0834	*
d_Temp_1	−0.0882	0.1624	-0.5432	0.5911	
d_Rain_1	0.0001	0.0006	0.2094	0.8356	
EC1	-0.0005	0.0003	-1.756	0.0897	*
EC2	5.9e-6	9.6e-5	0.0611	0.9517	
R^2	0.4654		Adjusted R^2	0.3179	
Rho	-0.0325		Durbin-Watson	2.04	

Note: d is used to specify a differenced variable, such as d_Prod1000MT, while d_Prod1000MT_1, d_ProdAr1000ha_1, d_Temp_1, and d_Rain_1 indicate lagged differenced variables. The greater the number of asterisks (*), the smaller the *p-value* to indicate the significance level of the variable. ***, **, and *are significant at 1%, 5% and 10% respectively.
Source: Authors computation, 2022

Table 8 shows the temperature (°C) equation, constant and coefficient of lagged differenced of ProdAr were found to be significant affecting oil palm production in Nigeria. The EC1 was also significance. EC2 and temperature are not found to significant to differenced Prod equation, the coefficient determinant (R^2) was 47%, which indicates that the model is a good fit, with adjusted R^2 of 0.3, for production of oil palm equation. Rho (-0.03) shows weak relationships and Durbin-Watson (2.0) within acceptable region of autocorrelation.

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Table 9: Equation 4: d_Rain

Variable	Coefficient	Std. Error	*t-ratio*	*p-value*	Indicator of low p-value
Const	−2657.99	5937.74	-0.4476	0.6577	
d_Prod1000MT_1	0.2713	0.3589	0.7560	0.4557	
d_ProdAr1000ha_1	0.0101	0.0251	0.4036	0.6894	
d_Temp_1	129.242	48.8920	2.643	0.0131	**
d_Rain_1	-0.4456	0.1692	-2.633	0.0134	**
EC1	-0.2512	0.0902	-2.785	0.0093	***
EC2	0.0618	0.0291	2.122	0.0425	**
R^2	0.564		Adjusted R^2	0.4440	
Rho	-0.1647		Durbin-Watson	2.27	

Note: d is used to specify a differenced variable, such as d_Prod1000MT, while d_Prod1000MT_1, d_ProdAr1000ha_1, d_Temp_1, and d_Rain_1 indicate lagged differenced variables. The greater the number of asterisks (*), the smaller the *p-value* to indicate the significance level of the variable. ***, **, and *are significant at 1%, 5% and 10% respectively.
Source: Authors computation, 2022

Table 9 shows the rainfall (mm) equation, the coefficient of lagged differenced of Temp and Rain were found to be significantly affecting oil palm production in Nigeria. The EC1 (-0.25) was negatively significance at 1%, this implies that 25 percent of the error will be corrected in the next period concerning the long-run relationship, as well as inversely related to differenced production of oil palm in Nigeria. This indicates that the relationship is corrected when inversely related to differenced Prod. Oil palm yield is limited by the length of annual dry season, so areas with consistently high rainfall throughout the year have particularly high yields (Munévar, 2003). In a similar view, Noojipady *et al*, (2017) noted that the most important factor determining oil palm yield is the availability of water in the soil, which largely depends on rainfall, but is also affected by temperature and other factors such as soil type. When there is less rainfall, there is also greater risk of fire, as seen during recent events in Nigeria, which is a hazard for workers, in terms of air quality, and causes loss of yield.

EC2 was also significance at 5% level, with Durbin-Watson of 2.3, which is within the range of acceptance, and with high determinant R^2 of about 73%, which implies that the model is a good fit.

Table 10: Residuals diagnostics of the estimated error correction model

Diagnostic tests	Oil palm production	
	Statistics-value	*p*-value
ARCH	115.01	0.14
Autocorrelation	1.26	0.24
Doornik-Hansen test	18.06	0.02**

** Significant at 5%
Source: Authors computation, 2022

This study confirmed the robustness of the error correction model in Nigeria oil palm production using Doornik-Hansen test, autocorrelation and ARCH. The result is in Table 10 above. The result shows that the single error correction model of oil palm production in Nigeria is serially correlated since statistic-value of autocorrelation test cannot reject the null hypothesis of the serial correlation. This implies that the residuals in the function are not correlated with one another. Using ARCH chi-square test, heteroskedasticity was not significant, which indicates that the residuals are homoskedasticity.

4.0 Conclusion and Recommendation

The study established that the time series on Prod, ProdAr, Temp, and Rain were cointegrated using time series data from 1981 to 2020. Augmented Dickey-Fuller (ADF) unit root tests were conducted for stationary test. The ADF shows that at the level all the series data were non-stationary (p-value > 0.05). Johnansen's cointegration method presents the long-

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run relationships and the extent of adjustment assuming there is deviation in the long-run relationship. Also, VECM was used to estimates the error correction (EC); which presents the relationships on the differenced variables in the presence of level variables. The robustness of the error correction model in Nigeria on oil palm production using Doornik-Hansen test, autocorrelation and ARCH was also examined in the study. The study, therefore recommended;

i. There is need to increase the population of oil palm in Nigeria in order to increase oil palm production;
ii. There is need to invest in research and development (R & D) activities; and
iii. Climate factor trends should be related to stakeholder in oil palm industry.

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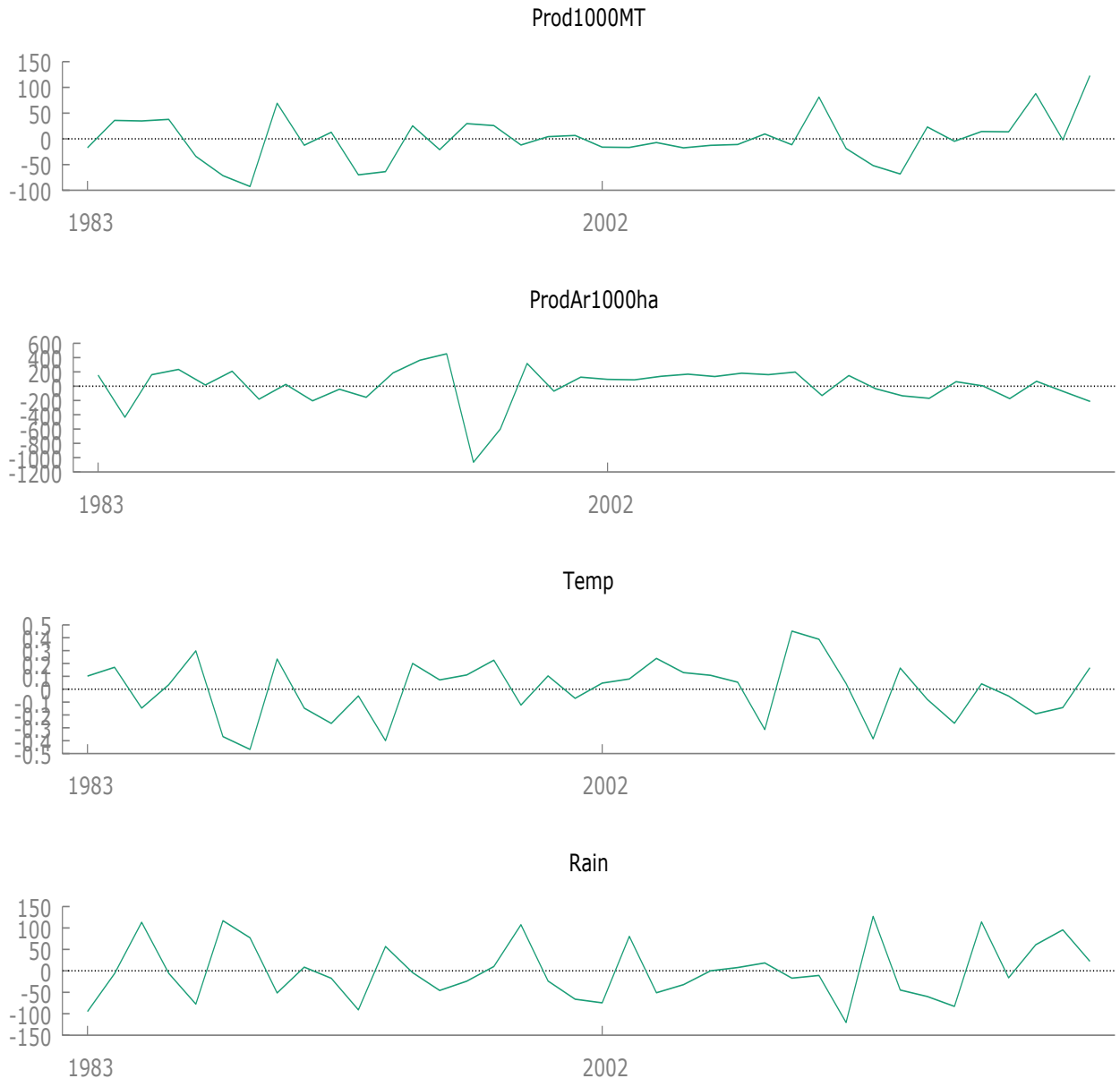
Appendix: Trend of oil palm production and climate factors in Nigeria



Source: Authors computation, 2022

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Climate Variability, Cassava Output and Food Security in Nigeria

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A R T I C L E I NFO

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ABSTRACT

This study examined the effect of climate variability and cassava output on food security in Nigeria from 1990 to 2020. Both descriptive statistics and hierarchical multiple regression analysis were used to achieve the objectives of the study. Data for the study were gathered from the Food and Agriculture Organization Statistical database (FAOSTAT); World Bank database; Central Bank of Nigeria Statistical Bulletin and Nigeria Meteorological Agency (NIMET). The result from the study showed that rainfall was a major climatic element that affects cassava production output and food security (average value of food production) in Nigeria. The Beta weights in model 1 showed that rainfall (β= 0.372: P<0.1) had a positive effect on average value of food production. Also, the Beta weights of model 2 showed that cassava output (β= 0.412: P<0.05) had a positive effect on average value of food production. The study therefore recommended that since rainfall affects crop production, there should be adequate provision of artificial irrigation facilities in order to boost cassava production in areas with limited amount of rainfall.

1.0 Introduction

The Intergovernmental Panel on Climate Change (IPCC, 2007) defines climate change as a variation in the condition of the climate that can be distinguished by changes in the mean and the variability of its properties which continues for a drawn-out period, normally a decade or more. Climate variability has before now affected crop output in many countries (IPCC, 2007; Deressa *et al*, 2008; Rosenthal & Ort, 2012; Murniati, Widjaya, Rabiatul & Listiana, 2019). This is mainly valid in low-income countries, where climate is the primary factor of agricultural production where adaptive abilities are low (Apata, Samuel & Adeola, 2009; Amelework, Bairu, Maema, Venter & Laing, 2021). This susceptibility in Nigeria has been established by the destructive outcome of flooding in the Niger Delta region, parts of South Eastern states, Middle belt and other parts of the country while a variety of prolonged droughts are been experienced in some areas of northern region (Apata, 2012; Akomolafe, Awoyemi & Babatunde, 2018).

As the principal sector in Nigeria's economy, agriculture is of great importance because it contributes 42 percent to the country's Gross Domestic Product (GDP). It utilizes around 80% of the country's poor who live in the rural regions and work essentially in agriculture (NBS, 2018). Since agricultural production in Nigeria relies incredibly upon climate, temperature, daylight, relative humidity and water are the primary drivers of crop growth and crop output. With the rain dependent nature of agriculture in Nigeria, the area has been pronounced to be defenceless to the impact of variability of climatic elements (Agwu, Nwachukwu & Anyanwu,

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2012). Climate change coupled with ecological degradation and water scarcity has curtailed food productivity, availability, accessibility, and quality at the national level. The above factors also aggravate the appearance of novel pests and diseases (Jones & Barbetti, 2012). The contemporary appearance of the fall army worm, which has obliterated maize, wheat and potato crops across Africa and Asia, is one of the adverse consequences of climate change seen in Nigeria (Amusan & Olawuyi, 2018).

The current reliance on traditional crop commodities that compete in export markets and reduce imports has opened windows to promote cassava production in Nigeria. Cassava is dry season safe and resilient to climatic variability, high temperatures, and poor soils, which makes it an important crop for the twenty-first century (Mupakati & Tanyanyiwa, 2017). Water scarcity presents difficulty in cropping maize, wheat and potato. Cassava can fill in a more extensive scope of climatic circumstances and soil types than other tropical staple crops. Relative to grain crops, cassava is more tolerant of low soil fertility and is more resistant to drought. Hence, cassava can provide Nigeria with choices for economical food security, while other significant staples crops like maize and wheat face difficulties. Likewise, cassava can possibly produce and store more carbohydrate than some other significant grain or root crops (El-Sharkawy & De Tafur, 2010). It can give a choice to the advancement of an improved crop, with in excess of 300 industrial items including the production of tire, glues, ethanol, drugs, domesticated animals feeds, biofuels, cold meats, and liquor.

Its attributes, for example, resilience to dry season, the capacity to fill in negligible soils and long haul storability of the roots in the ground make cassava a versatile crop for food and nutritional security (Jarvis *et al*., 2012). Cassava roots can be stored underground for as long as 24 months after maturity, and these can be harvested at any time of the year when a household needs food (Sanchez *et al*., 2013). Farmers can plant and still harvest cassava without critical inputs, utilizing negligible terrains where different crops can't be produced. Cassava commonly yields 8-10 tons ha-1 of fresh roots with zero input.

Regardless of cassava's significance as a food security crop in Nigeria, and its industrial potential, relatively little research has been conducted to examine its importance to food security in Nigeria. In this study, the significance of cassava as food, feed, and industrial crop has been reviewed. It is opined that this study will act as a manual to foster the right advances and proper methodologies for coordinating cassava into the farming system and to convey monetary benefits to both commercial and smallholder farmers. In line with the foregoing this study therefore, examines the effect of climate variability (temperature and rainfall) and cassava output on food security in Nigeria. The specific objectives are to:

i. describe the relative trend of rainfall, temperature and cassava output in Nigeria; and
ii. examine the effect of variability of climatic factors and cassava output on food security.

1.1 Hypotheses of the Study

There following null hypotheses were tested;

Ho1: There is no significant relationship between variability of climatic factors and average value of food production in Nigeria.

Ho2: There is no significant relationship between variability of climatic factors, cassava production output and average value of food production in Nigeria.

2.0 Methodology

2.1 Area of Study

The Federal Republic of Nigeria is the study area. Geographically, Nigeria occupies a landmass of 923,768sq km in the West Coast of Africa between the latitudes of 4^0 and 14^0N and longitudes of 2^0 45' and 14^0 30'E. Nigeria shares boundaries with Niger Republic to the North, Benin Republic to the West, Chad and Cameroun to the East and Gulf of Guinea (Atlantic ocean) to the South. Organizationally, the country is divided into 36 States with Abuja as the Federal Capital territory, and with a population of 140,003,542 persons (NPC, 2007). The country is blessed with abundant land, natural resources and labour.

Climate in Nigeria changes from humid tropical in the South to sub-humid tropical in the north, having wet and dry seasons. Nigeria's atmospheric temperatures are continually high throughout the year with mean temperature ranging from 25°C in the South to 20°C in the North (Agwu, 2012).

2.2 Data Collection

Data for this study such as the mean annual temperature, mean annual rainfall, food security indices and cassava production output from 1990 to 2020 were gathered from various secondary sources. The secondary sources of data collection were; Food and Agriculture Organization Statistical database (FAOSTAT); World Bank database; Central Bank of Nigeria Statistical Bulletin and Nigeria Meteorological Agency (NIMET).

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2.3 Data Analysis

Three analytical tools were employed to analyse the data collated. These include Unit Root Test, descriptive statistics and hierarchical regression analysis.

Unit Root Test

Unit root test was utilized in testing whether the time series variables were stationary or non-stationary.

Descriptive Statistics

Descriptive statistics such as line graphs were used to determine the relative trend of the climatic factors as well as the cassava production output in Nigeria.

Multivariate Regression Analysis

Hierarchical multiple linear regression was used to analyse the effect of the climatic factors (rainfall and temperature) and cassava output on food security index of the country. Hierarchical regression adds terms to the regression model in stages. At each stage, an additional term or terms are added to the model and the change in R^2 is calculated. A hypothesis test is done to test whether the change in R^2 is fundamentally not the same as zero. Hierarchical or Multi-level modelling is proper, as the name proposes, when data have impacts happening at various levels (individual, over the long run, over spaces, and so forth). Single level displaying expects everything is happening at the most reduced level. Something else that a multi-level model does is to present correlations among nested units. Thus, level-1 units inside a similar level-2 unit will be related (Raudenbush, 2002; McNeish & Hamaker, 2020). In this study, two regression models were built by adding variables to the previous model. The purpose is to determine whether newly added variables show a significant improvement in R^2 (the proportion of explained variance in dependent variable by the model). If the difference of R^2 between Model 1 and 2 is statistically significant, we can say the added variables in Model 2 explain the dependent variable (Raudenbush, 2002; McNeish & Hamaker, 2020).

Model Specification

Unit Root Test

The autoregressive integrated moving average (ARIMA) test was used for the quandary of non-stationarity or unit root in the data. ARIMA models are best built-in to time series either to better comprehend the data or to envisage future points in the series. They are useful in some cases where data show indication of non-stationarity, where a preliminary differencing step (equivalent to the ''integrated'' part of the model) can be useful to reduce the non-stationarity. The regression equation to test for stationarity according to Gujarati (2004), is expressed as given below:

$$\Delta \ln FS = \alpha_0 + \sum_{t-1}^{p} \alpha_1 \Delta \ln CPDN_{t-1} + \sum_{t-1}^{p} \alpha_2 \Delta \ln RF_{t-1} + \sum_{t-1}^{p} \alpha_3 \Delta \ln TEMP_{t-1} + \beta_1 \ln CPDN_{t-1} + \beta_2 \ln RF_{t-1} + \beta_3 \ln TEMP_{t-1} + U_t \ldots\ldots\ldots\ldots 1$$

The presence of unit root problem or non-stationarity was accessed through hypothesis as follows:

H_0: $\alpha_1 = \alpha_2 = \alpha_3 = 0$ (the time series FS is non-stationary or has a unit root)

H_a: $\alpha_1 < 0$, $\alpha_2 < 0$, $\alpha_3 < 0$ (the time series FS is stationary or has no unit root)

Where:

α_0= constant term

U_t =white noise

α_1- α_3 = coefficients of the first difference variables

β_1- β_3 = coefficients of the explanatory variables

p = lag length

FS = food security index (Average value of food production)

CPDN = cassava production output (calories)

RF = Rainfall (mm)

TEMP = Temperature (^oC)

Augmented Dickey-Fuller (ADF) test was carried out to test the regression results to show the existence of unit roots as expressed in the hypothesis above.

Regression Model

The regression equation is given below.

AVFP = f(Temp,Rain)…….……2

AVFP = f(Temp,Rain,Cassava output)…….6

Where;

AVFP = Average value of food production,

CPDN = Cassava production output (calories)

Temp = change in temperature (^oC)

Rain = change in rainfall (mm)

The regression model can further be expressed as;

$$Y(AVFP) = \beta_0 + \beta_1 \Delta X_1 + \beta_2 \Delta X_2 + e \ldots\ldots\ldots\ldots .9$$

$$Y(AVFP) = \beta_0 + \beta_1 \Delta X_1 + \beta_2 \Delta X_2 + \beta_3 \Delta X_3 + e \ldots\ldots 14$$

Where;

Y(AVFP) = Average value of food production,

β_0 = intercept

$\beta_{1\text{-}3}$= Regression Coefficient

ΔX_1 = change in temperature (^oC)

ΔX_2 = change in rainfall (mm)

ΔX_3 =change in cassava output

e = Random error term

Measurement of Food Security Indicators (Average value of food production)

The indicator communicates the food net production value as assessed by FAO and distributed by FAOSTAT, in per capita terms. It gives a cross-country practically identical proportion of the relative financial size of the food production sector in the country.

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3.0 Results and Discussions

3.1 Unit root test The result of the Augmented Dicky Fuller (ADF) (Table 1) shows that the variables are non-stationary in their levels. The variables only became stationary after first difference except for average value of food production (AVFP) which was found to be stationary after the second difference.

Table 1 Unit Root Test Result

Variable	Level data	Difference level	1% critical value	5% critical value	10% critical value
Mean annual temperature	-3.496371	-13.37642(D1)*	-3.769597	-3.004861	-2.642242
Mean annual rainfall	-3.127906	-7.829611(D1)*	-3.752946	-2.998064	-2.638752
Cassava output	-1.002352	-4.574412(D1)*	-3.752946	-2.998064	-2.638752
Average value of food production	-1.670545	-5.280128(D2)*	-3.831511	-3.029970	-2.655194

*Note: * indicates 5% level of confidence.*
Source: Field Survey (2022)

Note:
D1 = first difference, D2 = second difference
Decision Rule:
If ADFs > critical value- stationary
If ADFs < critical value- Non stationary

Relative trend of rainfall, temperature and cassava output in Nigeria

The figure 1 shows the trend in cassava output in Nigeria from 1990 to 2020. The result indicates an increase in the trend of cassava output. The output of cassava production steadily rose from 30.27838 billon calories in 1990 to 51.98823 billon calories in 1999, thereafter dropped to 51.98823 billon calories in 2000. In 2009 cassava output dropped to 58.547378 billon calories. It was after the year 2009 that cassava output continued to rise gradually to a peak of 91.13818 billon calories in 2020. As shown in Figure 1 the lowest production output of 30.278383 billon calories was recorded in the year 1990 and the highest production output of 91.13818 billon calories was recorded in 2020. The climatic variables also move in a similar direction. The result on temperature showed that there was an increase over the years. The result in figure 1 indicated that temperature was high in 1991 at 26.63^{o}C and dropped in the year 1992 at 25.06^{o}C. From Figure 1 the lowest amount of rainfall of 1344 mm was recorded in 2004 while the highest amount of1719.6 mm was recorded in the year 2007.

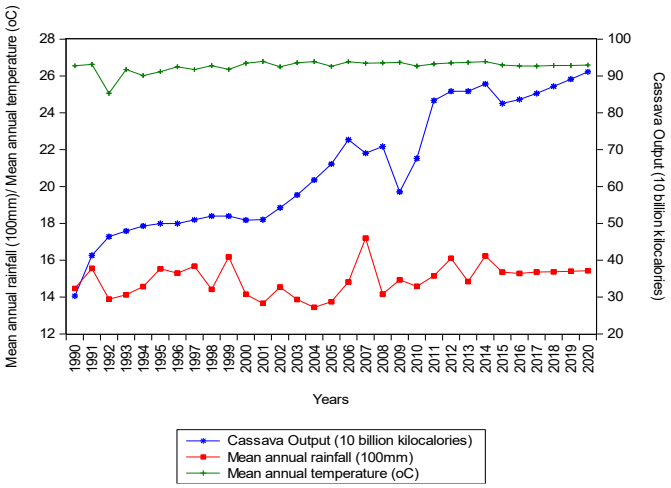

Figure 1. Relative trend of rainfall, temperature and cassava output in Nigeria

Effect of variability of climatic factors and cassava output on food security

Model 1 in Table 2 presents the result of effect of temperature and rainfall on average value of food production**.** The regression model had an R^2 of 0.141 (14%). This implies that the extent to which rainfall and temperature predicts average value of food production is 14%. The adjusted R^2 of 0.055 shows that 5% of the variance in average value of food production was accounted for by the effect of temperature and rainfall for the period under review. The Beta weights in model 1 as seen in Table 2 showed that rainfall (β= 0.372: P<0.1) predicts a positive relationship with average value of food production and hence contributes to it.

The positive value of the Beta coefficient indicates that increase in rainfall will lead to an increase in average value of food production. The null hypothesis is therefore rejected and the alternative holds true. Therefore, there is a significant relationship between

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variability of climatic factors and average value of food production in Nigeria.

The implication of the result in model 1 of Table 2 is that a 1% increase in rainfall will increase the average value of food productionby 0.37%. This result is an indication that increase in the mean annual rainfall in Nigeria exerts a positive effect on average value of food production. This result is in line with the findings of Sowunmi and Akintola (2009) who stated that the potential of savannah zones in Nigerian food crop production cannot be overemphasized. This is in agreement with *a priori* expectation, since farmers perception about crop production especially cassava is influenced by availability of rainfall during the production process. According to Nwaobiala and Nottidge (2015), cassava has a special attribute which is thriving well even in extreme conditions of drought and such has been called the famine security crop. The need for the development of irrigation facilities in these zones in order to make water available by augmenting the unimodal rainfall distribution of the zones is imperative. Moreover, development of short, drought resistant and early maturing variety of crops suitable for this zone so that the short-wet season can be fully utilized.

Model 2 in Table 2 presents the result of effect of temperature, rainfall and aggregate cassava output on average value of food production**.** The regression model had an R^2 of 0.299(30%). This result implies that the extent to which rainfall, temperature and cassava output predicts average value of food production is 30%. The adjusted R^2 of 0.189 shows that 19% of the variance in average value of food production was accounted for by the impact of temperature, rainfall and cassava output for the period under review. The Beta weights of model 2 as seen in Table 2 showed that cassava output (β= 0.412: P<0.05) has a positive relationship with average value of food production and hence contributes to it. The positive value of the Beta coefficient indicates that increase in cassava output will lead to an increase in average value of food production. The null hypothesis is therefore rejected and the alternative holds true. Therefore, there is a significant relationship between variability of climatic factors, cassava output and average value of food production in Nigeria.
The result in Table 2 also revealed that the difference in R^2 between Model 1 and Model 2 was 0.158 (0.299-0.141 = 0.158). Therefore, cassava output explains an additional 16% of the variance in average value of food production and it is statistically significant.

Table 2: Effect of temperature, rainfall and aggregate of cassava output on Average Value of Food Production

Model Summary					
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**	**Durbin-Watson**
Model 1	0.376	0.141	0.055	6.92071	
Model 2	0.547	0.299	0.189	6.41335	2.452

Coefficients					
	Unstandardized Coefficients		**Standardized Coefficients**		
	β	**Std. Error**	**Beta**	**t**	**Sig.**
Model 1					
(Constant)	-0.441	1.443		-0.306	0.763
Mean annual rainfall (mm)	0.002	0.001	0.372	2.000	0.034**
Mean annual temperature (°C)	2.489	3.188	0.165	0.781	0.444
Model 2					
(Constant)	-1.711	1.471		-1.163	0.259
Mean annual rainfall (mm)	0.002	0.001	0.270	2.000	0.037**
Mean annual temperature (°C)	2.781	2.957	0.185	0.940	0.359
Aggregate cassava output(calories)	1.257E-6	0.000	0.412	2.071	0.022**

*(*significant at 10%; **significant at 5%)*
Model 1:Dependent Variable: Average value of food production
Independent variable: Mean annual temperature (°C), Mean annual rainfall (mm)
Model 2: Dependent Variable: average value of food production
Independent variables Mean annual temperature (°C), Mean annual rainfall (mm) and aggregate cassava output
Source, Field Survey 2022

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4.0 Conclusion and Recommendations

This study examined the effect of climate variability and cassava output on food security in Nigeria from 1990 to 2020. The study explored two major climatic elements (rainfall and atmospheric temperature) that affect agricultural production activities in Nigeria. In the study it was observed that there was a steady fluctuation in the trends of atmospheric temperature and rainfall whereas cassava production output witnessed a steady increase during the period under review. The study reported that rainfall was a major climatic element that affects cassava production output and food security (average value of food production) in Nigeria. The study therefore recommended that; since rainfall affects cassava production, there should be adequate provision of artificial irrigation facilities in order to boost crop production in areas with limited amount of rainfall. There is need to help the indigenous farmers adaptation techniques by providing them with an extensive variety of institutional, policy, and technological support, some of it designated on poor and small-scale farmers. For this reason, the role of government and NGOs is important. As the wet seasons are as of late turning out to be increasingly erratic and unpredictable, relying upon rainfed agriculture is unlikely and thus policy driven activities to provide irrigation facilities in light of both ground and surface water are imperative. In addition, introducing non-farm income sources is significant as this assists farmers with participating in those activities that are less delicate to climate change. Besides, providing climate change data, extension services, and providing access to markets are critical. Hence, government should integrate issues of climate variability as well as adaptation strategies into the national developmental plan and project.

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Cost of Climate Change Adaptation Measures among Women Arable Crop Farmers in Ughelli-North and Sapele Local Government Areas of Delta State, Nigeria

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A R T I C L E I NFO

Keywords:

Climate Change,

Adaptation Measures,

Women,

Arable Crops

ABSTRACT

This study examined cost of climate change adaptation measures among women arable crop farmers in Ughelli-North and Sapele Local Government Areas of Delta State, Nigeria. It specifically ascertained the various climate change adaptation measures practiced against climate change, determined the cost of climate change adaptation measures by women arable crop farmers and estimated the effect of socioeconomic characteristics on cost of adaptation to climate change. Six communities were sampled from each of the two LGAs to give 12 communities. 15 women arable crop farmers were sampled from each of the community to give a total of 180 small scale women arable crop farmers that were utilized for the study. Result indicated that to combat effect of climate change, 77.2% used drought resistant varieties, 97%, early planting 80.6%, minimum tillage and 96.% crop rotation. Flooding caused the highest climate-related loss of ₦926,000.00 annually while gully erosion caused damage of estimated value of ₦842,000.00 and damage by wind storm was estimated at ₦832,433.00. Age, marital status, level of education, farming experience, access to credit and number of contact with extension agents were statistically significant in determining women arable crop farmers' expenditure on measures adapted against climate related challenges on their farms. The null hypothesis which stated that socioeconomic characteristics of women arable crop farmers do not affect their expenditure on adaptation measures to climate change was rejected. It is recommended that for consistent growth in agricultural production, it is important to equip rural women farmers with relevant and timely information and technology to improve their production techniques and increase their income and standard of living.

1.0 Introduction

Decreasing rainfall, increases in temperature as well as increasing incidence of late onset of rains in the northern part of Nigeria are all signs of climate change. In the southern part, the main challenge remains mostly flooding of high intensity. As agricultural production in Nigeria is mostly dependent on rainfall, any erratic changes in rainfall and temperature will always exert adverse effect on her agricultural production as the country has only one rainy season which the agricultural production depends on (Assan *et al*, 2018). Ike and Ezeafulukwe (2015) explained that among the consequences of climate change on agriculture are the reduction in yield, losses in farm income, and a reduction in the well-being of farm households. These adverse impacts of climate change could also stifle efforts toward poverty reduction among rural dwellers that depend on agriculture and other climate-sensitive activities for their livelihoods and well-being. Some other studies in Nigeria have shown that losses due to the climate change annually is on the average of 5.5% of total output of some major staple crops such as maize, rice, cassava, yams, millet, sorghum, groundnuts, and plantain (Emaziye, Okoh and Ike, 2012). The study also concluded that revenues generated from crop production by farmers was impeded by increases in temperature occasioned by climate change. Thus, it is crucial for farmers to undertake adaptation strategies to help cushion them against the adverse impacts of climate change. Again,

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there is the need for agents of the State and other agricultural stakeholders to undertake appropriate adaptation measures as well as implement policies that will focus on transforming the agricultural sector which will ultimately enhance resilience of farm households.

Smallholder farmers in Nigeria have been adapting to variability in precipitation and average temperature over several decades. They engaged in livestock and crop diversification and also diversification into non-farm income-generating activities to improve their livelihoods. According to Nyong, Adesina and Elasha (2007) Climate change adaptation methods are strategies which enable individuals or communities to cope with or adjust to the impacts of changes in climate. Institutional support for adaptation improves farmers' ability to adapt to projections made on expected trends in rainfall, flood and temperature. Such institutional support must be made in such a way that all gender are accommodated. The impacts of climate change are expected to differ across agro-ecological zones and among households because of differences in resources, which tend to influence adaptive capacity.

Ike and Ezeafulukwe (2015) observed that women small scale farmers are much more affected by the challenges arising from changes in climate due to the inherent inadequacies as well lack of capacities to adapt and diversify into other livelihood options. There is gender bias in the nature of vulnerabilities to climate change. This therefore makes the mainstreaming of gender in interventions in climate change adaptation to be very important. As is the case with males, female farmers also have agency and as well possess important knowledge which is useful in planning interventions in climate change adaptation and also strategy development for tackling climate change impacts that are related to food security and household well-being.

Studies have been conducted in Nigeria to explore how agriculture have been impacted by climate change. Others studies have been on vulnerability to climate change and adaptation strategies by farm households in countering the negative challenges of climate change, and also the importance of adaptation strategies among others. None of these studies have focused solely on cost of climate change adaptation measures among women arable crop farmers in Delta State, Nigeria. Hence, this study which sought to analyse the Cost of Climate Change Adaptation Measures among Women Arable Crop Farmers in Ughelli North and Sapele Local Government Areas of Delta State, Nigeria. The study objectives were to: (i) ascertain the various climate change adaptation measures practiced against climate change, (ii) determine the cost of climate change adaptation measures by women arable crop farmers and (iii) estimate the effect of socioeconomic characteristics on cost of adaptation to climate change.

2.0 Review of Literature

According to Farauta, Egbule, Idrisa and Agu, (2011), natural changes in climate result from interactions such as those between the atmosphere and ocean and are referred to as internal factors, and from external causes, such as variations in the sun's energy output which would externally change the amount of solar radiation that reaches the earth's surface and in the amount of material injected into the upper atmosphere by explosive volcanic eruptions. A conceptual model was developed (Figure 1) that facilitates the understanding of farmer adaptive decision making. The framework is a combination of that adaptive decision making as developed by Smit and Skinner (2002) and the Theory of Planned Behavior (TPB) as put forward by Ajzen (1991) as well as the Reasoned Action Approach (RAA) by Fishbein and Ajzen (2010).

The linking of these two conceptual frameworks together brings about a better understanding of the intention of the farmer to adapt to climate change in the agricultural context. The various factors that help to explain decisions taken by farmers to manage the various risks associated with weather were explained by Smit *et al*. (2000). Among these factors are climate related stimuli, the scale and responsibility of farmer, the various forms of adaptation and other non-climatic factors/conditions, as well as the evaluation of the effects of adaptation. Climate-related stimuli according to Smit *et al*. (2000) is the form, timing, and severity of a given climate signal while scale and responsibility refers to whom or what entity is involved in adapting and at what scale.

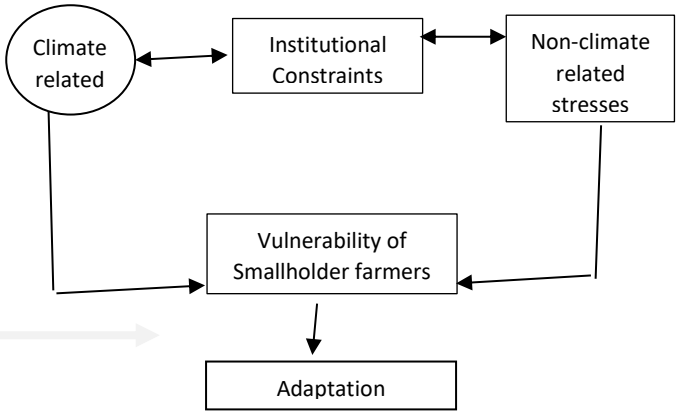

***Figure 1**: Conceptual Framework on Climate Change Impact on Arable Crop Farmers*

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This research focused on how women small scale arable crop farmers would change or maintain their current farm management practices as a response if there is a signal of changes in climate and the form of adaptive actions. Smit and Skinner (2002) identified four different types of adaptation in the agricultural sector. These forms are technical development and government/insurance while others are farm production practices, and farm financial management.

The second conceptual framework developed on cost of climate change adaptation and presented in Figure 2 shows the linkage between climatic variables with agricultural production, hence food security. Climate change influence the various policies that governments make and the adaptation strategies adopted by victims of climate change. Policies and various Institutions existing also have influence on households' susceptibility to climate change. Crop yield and the livelihood patterns of different households are affected by changes in climate depending on adaptation strategies put in place.

Smit and Pilifosova (2001) observed that the adaptation strategies of households generally determine to a great extent the productivity of ecosystems as well as their food security status. Households' livelihoods and food security is negatively impacted by low agricultural production and productivity due to climate change. It is well known that as defined by FAO (1996) that food security exist 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 health life. Food availability is a function of domestic production, distribution, storage, imports and exports. In most cases food availability is used as a measure of food security.

The conceptual framework was developed on the bases that climate change has an impact on agriculture. To improve on this situation, households adapt to the changed climate with the aim of reducing the effects. However, to achieve maximum yields, the adaptation strategies must be assessed to identify the most economic and effective adaptation strategies. Cost benefit analysis is used to evaluate the strategies such that improved yields can be realized even if there are negative impacts of climate change. This also allows farmers to choose the most efficient strategy.

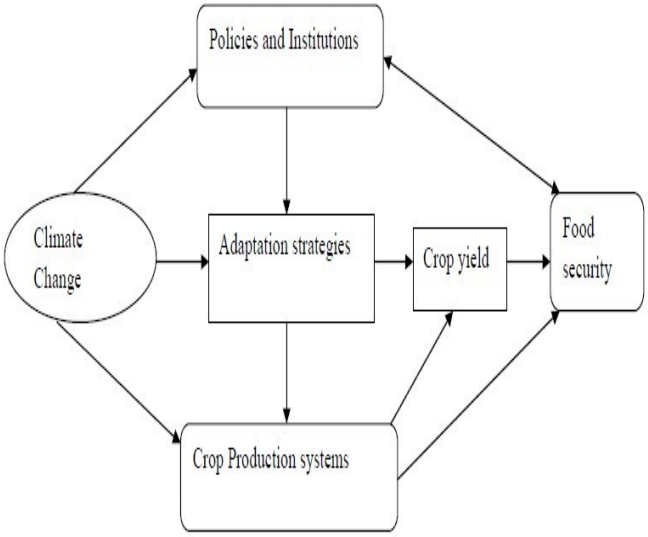

Figure 2.2 *Conceptual framework on Cost of Climate Change Adaptation Measures*

3.0 Methodology

The study was carried out in Ughelli North and Sapele Local Government Areas (LGAs) of Delta State, Nigeria. The two LGAs are among the twenty-five (25) LGAs that make up Delta State. They are both in the Central Agricultural zone of Delta State. The two LGAs were selected for the study because they are the areas where farming is mostly carried out in the zone. **Ughelli North** LGA has the headquarters located in Ughelli town and it has a land area of about 818 Km^2 with a population of 321,028 in 2006 while **Sapele** LGA on the other hand has its capital/administrative headquarters in the Sapele town. Sapele is part of Okpe kingdom which is under the Urhobo ethnic group with a population of 242,652 as of 2005/06 (NPC, 2006).

3.1 Sampling Procedure/ Data Collection

A two-stage sampling procedure was used for the study. Stage one involved the random selection of six communities from each of the two LGAs. This gave a total of twelve (12) communities. The second stage involved selecting randomly fifteen women arable crop farmers from each of the sampled community. This gave a total of 180 small scale women arable crop farmers that were utilized for the study.

Data for this study were collected from primary sources through the use of a structured questionnaire. Data were generated on women small scale arable crop farmers' socioeconomic characteristics, various adaptation measures against climate change, cost of

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climate change adaptation measures and constraints of small scale farmers to adaptation to climate change.

3.2 Methods of Data Analysis

Data for this study were analysed through the use of descriptive and inferential statistics. Descriptive statistical tools such as mean, percentages and frequency tables were used to summarize the data in ascertaining the various climate change adaptation measures practiced against climate change. The cost of climate change adaptation measures was realized by the use of cost and return analysis while the effect of socioeconomic characteristics on cost of adaptation was achieved through the use of Ordinary Least Square (OLS) Regression analysis.

The stated Hypotheses was tested through the use of Multiple Regression analysis.The multiple regression was adopted to examine the effect of socioeconomic factors of smallholder farmers on cost of adaptation measures to climate change. The model is implicitly expressed as:

$COA = f(AGE, MTS, HHS, EDU, FMA, EXP, ACC, EXTC; e_i$

Where:

COA = Cost of Climate change adaptation in Naira
AGE = Age of smallholder farmer (years)
MTS = Marital status (dummy: married 1; otherwise 0)
HHS = Household size (number of persons in a household)
EDU = Educational level (years of formal education)
FMZ = Farm size in hectares
EXP = Years of experience in the farming enterprise (years)
ACC = Access to credit (dummy: If credit was accessed 1; otherwise 0)
EXTC = Extension contact (Number of visits of Extension officers)
$\beta_0 - \beta_8$ = Parameters to be estimated
e_i = Error term

The equation is explicitly specified and tried in four functional forms of the regression model (linear, exponential, semi-log and double-log) and output of the form with best result according to econometric *apriori* criteria was adopted as the lead equation.
The ordinary and transformed values of the dependent and independent variables were fitted into the respective models and analyzed using appropriate statistical package. The regression output that produced the best result in terms of number of significant parameters, values of F- statistic and coefficient of multiple determination (R^2) was chosen as the lead equation.

4.0 Results and Discussion

(i). Adaptation Strategies Employed by Women Arable Crop Farmers against Climate Change

According to Sofoluwe, Tijani and Baruwa (2011) as reported by Shongwe, Masuku & Manyatsi (2014), agriculture is negatively affected by climate change, while adaptation reduces the impact and increase resilience to climate change such that those farmers who adapt are less vulnerable to these negative impacts of climate change. Adaptation strategies employed by the respondents are indicated on Table 1.

The results indicate that the majority (77.2%), of the women arable crop farmers in the area were adapting by using drought resistant varieties. Early planting as a strategy for averting the consequences of climate change on their farming activities was employed by over 97% of the respondents. This goes to show the importance of this strategy in checkmating the consequences of climate change in the area. The use of early planting as an adaptation strategy against climate change by large number of farming household has also been reported by Shongwe *et al* (2014) in their study on Cost Benefit Analysis of Climate Change Adaptation Strategies on Crop Production Systems in Mpolonjeni Area Development Programme (ADP) in Swaziland.

The respondents indicated that they took advantage of early rains as compared to late planting. Two other strategies, minimum tillage (80.6%) and crop rotation (96.7%) were alluded to as among the most effective measure of combating the negative effects of climate change in arable crop production by the respondents. The use of crop rotation as an important method of averting the consequences of climate change has been reported by many researchers including those of Sofoluwe *et al,* (2011) and Shongwe *et al* (2014).

Adaptation strategies that received the least responses were mulching (11.1%) and irrigation (19.4%). This is in support of the work of Abiodun *et al,* (2011) that irrigation involves high capital investment, which can be a challenge to most rural households because of poor financial background. The strategy also needs a good, reliable water source, which is not the case at in most communities under study in both Ughelli North and Sapele LGAs.

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(ii). Cost/Expenditure on Climate Change Adaptation Measures by Women Arable Crop Farmers

The various damages to the farms/products of women arable crop farmers in the study area which are climate-related were identified and the financial cost for their remediation as well as losses were presented in Table 2.

The result in the table shows nine climate-related damages/losses/mitigations and annual remediation values. Most of the respondent women small scale arable crop farmers (91.7%) suffered flooding following heavy rainfall and overflow of river banks after such heavy rains. The swampy nature of some farm land according to the respondents also contributed highly to the flooded situations in the farms. Damage to crops was perceived as the highest climate-related expenditure (₦926, 000.00 annual losses) by the women arable crop farmers in the study area and was ranked first.

These heavy rains occasioned by changes in climatic condition most times created erosion, especially gully erosion causing damage to an estimated value of ₦842,000.00 to over 68% small scale women arable crop farms in the area and was ranked second. In the same vein, Wind storm was equally devastating creating annual damages of an estimated value of ₦832,433.00 to over 81% of the women arable crop farms. This was ranked third. Most of the crops affected in this category were plantain and maize farms. Reports showed that at times, farmers wake up to see all the growing plantain farms with promising bunches all broken and some fallen flats due to the activities of violent wind storm which is one of the consequences of climate change.

Damages to crops by thunder and lightning, rot arising from high temperature (heat), control of excessive weeds and insect pests due to high rainfall, damages to harvests due to absence of sun rays for drying/preservation, control of excessive heat and drought by tree planting and cultural control of erosion and flood were climate related effects as perceived by the women small scale arable crop farmers and were ranked fourth, fifth, sixth, seventh, eighth and ninth respectively.

(iii). Effect of Socioeconomic Characteristics of Women Arable Crop Farmers on Expenditure of Adaptation Measures to Climate Change

The various socioeconomic variables of women arable crop farmers in the study area which could impact on their expenditure on different forms of adaptation measures to climate change were examined. The analysis revealed the effects of the socioeconomic characteristics of women arable crop farmers on the amount of money spent on various adaptation measures against the effect of climate change variables in the area (Table 3).

Four (4) different functional forms were fitted to the data and the lead equation was chosen based on the normal econometric and statistical criteria. The coefficient of multiple determination (R^2) for the double log function was the highest (0.7784). Hence the double log model was chosen as the lead equation and used for further analysis of the data. The result revealed that the R^2 was 0.7784 and showed that the extent to which the socioeconomic characteristics of the women arable crop farmers predicts the amount that can be spent on adaptation measures against climate change effects was 77.8%. The adjusted R^2 was 0.6607 and this indicates that 66% of the variance in the amount spent on adaptation measures was accounted for by the socioeconomic characteristics of the respondents in the study area.

Age of women arable crop farmers, marital status, level of educational attainment, farming experience, access to credit and number of contact with extension agents were all statistically significant in determining women arable crop farmers' expenditure on measures adapted against climate related challenges on their farms. While age of the farmers and contact with extension agents were significant at the 5% level, level of educational attainment, farming experience and access to credit were significant at the 1% level. Marital status of the farmers however was significant at the 10% level.

Age of women arable crop farmers: The Beta coefficient had a positive value (β=0.9072; P<0.05) implies that an increase in age of the women arable crop farmers lead to an increase in the amount of money spent on fighting against the challenges of climate change. This result suggested that a 1% increase in age increased the probability of the respondent to make more expenditure by 0.9072%.

Marital Status: This was found to negatively determine women arable crop farmers' expenditure on measures adapted against climate related challenges at 10% significance level (β=-2.0181; P= <0.10). This result implied that married respondents has the probability of reducing their expenditure on adaptation measures to climate change related problems.

Education: This was found to be a positive predictor (β=0.5157; P<0.01) of amount of women arable crop farmers' expenditure on measures adapted against

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climate related challenges in the study area. This result implied that a 1% increase in level of educational attainment by the respondents had the probability of increasing expenditure on adaptation measures by 0.52%, *ceteris paribus*.

Farming Experience: The number of years of farming experience by the women arable crop is positive and statistically significant on its effect on the level of expenditure on climate adaptation measures. The parameter estimate (β= 0.6254) with a t-value of 4.2256 is statistically significant at the 1% level. This result implies that a 1% increase in farming experience of respondents increases the probability of spending more on adaptation measures by 0.63%.

Access to Credit: Access to agricultural credit by women arable crop farmers had a positive statistically significant effect on the amount of money that can be expended on climate change adaptation measure. With a coefficient value of 4.6472 and a t-value of 3.6557, it is significant at the 1% level. The implication of this is that an increase in financial credit given to the women arable crop farmers will propel them to spend more in combating the challenges posed by climate related damages in their farms.

Extension Contact: The number of contact with extension farmers affected the level at which women arable crop farmers spend to combat the incidences of climate change in the study area. The coefficient (β= 0.6625) with a t-value of 2.5346 is positive and statistically significant at the 5% level. This implies that a 1% increase in the frequency of contact with extension officers will improve the women arable crop farmers by about 0.66%.
The F-statistic value of 15.0693 indicated that collectively all the socio-economic characteristics of the women arable crop farmers significantly influenced expenditure on checkmating damages of climatic variables, and that the regression model was a good fit for the data. Therefore, the null hypothesis which stated that socioeconomic characteristics of women arable crop farmers do not affect their expenditure on adaptation measures to climate change is hereby rejected.

5.0 Summary and Conclusion

The different strategies employed by women small scale arable crop farmers to combat the challenges of climate change indicated that majority (77.2%) were adopting by using drought resistant varieties, early planting was employed by over 97% of the respondents while minimum tillage (80.6%) and crop rotation (96.7%) were alluded to as among the most effective measure of combating the negative effects of climate change in arable crop production by the respondents. Others were mulching (11.1%) and irrigation (35%).

Most of the respondent women small scale arable crop farmers (91.7%) suffered flooding following heavy rainfall and overflow of river banks after such heavy rains and damage to crops was perceived as the highest climate-related loss of ₦926, 000.00 annually while gully erosion caused damage to an estimated value of ₦842,000.00. Damage by Wind storm was estimated at value of ₦832,433.00 while damages to crops by thunder and lightning, rot arising from high temperature (heat), control of excessive weeds and insect pests due to high rainfall were minimal.

The various socioeconomic variables of women arable crop farmers which could impact on their expenditure on different forms of adaptation measures to climate change revealed that age, marital status, level of educational attainment, farming experience, access to credit and number of contact with extension agents were statistically significant in determining women arable crop farmers' expenditure on measures adapted against climate related challenges on their farms. While age of the farmers and contact with extension agents were significant at the 5% level, level of educational attainment, farming experience and access to credit were significant at the 1% level and marital status was significant at the 10% level. The null hypothesis which stated that socioeconomic characteristics of women arable crop farmers do not affect their expenditure on adaptation measures to climate change was rejected.
Apart from labour issues more than half of the respondents rated every other constraint as being an impediment to adaptation measures against climate change in the area. Among these are farm land related constraints which includes limited availability of land for farming, high cost and system of land ownership (tenure system). Other major constraints were rain fed/ unreliable water source, high cost of farm inputs (i.e. fertilizer, pesticides, seeds etc.), inadequacy of information on climate change and poor agricultural extension service delivery system.

5.1 Conclusion

This study concludes that flooding was the major damage to crops incurred the highest climate-related expenditure of ₦926, 000.00 per annum. Age of the women farmers, marital status, level of education, farming experience and access to credit, number as well as contact with extension agents were all statistically significant in determining women arable

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crop farmers' expenditure on measures adapted against climate related challenges on their farms.
Based on the findings of the study, the following recommendations are made:

i. For consistent growth in agricultural production, it is important to equip rural women farmers with relevant and timely information and technology to improve their production techniques and increase their income and standard of living.

ii. There is the need for Government at all levels to make agricultural extension programme more effective through employment of more extension agents so that there will be adequate dissemination of appropriate and timely information to women arable crops farmers so as to enhance production which could in turn improve their household food security, income and standard of living.

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Table 1: Adaptation strategies employed by women arable crop farmers against climate change

Adaptation Strategy Used	Frequency (Did Use)	Percentage (Did Use)	Frequency (Did Not Use)	Percentage (Did Not Use)
Drought resistant varieties	139	77.2	41	22.8
Early planting	176	97.8	4	2.2
Late planting	56	31.1	124	68.9
Minimum tillage	145	80.6	35	19.4
Crop rotation	174	96.7	6	3.3
Mulching	20	11.1	160	88.9
Irrigation	35	19.4	145	80.6
Intercropping	138	76.7	42	23.3

**Note: Multiple responses were recorded*

Table 2: Estimated annual average expenditure/ cost of adaptation on climate related damages in the Farm (180)

Damages/Losses	Frequency	Percentage (%)	Annual Estimate of Cost/Loss (₦)	Rank
Damages to Crops in the Farms by flood	165	91.7	926,000.00	1st
Damage to Crops occasioned by gully erosion in farms	123	68.3	842,000.00	2nd
Damage to crops due to wind storm	147	81.7	832,433.00	3rd
Damage to Crops due to thunder and lightening	132	73.3	723,825.00	4th
Rotting of Crops due to excess heat	117	65.0	642,000.00	5th
Control of excessive weeds and insects pests due to high rainfall	109	60.6	628,120.00	6th
Damages to harvest due to absence of sunlight for drying/preservation i.e. High relative humidity	105	58.3	530,120.20	7th
Control of excessive heat and drought by tree planting	99	55.0	527,060.00	8th
Cultural control of erosion and flood with bonds, cross bars, cover crops and alley cropping	123	68.3	522,300.00	9th

**Note: Multiple responses were recorded*

Table 3: Determinants of expenditure on climate change adaptation measures by women arable crop farmers

Variables	Linear	Semi-log	Double log	Exponential
Constant	2.3624**	0.4572***	0.3658***	0.9907***
	(0.2985)	(4.3651)	(4.9427)	(4.1257)
Age	0.1245	0.8123**	0.9072**	0.6325**
	(0.2743)	(2.4127)	(2.5457)	(2.3254)

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Variables	Linear	Semi-log	Double log	Exponential
Marital status	-0.3755	-2.3913**	-2.0181*	-0.5621
	(-0.1246)	(-2.5128)	(-1.8366)	(-0.6248)
Household size	0.9658	1.7505	0.4733	-1.0728***
	(0.9685)	(1.3734)	(0.3561)	(-3.2721)
Educational level	0.2187	0.5138	0.5157***	1.0139**
	(0.3561)	(0.7851)	(3.1569)	(2.5031)
Farming experience	-0.3525***	0.7854	0.6254***	2.8110**
	(3.9657)	(0.4589)	(4.2256)	(2.9659)
Farm size	0.3546	0.7821	0.4325	0.8198
	(0.2487)	(0.6953)	(0.1254)	(1.9832)
Access to Credit	4.9856***	3.6732	4.6472***	2.0984
	(3.91240)	(0.7892)	(3.6557)	(0.5746)
Extension Contact	0.3682	0.3357	0.6625**	0.4362
	(0.3566)	(0.2548)	(2.5346)	(0.5202)
R^2	0.4957	0.4555	0.7784	0.6213
Adjusted R^2	0.4542	0.4254	0.6087	0.5922
F-ratio	9.1254***	6.4653***	15.0693***	12.5476***

Figures in Parenthesis are t-values
Note *** = Significant at 1%; ** = Significant at 5%; * = Significant at 10%;

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Utilizing ICTs in Climate Change Resilience Building Along Agricultural Value Chains in Sub-Sahara Africa

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A R T I C L E I NFO

Key Words:

Sustainable development,

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ABSTRACT

This study, reviewed the challenges faced by agribusinesses in improving their value chains while under risks of climate change and variability in SS Africa. The study is anchored on the The study is anchored on Motivational Model (MM) and Uses and Gratification Theory.It identified challenges facing them as they attempt to adopt ICT. These ranged from poor access to ICT infrastructure, poor rural infrastructure, poverty, illiteracy, market failures, poor governance/institutional barriers and behavioural barriers among others. We also observed that some ICT tools (e.g. GIS, use of wireless communications, early warning systems and E-resilience development) are capable of boosting agricultural productivity of African's smallholder along value chain even when under climate variability. We documented other adaptation measures farmers were adopting to cope with climate change and variability which include altering of production patterns, adopting new technologies and other climate smart agricultural practices from across SSA. The study also identified options available to African agribusiness and authorities to build resilience against climate change risks such as GIS, E-Governance, Wireless Communications and Early Warning Systems. Such ICT tools can raise the agricultural productivity of African's smallholder farmers across the produce value chain under climate variability in various ways. Based on the findings, the provision of ICT infrastructure, capacity building of farmers and authorities; formulation of appropriate policies that can improve the resilience and productivity of agriculture with ICT tools were some of the key recommendations.

1.0 Introduction

Over the recent years Information and Communication Technology (ICT) has become a very useful tool available for use by both individuals and institutions in mitigating and prevention of harsh impacts of various forms of shocks and emergencies that can affect both economic and physical well-being (World Bank, 2012). Agriculture, the most significant livelihood activity to most of the citizens of Sub-Sahara Africa (SSA) is under the threat of climate change. Even though agricultural activities (which engage about 70 percent of SS Africans) serves as both a mitigating industry and at the same time a major source of carbon sequestration. It is also a major source of global biofuel supplies. According to FAO (2003) in SSA where the level of dependency on agriculture for job creation and provision of household incomes is very high agricultural transformation remains one of the best approaches in

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developing the local food supply and availability. Unfortunately, credible institutions are warning about impending negative impacts of climate change with some degrees of positive impacts in some areas especially in SSA (Inter-Governmental Panel on Climate Change, IPCC, 2001a, 2001b, 2001c).

Of late, climate variability unarguably continued to influence temporal fluctuations recorded in SS African agricultural production and other low income economies of the world. The most serious threat, according to IPCC (2001a) is drought. A fluctuation of that nature could be reversed through investment in irrigation or via import of foods. However, these options are very difficult for low-income economies as SSA countries. Any level of decline in the quantity and quantity of available agricultural resource to the farmers can spell a significant negative effect on their livelihoods (especially food security).

So far, the responses to these threats have largely been confined to boosting economic growths and diverting economies from over reliance on agricultural resources that are vulnerable, developing new resilient technologies capable of adapting to the varying ecological conditions and climate change. So far, at the regional, national and local levels, many new policies have been formulated to facilitate uptake of resilient practices including a host of innovative financing mechanisms aimed at insulating farmers from the negative effects of climate change. Unfortunately, there are no sufficient documentation on how such innovations have worked or how they can be up-scaled for improved agricultural productivity and resilience building across the Sub-Sahara African agricultural value chains.

For instance, while identifying the key the UN Economic Commission for Africa (UNECA) (2014) identified the major, comprehensive options Africa could adopt in responding to various climate change scenarios predicted for the current and projected periods left out the use of ICT. This assertion was corroborated by Ospina and Heeks (2010) who regret that a review of literature on ICTs and climate change showed that "not only is the literature, overall fairly limited to date", but were seriously deficient in discussion of contemporary country priorities and climate change adaptation. The issue of small scale farmers in developing economies who remained locked out of access to critical information needed to build up their agricultural productivities were insufficiently addressed. Meanwhile, if given access to the right information and conditions, these farmers can attain the frontier of their productivity growth (Plechowski, 2014). FAO (2003) offered hope when it observed that progress in scientific knowledge and technology which we now have could potentially help in improving crop productivity. It is therefore surprising that even in this present information age, not much is known about how ICT can be effectively utilized in building resilience against shocks related to climate change and variability. Just like agricultural market information, climate information can help farmers, agricultural policy makers, commodity consumers and traders, researchers and other agricultural stakeholders in African agricultural value chain to take an informed course of action that will result in value addition to agriculture. Since current options in ICTs have not been well explored by policy makers and stakeholders in African agriculture as earlier noted, this study therefore comes as a timely response to this gap.

1.1 Research Aim and Objectives

The broad objective of this research therefore, is to review the options available in literature amenable to the use of ICT for disseminating climate information which can strengthen the entire agricultural value chain in SSA. Specifically, the following objectives were explored, to:

(i) describe the climate change related challenges faced by farmers in their attempts to improve their value chains in SSA;

(ii) explore options available to African agribusiness firms to build resilience against climate change risks that face different aspects of agricultural value chain in SSA.

(iii) describe the major challenges faced by farmers in improving productivity along value chains of agriculture in SSA.

1.2 Theoretical Frameworks

The study is anchored on two major theories of innovation and technology adoption : Motivational Model (MM) and Uses and Gratification Theory. The Motivational Model, a theory proposed by Davis, Bagozzi and Warshaw (1992) holds that use of any system is explained by two major factors: intrinsic and extrinsic motivation. The extrinsic motivation is a perception which holds that users or adopters of technologies (or innovation) are goaded to carry out a given activity as a result of their perception that the activity will be instrumental in attaining some valued outcomes that are distinct from the activity itself, such as improved productivity of their production system. On the other hand, the users of the technology or innovation may like to embark on some activities with no vivid reinforcement besides the process of adopting the technology or carrying out the activity per se. Davis et al (1992) idndicate that while

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percieved usefulness may be a perfect example of an extrinsic motivation, perceived enjoyment or gratification is an example of an intrinsic motivation. Thus, in general the *quality of output and users' perceived ease of use exerts major impact on the perceived enjoyment and usefulness of adoption of the technology.*

Taherdoost (2017) reviewed the Uses and Gratification Theory (U&G Theory) as proposed by Grellhesl(2010) and Chen et al (2015). The theory analyses the factors that drive people's involements in communication medium compared to others. This use of media has gained much from gratifications. The U&G Theory focuses more on the social and psychological dimensions of users' use as they seek for motivation and satisfaction. The theory constitutes of three major aspects: constructs, motivations, behavioural utilization and gratification or satisfaction. They see motivation as the general dispositions which exerts effects on individuals for their requirements. Accrording to Terhdoos (2017) the U&G model is applicable in media environment for communicaation purposes and can also be used where the media is used for work process (such as agriculture in our case) or games.

2.0 Literature Review

2.1 Climate Change and its Impacts on Agriculture in Sub-Sahara Africa

IPCC (2001a) defined climate change narrowly as "the statistical description, in terms of the mean and variability of quantities such as temperature, precipitation and wind over a period of time ranging from months to thousands of years." However, IPCC noted that, based on Meteorological Organization (WMO), the norm is 30 years. The term "Climate" differs from "weather" which refers to atmospheric conditions in a given place at a specific time. According to Wilkinson (2006) climate change connotes a major statistical variation in either the mean level of an area's climate or a variation in its variability over a long period of time, usually in decades or beyond. According to Morton (2007), some key climate risks affecting households include drought, flood, market shocks, crop and animal disease. According to the IPCC Fourth Assessment Report, temperature rises will surpass the expected global mean increase of 2.5^{o}C in every regions of SSA (Christensen et al., 2007 and TerrAfrica, 2009). In addition, global warming was expected to be intensive around the central semi-arid tropical fringes of the Sahara and the central southern Africa. In all, the subtropics were projected to get drier, with the tropics probably witnessing a slight increase in precipitation (Christensen et al., 2007; Cline, 2007 in TerraAfrica, 2009).

2.2 ICTs and Climate Information in Agricultural Value Chains

Minischetti (2013) defined ICTs as "any product that can store, retrieve, manipulate, transmit or receive information. Examples, personal computers, television, radio, email and mobile phones." Other types of ICTs found to be adoptable in agriculture, according to Minischetti, included Mobile Agriculture also known as mAgri); services related to provision of knowledge exchange networks and other information services for agricultural production such as: (i) mobile facilitated payment systems, (ii)financial services (e.g. electronic cash transfer services), (iii) weather forecasts, (iv) weather index, (v) market information services and (vi) agronomic information services. All these can help build the agricultural value chain as they link farmers to input providers, buyers, other farmers, meteorological agencies and financial institutions which will in the end help them boost their productivity across their commodity value chains.

With increasing popularity of mobile phone technology in developing economies, including SSA, ICT utilization for agricultural development is gaining ground faster than previously imagined. ICTs have been used for projects, such as for Projects involving monitoring water points, provision of cash transfers using mobile phones and applications (Apps) are forms of use of ICTs in farming. Livelihoods markets-based programmes, especially in rural and agrarian communities are now benefitting from some organizations who are adopting ICTs for strengthening their pro-poor service deliveries. Such programmes improve rural livelihoods through provisions of access to information like finding the best prices available at the nearest areas for farm inputs and products, locating transportation or vehicles that will convey their farm produce or help them travel around (e.g. Uber services), provision of weather forecasts and e-payment services, credit or insurance (Minisetti, 2003).

Small holder farmers too have the opportunities to raise their incomes by effective participation in commercial agricultural supply chains. However, Sen and Choudhary (2001) noted that a lot of challenges abound in attempting to include them in the highly commercialized agribusinesses systems. One reason they gave is that, for instance, for agribusinesses, high transaction and monitoring costs required to ensure quality, safety, and timely delivery are usually involved when other commercialized agribusinesses are interacting with a large group of small-scale farmers. These farmers may not be able to pay.

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Participation of the small holder farmers can pose high risks as there are other additional needs which they may not be able to meet up. For instance, there are further needs for access to inputs and training to satisfy stringent quality requirements which also attract costs. ICTs, while facilitating exchanges and flows of useful agricultural information between different parties all along the agricultural supply chain can equally aid in managing financial transactions, arranging logistics, and ensuring that quality specifications are well understood by the farmers before they supply the required goods by the consumers. However, when the right conditions are provided, agribusinesses can provide incentives, capacity, and necessary resources to provide and utilize appropriate technologies that can support inclusion of the small scale farmers too. Government at different levels have significant roles to play through relevant supportive policy formulation and implementation , forging public-private partnerships that can develop ICT applications. They can also do more by building and utilizing their own ICT applications for farmers too.

Markets do have strong roles to play in reducing farm households poverty in SSA and strengthening the agricultural value chains. However, there are a lot of constraints along the value chain that need to be surmounted for the smallholder agriculture to benefit from agricultural markets. These challenges range from -- problems of inadequate infrastructure, poor policies and weak institutions to poor provision of capacity building of farmers and inadequate access to technologies (including use and access to ICTs) as well as capital (ICRISAT, 2014). Miller and Jones (2010) defined value chain as a group of actors (including service providers, the public and private) and the various steps of value-adding activities encompassed in moving a product from production phase to the final consumer (or consumption). This is akin to what is referred to in agriculture as a 'farm to fork' group of processes and flows (Miller and da Silva, 2007 as cited in Miller and Jones, 2010). Paradoxically, value chain analysis also involves evaluation of the various agents and factors which significantly impacts on the performance of an industry, the relationships existing among its participants to proper identification of what constraints drive growth in efficiency, productivity and competitiveness of the industry, and how such challenges may be overcome (Fries, 2007 as cited in Miller and Jones, 2010).

Islam (2010) asserted that effective management of knowledge is said to have occurred "only if knowledge and information are conveyed to the right individual at the appropriate time in a user-friendly manner that is within reach thus helping the recipients to perform their jobs efficiently." They identified the outcome of effective knowledge management as including improved productivity of the agricultural sector's value chain. ICT has the capacity of penetrating the value chains to boost the knowledge and capacity of the value chain and thus raising farm productivities.

2.3 Challenges Facing Sub-Sahara African (SSA) Farmers in Improving their Value Chains Under Climate Change and Variability Risks

Approximately 80 percent of Africans south of Sahara reside in rural areas and depend on agriculture as their means of livelihoods, yet since 1991 there has been a declining trend in investment to agriculture by the governments of many African countries (UN Economic Commission for Africa [UNECA], 2011). Thus, over the years Agricultural productivity had declined significantly while poverty had increased owing to persistent increase in cost of agricultural inputs, prevalent market failure, inadequate access to farm credit, and rising cost of efficient irrigation in rural areas. To worsen the situation, many African countries failed to integrate climate change adaptation strategies (including building e-resilience e.g. use of ICT) into their national agricultural and economic development policies. The dearth of suitable policy frameworks to enhance such integration had largely resulted in the recorded decrease in investments in the agricultural and rural sector over these periods in contention. All these render agriculture in Africa significantly vulnerable to the negative effects of both short-term variability in climate and long-term change in climate.

The Fourth Assessment Report of the IPCC (1PCC, 2007) showed that temperature increase had been lingering since 1960s on the continent, though dotted with significant pockets of variations at different regions. These could potentially increase spoilage of foods in store, induce disease infestation and pests outbreak due to incidence of migrating insects and other pests. ICTs also hep in building knowledge on crops' projected responses to climate change in future through modelling of some crops' responses to climate change from controlled agronomic experiments using crop growth simulation models (Hassan, 2008). Such model have earlier shown projected poor yields and productivity which paints a worrying level of exposure to agricultural production risks in the entire agricultural value chain in Africa. Worsening the vulnerability of the agricultural value chains are factors such as too much reliance on rain fed agriculture, decay in the poor existing rural infrastructure, high poverty rates and poor status of

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physical and human capital development. The entire scenario compounds the problem of poor access to agricultural inputs and factor markets Therefore, to develop SSA agriculture would require radically new policies which will factor climate change into the development programmes and policies so as to stimulate the right investments from the public and private sectors in agriculture.

According to the International Food Policy research Institute (IFPRI) (2013), there had also been a steady increase in water scarcity and quality loss which have been attributed to increase in economic activities, population increase, negative impacts of climate change and inappropriate management of water resources. These reduce productivity in agriculture across various value chains too either in livestock production or in staple or cash crop production. For instance, livestock grazing grounds or ranges will be depleted or reduced in acreage as water scarcity deepens thus reducing even the available water for the livestock consumption. This will definitely affect the productivity of livestock in SSA.

With respect to increase ICT adoption in SSA, Productivity Commission (2012) identified the following major barriers : inefficient market systems, poor regulatory regimes, poor governance, weak institutions and behavioural barriers to adoption of ICT in agriculture. With respect to inefficient market system or market failures, we can see this when there are conditions that work against the attainment of optimal and efficient allocation of agricultural resources in the production process. For example, in the absence of appropriate information on climate change impacts useful for agricultural commodity consumers or for either private or public sector required for making well informed decisions on adaptation, a barrier to adaptation will occur. This then can worsen the problem of poor access to climate related information as well as poor market information system. This is where ICT can play a major role in providing information. Poor regulations such as inability to integrate building and town planning regulations can potentially hamper adaptation to climate change for instance where environmental hazards (which could be a consequence of this poor regulation) can result in flooding. Weak governance and institutions could become barriers when governance plans which are not in sync with best practices impede attempts to coordinate governments and agencies for instance leads to reduction in accountability or rather cause authorities to be assigned responsibilities for which they do not have any capacity to effectively execute. For instance, this can be seen when the present legal liability of councils is not known with certainty while making land use decisions related to a land that is vulnerable to future risk of climate change (Productivity Commission, 2012). With respect to behavioural adaptation, this implies how people assimilate and process information and make decisions with it and by so doing possibly constitute hinder effective adaptation. For instance, when given a projection on possible climate change impacts, an individual may be unable to assess the costs and benefits of decisions to be taken to adapt on a long term. This may result in such entities responding poorly to the real and uncertain impacts of climate change through deferment of needed adaptation decisions which could have been done in their own best interest.

Other barriers in adopting ICT in building resilience along agricultural value chains were equally documented for Ethiopia by UNDP (2012) as a case study for SSA. Davis et al (2010) as cited in UNDP (2012) noted that budgetary shortfalls, poor infrastructure as well as localized technical information were the major constraints to agricultural extension services in Ethiopia. Poor access to electricity and poverty which is exemplified by lack of electronic equipment such as TVs and computers that information workers and farmers needed to effectively discharge their works largely constrained their productivities. Owing to the fact that some schools in Africa do not have modern teaching equipment such as computers and access to the internet, it would be important to build capacities of teachers who can train young and old farmers whenever authorities concerned provide these facilities.

2.4 Available Options to Build Resilience Against Climate Change's Risks in SSA Agricultural Value Chains

According to IPCC (2007) resilience implies the ability of a system (ecological or social) to take in disorder without losing its fundamental composition and ways of operating. Resilience, as a concept extends to elements of transformation to better states. There have been a lot of practices and technologies adopted in the past and present in SSA and other places to build resilience in agricultural value chains against shocks of climate change. Some of these practices can be referred to as adaptation practices. Any adjustment by human or natural systems as a response to real or anticipated climatic stimulus or their impacts, which reduces harm to its minimum level or take advantage of rewarding opportunities is called *adaptation* (IPCC, 2001a, 2001b). The adaptation types could be anticipatory or reactive; planned or autonomous; public or private. The IPCC also referred to it as "the ability of a human or natural

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system to minimize potential damages, to take advantage of opportunities or to cope with the outcomes."

There are many other adaptation strategies applied by Sub-Saharan African farmers. These in specific terms include improving crops and agricultural practices, biofortification, erosion reduction and other use of climate smart agriculture to enhance resilience to climate shocks (United Nations Systems Standing Committee on Nutrition, 2014).Some of adaptation measures to climate change identified by Kaliba and Rabele (2009) included irrigation, mulching, crop rotation, terracing, contour planting, intercropping, cropping along flood plains, bonding, changing timing of planting, planting early maturing crop varieties etc. Empirical work of Kalibba and Rabele (2009) indicated that the most common adaptation strategy utilized by the farmers in building resilience against climate change and related environmental problems were crop rotation, fallowing, construction of waterways, vegetable cover, contour farming, sandbag construction and interplanting. Onyeneke and Nwajiuba (2010) in an empirical research found that diversification of crops planted, soil conservation measures, changing planting dates, planting of trees, irrigation and rainwater harvesting were the most common forms of adaptive strategies to the harsh effects of climate change by the crop farmers in Eastern Nigeria. Some other resilience building approaches related to livestock production include improved livestock management practices, rearing of disease resistant and hardy stocks of livestock as well as adoption of mixed farming.

On the policy side, earlier in this report, it was hinted that UNECA (2014) proposed a multifaceted options to Africa in responding to climate change scenarios whether it is the projected or current levels. These include applying appropriate policies; domestic and foreign mobilizing foreign finance; adoption of climate research for development (i.e. CR4D); investments on clean energy, irrigation and promotion of green economy.

Another way of building resilience that is yet to be largely explored in SSA is what is now referred to as building e-resilience. Ospina and Heeks (2010) defined “e-resilience” as "a property of livelihood system to adapt to the effects of climate change." E-resilience, they observed, more generally aimed at facilitating the process of identification, incorporation and analysis of ICT’s potentials with respect to its contribution to climate change adaptation. This should be a part of the complex set of linkages and interactions already existing within the context They equally noted that with the use of geographic information systems (GIS), use of computer applications including positioning and modelling software, ICTs would be able to improve the physical readiness of livelihood systems for climate change related extreme events. These, then can subsequently improve the design of the defences and also determine their best location; and by so doing, enhancing the robustness of the livelihood system.

Sen and Choudhary (2011) noted that modern ICTs and their applications significantly affected smallholders’ inclusion in commercial supply chains. Through the use of ICT applications, especially when guided by sound business logic, inclusion of small scale farmers can be enhanced through one or more of the following interventions in the agricultural supply chains: i) reduction of coordination costs. ii) enhancement of transparency in inter partners decision making process; iii) reduction of transaction costs; iv) dissemination of market demand and price information; v) transmission of weather related, pest infestation or outbreak and risk management information for more proactive decisions; vi) dissemination of best practices that can meet high quality and certification standards; vii) collection of management data from the farm or field; and viii) ensuring traceability. Such interventions, they noted, have were erstwhile driven by both private and public sectors. Due to a slight variation in their focus and resource base, the nature and sustainability of ICT applications they propound also varies.

An ICT tool called Supply-chain management (SCM) software running on networked computers and handheld devices typically can also be applied in African agribusiness firms to boost productivity under any conditions of uncertainty (including climate change and variability). This software has been discussed extensively in Payne (2010), and Sen and Choudhary (2011). Sen and Choudhary (2011) noted that the software performs some or all of the following functions: (1.) Stores data about suppliers. In the context of sourcing agricultural products from smallholders, this function would allow a food processing company to know which farmers grow what, as well as other information, such as farmers’ names, locations, previous transactions, and previous performance. Such a database makes it much easier to deal with a large base of smallholders; (2) Allows the company to pass on an order to farmers. The order would stipulate what is required, when it will be collected, and how much will be paid for it; (3) Preferably, lets production to be monitored, making it possible to manage quality and incentivize high performing suppliers or support poorer performers.

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(4) The software could also provide answers to queries such as which farmers are on schedule, which are behind, and how much product has already been collected from each farmer. If connected to the bank accounts or mobile transaction accounts of the procurer and supplier, such software might also transfer payments when orders are fulfilled. (5) Lastly, SCM software might track the transport of goods from the farm gate to the warehouse or retailer. Such tracking can give an explanation or data about what damage that could have hindered effective movement of agribusiness product from farm to the market probably because of risk of climate change related risks such as flooding or erosion which could have destroyed the roads on which the commodity were transported. The above functions can enable an agribusiness build financial resilience against climate change effects. For instance, it was noted that the software could provide answers to queries such as which farmers are on schedule, which are behind, and how much product has already been collected from each farmer. If the farmer is behind as a result to late arrival of rain occasioned by climate variability or change such data can be retrieved from the software later and used for policy making against climate change and variability that can impede growth of the agricultural value chain. Farmers suffering from delays occasioned by delayed planting dates or other climate change related risks which have led to untimely delivery of commodity to suppliers, may be traced using GIS mapping with barcodes but is typically done by physically marking the items

2.5 Strategies Adopted by Some African Countries in Upgrading their Authorities' and Farmers' Capabilities using Various ICT Tools

Evidence abounds on current increasing ICT penetration in Africa. For instance, World Bank (2012) asserted that growth in access to and use of ICT across the developing world had been exponential. This, they noted included the entire range of telecommunications networks, information technologies (IT), and electronic services (e-services). There is no doubt that ICT has been growing stronly lately in Africa. A study, the report noted, found that between 2002 and 2008, while the French telecom market grew at an annual rate of 7.5 percent and the Brazilian market at a rate of 28 percent, the African market experienced 49.3 percent annual growth. Within the same period, the African continent's mobile phone use grew at an annual rate of 65 percent, which was twice the global average. Internet penetration, they also noted, even though was still low in Africa, registered the world's highest growth rate at 9 percent in 2009, with public-sector institutions fast embracing the use of internet in their daily operations. Farmers suffering from delays occasioned by, for instance delayed planting dates or other climate change related risks which have led to untimely delivery of commodity to suppliers, may be traced using GIS mapping with barcodes but is typically done by physically marking the items. Even though this study noted that not much emphasis has been placed by policy makers in adopting ICT as a tool for building resilience of farmers in various agricultural value chains in SSA, there are some few and remarkable success stories of adoption of ICT policy frameworks and technologies in some SSA countries. An exposition on such attempts can serve as lessons for up-scaling such successful strategies in other parts of SSA countries. This is the rationale that informs the discussion in this sub-section. One of such documented cases is a report from Magrath (2008) who noted that in Uganda, a country highly vulnerable and affected by climate variations and shocks, iPods and podcasts were being used in marginalized communities to access creatively-packaged content relevant to their livelihoods. The content includes generic agricultural improvement information but it could also include changing seed/crop choices and changes in agricultural practices. Kairo et al (2002) observed that remote sensing and GIS technology have been applied to map, rehabilitate and sustainably manage mangrove forests in Kenya. In the same vein, Kelly and Adger (2000) indicated that, given mangrove's role in reducing storm damage, the technology had aided in enhancing coastal defences and made these areas more robust even under the threat of climate events such as increased cyclone intensity. The World Bank (2012) reported that in a bid to refine ICT's role in the public sector, Mozambique had since long embraced policies aimed at leveraging ICT as a poverty reduction based on its ability to render better service and much offer of transparency in public sector institutions. Based on such policy framework and in a bid to enhance safety nets for cities and urban citizens, Mozambique started upgrading its local governments' capabilities using various ICT tools such as Geographic Information Systems (GIS), E-Governance, Wireless Communications, and Early Warning Systems. However, as the country made progress towards applying ICT in this direction, the World Bank report noted that the impact on the poor was not known. This therefore begs for proper study that can involve poverty and social impact analysis (PSIA) to be conducted for the purpose of gaining insights into the extent of impact of ICT related interventions on building of e-resilience against climate change and variability in Africa. USAID's Trade and Investment Program for Competitive Export Economy (TIPCEE) in Ghana was innovative in its use of ICTs to enable

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fruit and vegetable exporters to become sufficiently competitive to link with international value chains. There are lessons to learn from this project with respect to building resilience against climate change risks in agricultural value chains in Africa too. The project used barcodes, GPS, and geographical information system (GIS) to ensure that produce could be traced to the smallholders who grew it, a major requirement to participate in the target export markets (Sen and Choudhary, 2011). GPS readers communicate with global positioning satellites to specify the exact location of a place on the earth's surface through latitude and longitude coordinates. These coordinates can be collected from the boundaries of a particular farm and fed into a GIS application on a computer, which can map the location of the farm, often with great precision. After a farm is mapped electronically, a product from that farm can be traced back easily to the source if the product is marked with the coordinate information, which can be done with barcodes but is typically done by physically marking the items. By so doing, GIS maps can, in conjunction with barcodes, ensure traceability. Once such farmers are traced (and assuming their problem of delayed supply came as a result of climate change risks) they can be assisted to build resilience through capacity building after being identified. This is one way GIS can help in building farmers' capacities especially in building resilience against climate change risks in agricultural value chain. Naburo (2000) documented the use of ICT in effective land use management which can boost agricultural productivity by demonstrating how integration of remote sensing and GIS could improve or boost land use planning for sustainable natural resource management within the mount Cameroon region, Central Africa. A UNDP (2012) report which studied the adoption of ICT in agricultural production in Ethiopia noted that Information and communication technology (ICT) can play a critical role in facilitating rapid, efficient, and cost effective knowledge management. Meanwhile, ICT in Ethiopia still trailed behind other African countries. It was also noted by UNDP (2012) that in several SSA countries, small scale farmers were accessing technology related counsels in addition to location-specific market information related to farm inputs and outputs via ICT kiosks.

These were in addition to mobile telephone services which they used to deliver agricultural information to users. It was equally noted that in Ghana, Esoko, a local company, implemented Cocoalink, a pilot programme which provided cocoa farmers with useful information on how to improve their farm practices such as better farm safety measures, disease control and prevention in farms, postharvest processing and production, and farm produce marketing. In this programme farmers were given information and specific answers to questions at no cost via voice and SMS messages in their local language or English. In Kenya farmers were provided with agricultural insurance products through mobile phones. Three organizations: UAP Insurance, Syngenta Foundation for Sustainable Agriculture and Safaricom had developed a product called pay as you plant insurance. This insurance scheme assists farmers to hedge risks in agricultural inputs against severe weather conditions such as drought or flood. To be covered under the scheme, farmers were only required to pay an extra 5% for a bag of seed, fertilizer or other farm inputs. In a similar way, in Mozambique, a company called Agricultural Marketing Service (SIMA) collected and disseminated nation-wide and provincial data on market prices, product processing and availability using a variety of media including text messages, email, internet, national and rural radios, television and newspapers. The report added that a study conducted in selected countries in Sub-Saharan Africa (Tanzania, Malawi, Mali, Mozambique, Ghana, and South Africa) indicated that rural radios with innovative programmes, including dramas and radio forums tailored to local communities, were very effective way of communicating agricultural messages. In Nigeria, there was a provision for an extensive publicity campaign to popularize projects and stimulate participation in the nation's National Agricultural Investment Plan using ICT as a tool (Federal Republic of Nigeria, 2010) . The use of Information-Communication-Technology (ICT) mechanism was being developed to support the process, the report stated. Most NAIP projects (particularly those with bias for crop production) offer farmer support as well as capacity building . They also develop groups, build marketing access opportunities, offer agricultural finance services, development of rural infrastructure and improvement off-farm livelihood activities. The Nigerian Federal Ministry of Agriculture and Rural Development (FMARD) also distributed mobile telephones to a score of farmers who were duly registered as a way of targeting them for fertilizer distribution and provision of useful information for their farm production. A few examples of ICT use in Africa lately to build resilience in agricultural production are as follows: First is the case of use of ICT on intensive basis for increased irrigation efficiency. According to e-Transform Africa (no date), the increased utilization of ICT could have a positive effect on irrigation efficiency. The report indicated that Egypt depends almost exclusively on the Nile River for its water supply out of which 85 per cent is used for irrigation. One of the two cases of ICT use in the case of Egypt

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irrigation is exemplified here. The case in view is the Integrated Water Resource Management Action Plan which the Ministry of Water Resources and Irrigation in Egypt had been reportedly implementing in response to the increasing demand for water while the options for increasing supply remained limited. It is being implemented on more than 2,000 km in the Nile Delta, covering the command of two main canals, Mahmoudia and Mit Yazid. The project, according to Levidow, Zaccaria, Vivas and Todorovic (2014) focused on improving irrigation and drainage management and increasing the efficiency of irrigated agriculture water consumption and services in the site. The plan was aimed at improving irrigation and drainage systems and the water management institutional structure, the report noted. According to e-Transform Africa (no date) the first phase of the project had resulted in crop yield increases of 20 per cent, with drainage estimated to account for 15-25 per cent of this increase. A further benefit, it noted is the re-use of drainage water. The second application is the use of ICT as a tool for increased traceability of livestock. This is another initiative where ICT is deployed in Africa successfully for livestock production. According to e-Transform Africa (no date) livestock production remains the most widespread and generally practised agricultural activity in Africa. Given that, as a result of intensified use of ICT in livestock and meat production efficiency improvement is attained in selected African countries, significant increases in production are could be attained at affordable cost. Besides, these methods are relatively easy to replicate in areas with diverse natural landscapes, the potential for general increased wealth creation in all parts of the continent could be massive. The Namibian Livestock Identification and Traceability System (NamLITS), was studied by the report. In this system official identification was done through the use of animal identification devices as required by international standards. Other technologies being used include use of Radio frequency identification (RFID) particularly when automated data input as well as visual plastic ear tag that supports remote pastoral production in the face of limited technological support. To backup the system, branding of animals is continuing. Eligible cattle were given tags as part of a specific campaign after which further tagging took place during annual vaccination campaigns or community visit-based surveillance activities. Where there were no handling facilities or where they could be in a state of disrepair, mobile crush pens were normally used. Besides the above uses, the e-Transform Africa report (e-Transform Africa, 2012) noted that ICTs could be used when conducting spatial analysis or targeting of programmes; in improved risk management; improved financial services delivery for farmers. It could also be used in e-Education and for Virtual aggregation of small stakeholders for policy making.

2.6 ICT For Enhancement of Agricultural Value Chains' Productivities

FAO (2013) observed that information services provided data that were tied to helping farmers boost their productivity, yields and profitability along the various agricultural value chains. Such information systems, if adopted in Africa can enhance the productivity of the various value chains in SSA agriculture. Information services, according to FAO (2013) are one of the most common ICT-related categories for inclusive agricultural value chains. The FAO (2013) manual broke down these ICT-related information for value chain productivity enhancement into sub-categories of information services that involve short-term and long-term productivity enhancements; those that minimize the harsh effects such as informing farmers on how to protect crops from freezing weather in the short term; and those that could improve field-based risk management.

3.0 Conclusion

This study reviewed the potentials of ICT in developing African agricultural value chains. It was evident that the potentials were enormous and SSA cannot continue to relax while other regions of the world are accelerating their agribusiness resilience against climate change impacts. The study, after charting a theoretical frameworks for the research focus, reviewed the major challenges facing SSA agribusiness in their bid to boost their value chains under risks of climate change; explored feasible options in available to SSA in building resilience against climate change's risks in agricultural value chains after which it documented the various strategies that were adopted by some SSA countries in upgrading their authorities' and farmers' capabilities using various ICT tools. The researchers found several challenges ranging from poor access to ICT infrastructure, poor rural infrastructure, illiteracy, market failures, poor governance/institutional barriers and behavioural barriers among others. The researchers also noted that ICT tools such as GIS, E-resilience, wireless communications, and early warning systems can raise the agricultural productivity of African's smallholder farmers across the produce value chain under climate variability while we also identified other adaptation measures farmers were adopting to cope with climate change and variability in Africa. Based on our findings it is hereby recommend that African governments should take advantage of the potential role that ICT can play in enhancing the productivity of their agricultural

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value chains by implementing robust ICT programmes in their countries in collaboration with their ministries of agriculture and rural development in order to harness and turn the potentials into real development benefits. African governments, NGOs, international donors and other stake holders in SSA agriculture need to help address the issue of poor access to ICT infrastructure and services, as well as power supply problem in many SSA countries. Lessons from other few African countries implementing new programmes to build e-resilience in their agricultural value chain such as success stories from Ghana, Kenya, Malawi and South Africa in this aspect need to be up scaled by other African policy makers. For instance it will be agriculturally rewarding to embark on establishment of rural ICT kiosks, establish and strengthen community radios, integrate ICT at all levels of education, and make ICT hardware affordable to the users especially those in agriculture. With mobile phone platforms a veritable opportunity now presents itself for reaching out to farmers and knowledge intermediaries. Therefore use of mobile phone platforms' use in disseminating knowledge and information should be well explored and utilized. The use of ICT in intensifying irrigation efficiency is another practice that, if adopted in irrigation projects in Africa where there are problems of drought and aridity crop productivities can be raised to a higher level. Proper study that can involve poverty and social impact analysis (PSIA) needs to be conducted to gain insights into the extent of impact of ICT related interventions to build e-resilience against climate change in Africa. There is also an urgent need to elevate the position of African agriculture in international climate change negotiations. Such interventions should be based on win-win technological options that improve land use efficiency and increase crop and livestock productivity. In addition, appropriate policies need to be developed along crop and livestock production value chains that enhance the viability of agriculture as an economic activity.

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Estimation of Climate Change Influence on Poultry Production in Nigeria

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ABSTRACT

Poultry farming is at risk of both direct and indirect impacts of climate change effect. Hence, this study examined the estimation of climate change influence on poultry production in Nigeria. It is apparent that climate change has become a global phenomenon. In Nigeria, the prospect is that climate change will have adverse impact, not only as a result of anticipated warming and erratic rainfall patterns, but due to vulnerability of poultry birds. Its effect on poultry production will be of great magnitude, affect the growth, adaptation and production of poultry egg and meat. This study estimates the trends of poultry meat and egg production in Nigeria from 2009 to 2020, using Ordinary Least Square model. The study estimates that the annual growth rate of poultry meat and egg, between 2009 and 2020 to be 3.12% and 3.93% respectively, Durbin-Watson estimates (1.5; 1.3) obtained for poultry meat and egg production respectively (signify that the test is inconclusive; however, absence of autocorrelation is an indication that the OLS coefficients or parameter estimates are statistically unbiased and gives credibility to the data) indicate the positive correlation and acceptability. Poultry meat (0.002) and egg (0.0008) were found to be statistically significant at 1% probability value. The result shows that precipitation was significant at 1% for poultry meat, while precipitation is significant at 5% for poultry egg production. CUSUM and CUSUMSQ test presents the suitability of OLS for the study. Also, the study extensively elaborates on the possible adaptation strategies to climate change as a means of curbing and sustaining poultry farming in Nigeria. Conclusively, policy implications necessary to counteract the adverse impacts of climate change in poultry farming that can foster sustained productivity increases were proffered. This includes, embarking on enlightenment campaigns on climate change adaptation strategies so as to facilitate the adoption of appropriate poultry management practices.

INTRODUCTION

Climatic change presents a major hazard to the sustainability of poultry farming practices globally. As a result, adaptation to, and mitigation of the harmful impacts of extreme climates has performed a vital role in coping with the climate change impacts on poultry farming (Sejian, Bhatta, Soren, Malik, Ravindra, Prasad & Lal, 2015). There is little doubt that climatic variation will have an effect on poultry productivity in several regions. Climatic change may possibly reveal itself as prompt changes in climatic condition in the short period (some years) or more sharp changes more than decades. In general, climatic change is connected and bonded with rising worldwide temperature. Several climate model predictions propose that by the year 2100, average global temperature might be 1.1–6.4ºC warmer than in 2010. The problem confronting poultry is weather condition extremes such as: severe heat waves, high humidity, high temperature, floods and droughts. Beside production deficiency and high cost of inputs, severe events also result in death of poultry birds (Gaughan & Cawsell-Smith, 2015), reduction in egg size, thin or poor egg shell formation, reduction in growth rate, low egg production, low feed intake, and poor meat production. Poultry birds can adapt to warm climatic conditions; nevertheless, the reaction techniques and mechanisms that are beneficial for survival and growth may be unfavorableas well as could disrupt production and reproduction ability of the birds (Sejian, Gaughan, Bhatta & Naqvi, 2016). Hence, this study stressed the effect of climate change and adaptive strategies in poultry farming in Nigeria. The remaining part of this paper is divided into literature, methodology, results and discussion, and conclusion and recommendation. The specific objectives of this study were:

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i. to estimate the temperature and precipitation trends in Nigeria from 2009 to 2020; and
ii. to estimate the trends of poultry meat and egg production (in tons) in Nigeria from 2009 to 2020

Concept of Climate Change

The United Nations Framework Convention on Climate Change (UNFCCC) (as cited in Onyeneke & Madukwe, 2010) defines climate change as the variation in climatic conditions which is accredited directly or indirectly to human action that modifies the structure of the global, regional and/or local atmosphere in addition to inherent climatic alteration experienced over similar periods of time. Intergovernmental Panel on Climate Change IPCC (2007) defines climate change as the variation in the condition of the climate that can be described (for example by using statistical tools) by alteration in the mean and/or the inconsistency of its properties, and that continues for extensive period normally decades or more. Although the Planet's climatic conditions are continually changing and global climate variation happens naturally, the degree of future climatic change condition might be faster than at any experienced period in the last 10,000 years. Most of the world's scientists who study climate change conclude that this anticipated climate change would be different from prior climate change as a result of human activities (Koehler-Munro & Goddard, 2010).

Koehler-Munro and Goddard (2010) further stated that the atmosphere has an impact like a greenhouse on the planet earth atmosphere. The energy released by the sun reaching the planet earth is stabilized by the energy that the planet earth released back to the atmosphere. Greenhouse gases (GHGs) entrap some of the energy that the planet earth discharges to the atmosphere. These GHGs in the space act as a regulator regulating the planet earth's climate. Without this usual greenhouse influence, the mean temperature on the planet earth would be -18^{o}C instead of the present +15^{o}C. Therefore, life as we understand it would be unbearable. The main GHGs in our atmosphere are water vapour, carbon dioxide (CO_2), methane (CH_4), halocarbons — which are used as refrigerants, and nitrous oxide (N_2O). Since 1750, the atmospheric condition intensity of carbon dioxide, methane and nitrous oxide have increased by nearly 31%, 151%, and 17%, respectively.

Concept of Adaptation

Adaptation to climate change is an acclimatization made to human, environmental, physical, or socio-economic scheme, in reaction to perceived susceptibility or predicted and real climatic stimuli influence (Smit, Burton, Klein, & Wandel, 2000; IPCC, 2001;Adger, Agrawala, Mirza, Conde, O'Brien, Pulhin, *et al*, 2007). Nhemachena and Hassan (2007) elucidated adaptation to climate change as variations in agricultural operations and management procedures occur in reaction to variation in climatic conditions. Different forms of adaptation can be recognized, and they include: anticipatory and responsive adaptation; private and public adaptation; and independent and planned adaptation.

Adaptation is an essential constituent of climate change influence and susceptibility appraisal. Adaptation reaction or acknowledgement can be classified by the status of ownership of the adaptation rate or strategy. Individual or independent adaptations are measured to be those that take place in response to climatic stimuli (after appearance and expression of early impact), that is, as an issue devoid of supports from any public agency (Smit, Pilifosova, Burton, Challenger, Huq*et. al*, 2001).

Policy-driven or planned adaptation is frequently understood as being the response of a conscious and deliberate policy decisiveness on the part of a public organization, based on the knowledge and consciousness that situations are about to alter or have been altered, and that reaction is necessary to reduce losses and increase profit from opportunities (Pittock & Jones, 2000). Thus independent and policy-driven adaptation mainly tallies to private and public adaptation, respectively (Smit*et al.*, 2001). As implied, independent adaptation reactions will be assessed by the individual farmers in terms of availability of inputs and outputs. It is predictable that farmers will adapt effectively, and that markets only can strengthen effective adaptation in exchanged agricultural produce (Mendelson, 2000). Yet, in conditions where market deficiency occur, such as the lack of awareness and knowledge on climate change or poultry rearing system, climatic variation will further minimize the capability of individual farmers to handle risk efficiently. As a result, an accurate and suitable equilibrium between public agency efforts and inducement, such as competence structure, establishment of risk insurance and private venture, requires to be struck so that the misfortune and liability would be lifted from the poor producers (Rosegrant, Ewing, Yohe, Burton, Huq & Valmonte-Santos, 2008).

Direct impacts of climate change on poultry farming

The main substantial direct effect of climatic variation on poultry productivity occurs from the heat tension. Heat tension results in a vital financial problem to

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poultry farmers through reduction in meat production, soft egg shells, low egg production and bird health. Thus, a rise in atmosphere temperature, such as that forecasted by diverse climate change models, might directly have an effect on poultry bird performance (Sejian*et al,* 2016). Poultry birds opened to the elements of heat stress will reduce feed ingestion and increase water consumption, and there are variations in the endocrine level which in order to intensify the maintenance needs, result in low productivity (Gaughan & Cawsell-Smith, 2015). Ecological stressors lower body weight, mean daily attainment and body situation of birds. Adaptation to lengthened climatic changes may result in poultry production losses (Gaughan & Cawsell-Smith, 2015).

Indirect impacts of climate change on poultry farming

Majority of the poultry production losses are experienced through indirect impacts of climatic change mainly via declines or non-accessibility of feed and water resources. Climate variation has the capability to influence the quantity and availability of grains output, quality of grains, water require for growing grain crops. In the coming years, grain crops will keep on to be subdued to warmer temperatures, increased carbon dioxide, in addition to uncontrollably erratic water availability owing to changing in rainfall patterns. Climate change may negatively have an impact on production, variety composition and value, with potential effects not only on grain productivity but also on other environmental segments of grasslands (Giridhar & Samireddypalle, 2015). Due to the extensive instability in distribution of precipitation in planting season in some regions of the nations, the grain production will be significantly affected. With the possible emerging situations that are previously obvious impact of the climate change influence, the poultry farming systems are likely to confront more of harmful than the good impact. Also climate change affects the water requirement, accessibility and quality. Variations in temperature and weather conditions can influence the quality, volume and allocation of rainwater, snowmelt, river current and groundwater.

Climate change may lead to elevated intensity of rainfall that can result in greater height of excess and low groundwater boost. Excessive dry seasons may decrease groundwater boost, decrease River current and eventually distress water availability and drinking water supply for poultry birds. The deficiency of water has an effect on poultry bird physiological homeostasis resulting in loss of body weight, low egg production rates and reduced resistance to diseases (Naqvi, Kumar, Kalyan, & Sejian, 2015). Thompson, Berrang-Ford and Ford (2010) also noted that poultry farming is at risk of indirect climate change of feed materials availability, especially the commercial poultry farmers due to increase in temperatures, irregular rainfall patterns that affect abundant harvests required to stabilize feed prices particularly in arid and semi-arid regions. Climate change is envisaged to reduce crop production and increase market prices of crops in sub-Saharan Africa.

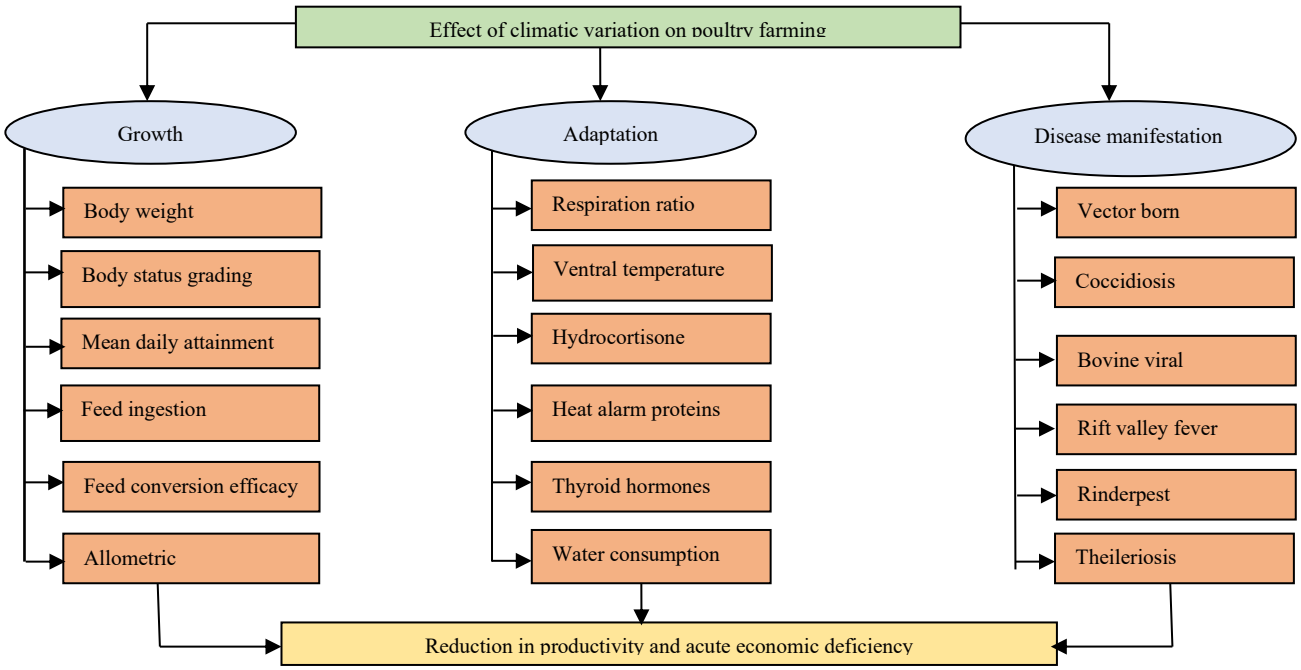

Figure 1: Effect of Climatic Variation on Poultry Productivity
Source: Gaughan & Cawsell-Smith, 2015

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Impact of climate change on poultry birds' diseases

Alteration in usual temperature and rainfall are the major considerable climatic change influencing poultry disease epidemic. Heated and damped environment conditions (particularly during raining season) will encourage the threat and incidence of poultry diseases, because specific variety act as disease vectors, like flies, mice and ticks, are more prone to live throughout the year (Sejian *et al,* 2016). Increase in precipitation may trigger epidemic of diseases in poultry such as coccidiosis, typhoid, equine infectious anemia (EIA), diarrhea and Marek's disease (MD) among others. The Figure 1 above shows the effect of climatic variation on poultry productivity.

Adaptation Strategies Practiced by Poultry Farmers

Poultry farmers have traditionally adapted to several ecological and climatic condition variations by building on their wide-range information available to them in the environment in which they dwell. But the increasing human population, rural-urban migration, environmental deterioration and higher consumption of poultry products have rendered some of those coping techniques ineffective (Sidahmed, 2008). Furthermore, changes brought about by climatic alterations are prone to occur at such a pace that they will surpass the ability of unplanned adaptation of both human communities and livestock varieties including poultry birds (International Fund for Agricultural Development, 2010). Studies on climate change (Food and Agriculture Organization FAO, 2008; Thornton, Herrero, Freeman, Mwai, Rege, *et al*., 2008; Sidahmed, 2008) have identified the following as medium to enhance adaptation strategies in poultry farming sector. These adaptation strategies can be categorized broadly into:

1. Production adjustments: Changes in poultry operations could include the following: diversification, expansion and/or incorporation of small ruminant, poultry and crop farming; changing the rearing system from extensive and semi-intensive to intensive system; varying the timing of rearing for farmers that specialized in seasonal production; preservation of environment and ecosystems by reducing the GHGs; moderating the stock level with the space available; and establishing mixed poultry farming systems, such as rearing layers, broiler and cockerels among others together.

2. Breeding strategies: A lot of local species are already coped to severe living situations. However, developing nations are generally described by inadequate of technology in poultry breeding and agricultural agenda that may facilitate the rapid adaptation. Adaptation strategies refer not to only the acclimatization of poultry bird to heat, humidity and wind speed but also their capability to stay alive, grow and produce in a situations of deficient nutrition, parasites and diseases (Hoffmann, 2008). Such actions could include: recognizing and improving local species that have adapted to native climatic trauma and feed resources; strengthening local heredities via cross-breeding with heat resistance, humidity tolerance and disease free breeds. when climate variation is quicker than natural choice, the possibility of the hybrid to live and adapt will be higher.

3. Market reactions: The agriculture market may possibly be strengthened by, for instance, the encouragement of interregional business and credit systems. Prices indicate the fundamental powers of supply and demand and influence national and international market of agricultural produce. Increase in the prices of agricultural products and price flows, were the cause of structural variations in international agricultural markets (FAO, 2018).

4. Institutional and policy changes: Eliminating or initiating subsidies, insurance schemes, revenue diversification procedures and establishing poultry early cautionary schemes and other predicting and crisis-awareness approaches that could help adaptation strategy influences.

5. Science and technology improvement: Operating with regard towards to develop understanding of the effects of climatic change on poultry, rising new varieties and genetically modified breeds, developing poultry bird vigor and improving water and soil management conditions could strengthen adaptation procedures in the long period.

6. Capacity building for poultry keepers: There is a desire to develop and strengthen the capacity of poultry product producers and workers to comprehend and treat the climate change by improving their knowledge of global climatic changes. Furthermore, training in agricultural ecological technologies and operations for the productivity and maintenance of grains enhances the supply of poultry feed and minimizes malnutrition, disease infestation and mortality in poultry.

7. Poultry rearing management systems: Effective and expansive adaptation strategies must be make available for the rural poor dwellers that are not capable to afford costly adaptation equipment and/or technologies. These could include: provision of shield or covering and water to minimize heat trauma from higher temperature. Knowing recent excessive energy costs, supplying natural (little cost) shield or covering

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in-place of expensive cost air conditioning system is more appropriate for rural poor poultry farmers; reducing the stock level of poultry birds numbers – a smaller number of better valuable poultry birds will results in high efficiency and reduced GHG emissions from poultry production operation (Batima, 2007); changes in poultry birds selection (selection of large breeds of birds instead of small); better management of water means via the establishment of simple methods for rural poor poultry farmers – for example construction of tanks to garner rainwater from the roofs and store it for farm uses (IFAD, 2009).

METHODOLOGY

The focus of this study is on the two major climatic factors which are: temperature and precipitation (rainfall). The data for this study were from the records of the monthly, quarterly and yearly official record of Food and Agriculture Organization Statistical Database, Nigeria Meteorological Data Website, Knoema Database, information on value of poultry meat and egg (in tonnes), temperature (in ºC) and precipitation (in mm) from 2009 to 2020. Ordinary Least Square (OLS) was used to estimate the trends of poultry meat and egg production (in tons) in Nigeria from 2009 to 2020 is expressed thus:

$$P_m = \beta_0 + \beta_1 T + \beta_2 P \quad (1)$$

Where;

P_m = poultry meat production
β_0 = Constant
β_1- β_2 = Coefficient of the parameters
T = Temperature
P = Precipitation

$$P_e = \alpha_0 + \alpha_1 T + \alpha_2 P \quad (2)$$

Where;

P_e = poultry egg production
α_0 = Constant
α_1- α_2 = Coefficient of the parameters
T = Temperature
P = Precipitation

Data was analysed and graphs plotted using Excel Spreadsheet and GRETL Software.

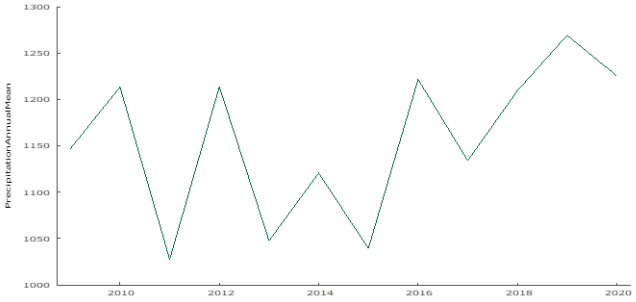
RESULTS AND DISCUSSION

The temperature and precipitation trends in Nigeria from 2009 to are presented in figure 2 and 3 below:

Figure 2: Temperature trends in Nigeria from 2009 to 2020

Source: Authors estimates, 2022

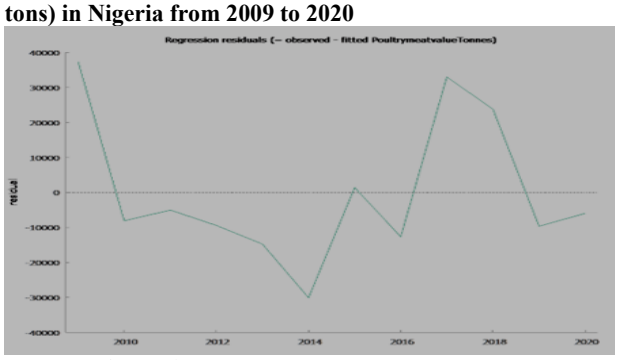
Figure 3: Precipitation trends in Nigeria from 2009 to 2020



Source: Authors estimates, 2022

Figure 2 and 3 above was the annual graphs plotted for the the relationship between the temperature, precipitation and the years. It was observed that the temperature was at the lowest in 2012 and 2019. While the lowest precipitation (rainfall) are 2011, 2013 and 2015 respectively as shows on the graph. This finding agrees with World Bank Group (2021) report of annual mean temperature and rainfall of 27.2ºC and 1,162.8 mm respectively. Both temperature and precipitation witnessed the highest increase in 2015 to 2016 and reduced collectively from 2016 to 2017, which shows the evidence of change in climatic factors.

Figure 4: Estimated trend of poultry meat production (in tons) in Nigeria from 2009 to 2020



Source: Authors estimates, 2022

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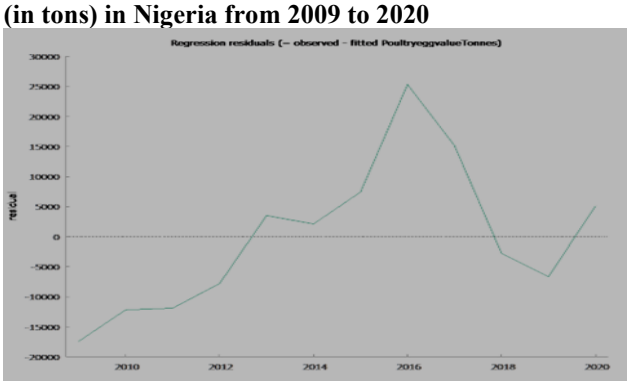
Figure 5: Estimated trend of poultry egg production (in tons) in Nigeria from 2009 to 2020



Source: Authors estimates, 2022

Figure 4 and 5 above shows the trend of poultry meat and egg production (in tonnes) in Nigeria from 2009 to 2020. Between 2016 and 2018 both poultry meat and egg production shows increase in production; this could be as a result of equal increase in temperature and precipitation as seen in figure 2 and 3 which implies that there was equilibrium in both temperature and precipitation. This finding is consistent with Capital Partners and Advisory Limited (2015) in their assessment of the growth of the poultry farming sector in Nigeria. Also, it is in consonance with Akande (2016) that reported that temperature between 26-29^{o}C is the best condition at which poultry birds produce meat and egg at maximum proportion, with accompanying normal mortality rate. Temperature above 29^{o}C could reduce the productivity and increase mortality and feed intake. Poultry meat production in Nigeria increased in 2009 from about 273,000 tons to about 238,250 tons in 2020, thus growing at an average annual rate of 3.12%. While poultry egg production in Nigeria increased in 2009 from about 612,600 tons to about 646,667 tons in 2020 with annual growth rate estimated to be 3.93%.

Table 1: Ordinary Least Square (OLS) of the trend of poultry meat production (in tons) in Nigeria from 2009 to 2020

Variables	Coefficient	Std. Error	t-ratio	p-value
Constant	−176283	4.21176e+06	−0.04186	0.9676
Temperature	23582.1	22530.4	1.047	0.3258
Precipitation	218.936	47.4305	4.616	0.0017***

Log-likelihood = −135.6622; R^2 = 0.450051; Adjusted R^2 = 0.243820; Durbin-Watson = 1.472215; F(3, 8) = 12.93631; P-value(F) = 0.001951***;*** is significant level at 1%; Observations 2009-2020 (T = 12)

Source: Authors estimates, 2022

Table 1 shows the log-likelihood function of -135.6622, suggesting that the model is well fitted. Thus indicating the goodness of fit of the model. The coefficient of multiple regression (R^2) shows that the set of variables have an importance of 0.45 while Adjusted R^2 (0.24) obtained shows the reliability of the variables included in the model. The Durbin-Watson statistic will always have a value ranging between 0 and 4. A value of 2.0 indicates there is no autocorrelation detected in the sample. Values from 0 to less than 2 point to positive autocorrelation and values from 2 to 4 mean negative autocorrelation; acceptable range is from 1.5 to 2.5. Hence, the estimated Durbin-Watson coefficient (1.5) indicates the positive correlation and acceptable. The estimate from F-statistic (P-value — 0.002 < 0.01) is significant at 1%. The result from the factors influencing poultry meat output indicates that precipitation is significant at 1%. This implies that 1% increase in precipitation during high temperature will result in about 218.58 tons increase in poultry meat production. High temperature reduces the appetite of poultry birds to feed as they tend to resort to more water intake to cushion their internal temperature. As a result, the birds may loss some body weight thereby lowering the growth rate of the poultry birds. This finding agrees with Akande (2016) who discovered that high precipitation will result in high relative humidity which in consequence lead to the proliferation of disease-causing organisms to poultry birds, loss of body weight, low quality and quantity of poultry meat, death and eventually, economic losses.

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Table 2: Ordinary Least Square (OLS) of the trend of poultry egg production (in tons) in Nigeria from 2009 to 2020

Variables	Coefficient	Std. Error	t-ratio	p-value
Constant	−6.03600e+06	2.95164e+06	−2.045	0.0751*
Temperature	−11439.6	22556.4	−0.5072	0.6257
Precipitation	−112.151	35.0899	−3.196	0.0127**

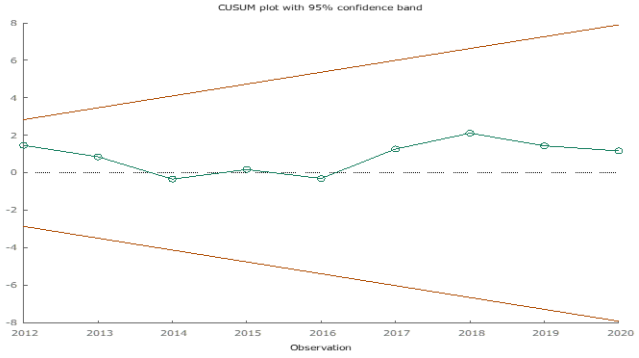
Log-likelihood = −124.3966; R^2 = 0.743665; Adjusted R^2 = 0.647539; Durbin-Watson = 1.331624; F(3, 8) = 16.75530; P-value(F) = 0.000825***;***, **, and *are significant at 1%, 5% and 10% respectively; Observations 2009-2020 (T = 12)

Source: Authors estimates, 2022

Table 2 shows the log-likelihood function of -124.3966, this indicating the goodness of fit of the model. The coefficient of multiple determination (R^2) shows that 74% variation in poultry egg output were explained by the independent variables included in the model, while the Adjusted R^2 estimated to be 0.64, shows the correct specification of the model. The estimated Durbin-Watson coefficient (1.3) indicates the positive correlation and falls within the inconclusive regions, since it value is below 1.5. However, absence of autocorrelation is an indication that the OLS coefficients or parameter estimates are statistically unbiased and gives credibility to the data. The F-ratio estimated [P-value(F) — 0.0008 < 0.01] is significant at 1%. Precipitation (−112.151) is the parameter estimates that significantly influenced the output of poultry egg at 5% level of significance. This implies that increase in precipitation could lead to reduction in poultry egg production; because poultry birds would not be able to drink optimally during high rainfall which could affect their laying capacity. This also indicates that the years are favourable years for the birds to produce eggs. In addition, these are the years with a stable and measured increase in precipitation, with a corresponding moderate temperature. This finding agrees with Akande (2016) who reported that 46.6% of poultry egg production was at 28°C with low mortality, while 44.9% of poultry egg was produced at 29°C with relatively lesser mortality.

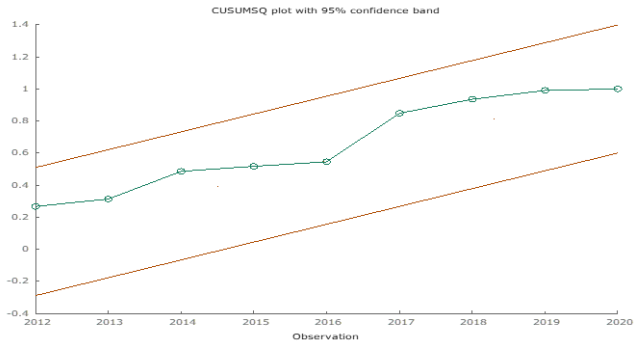
Diagnostic Test

Figure 6: CUSUM Test of poultry meat production



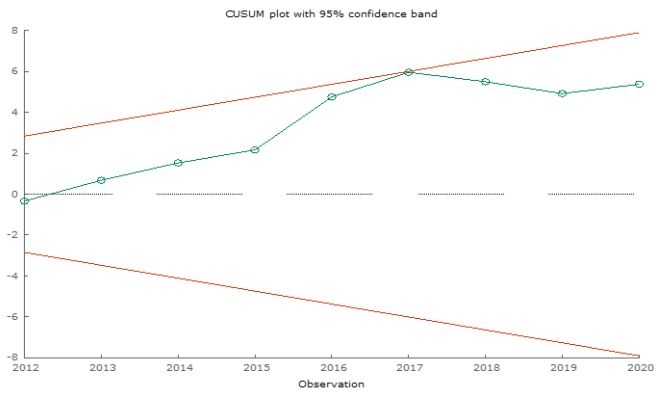
Source: Authors estimates, 2022

Figure 7: CUSUMSQ Test of poultry meat production



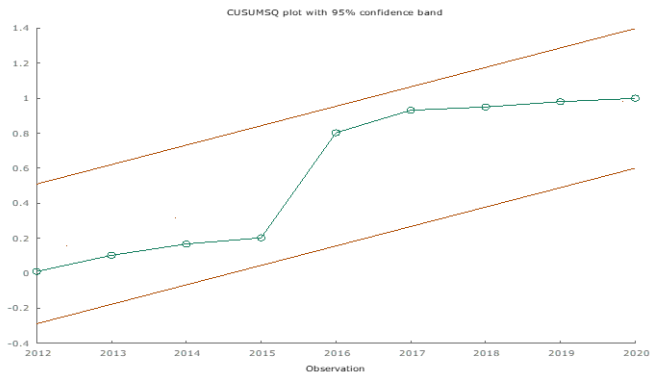
Source: Authors estimates, 2022

Figure 8: CUSUM Test of poultry egg production



Source: Authors estimates, 2022

Figure 9: CUSUMSQ Test of poultry egg production



Source: Authors estimates, 2022

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For the robustness test of the OLS model, the cumulative sum control chart (CUSUM) and cumulative sum control chart of the square (CUSUMSQ) testing methods were used in this study. CUSUM and CUSUMSQ test are used to test for the stability of the parameter. The test results are presented in Figure 6 and 7, as well as 8 and 9 for poultry meat and egg production respectively. As it can be seen the broken line that formed the data collected shaped by the CUSUM and CUSUMSQ does not formed or extended outside the boundary under the 5% significance level. Hence, it can be concluded that the OLS model employed in the study is suitable.

CONCLUSION AND RECOMMENDATION

The effect of climate change on poultry farming in Nigeria, as noticed and observed is a very essential part of poultry farming that should be taught to the poultry farmers. The effects of climate change on poultry farming affect the growth, adaptation, egg and meat production and optimal productivity in general due to variations in rainfall, temperature and sunshine intensity. High sunshine intensity makes the poultry birds to drink more water and reduces their feed consumption which subsequently, results in low feed conversion rate, increases mortality and significantly impact on the egg and meat production. CUSUM and CUSUMSQ test present suitability and stability of OLS parameter model used for this study.

The study therefore recommended that:

i. Awareness campaign to minimize the effects of climate change and adaptation strategies on poultry farming should be intensified.
ii. Extension agents and other agencies should intensify educating poultry farmers on productive adaptation strategies for optimum production.
iii. Poultry farmers should adopt and follow some set of adaptation strategies to climate change, such as use of livestock insurance, revenue diversification, improve air and water ventilation, and incorporation of small ruminants to poultry farming.
iv. Poultry farmers should rear poultry birds that are adapted to their environment and adopt effective management systems.

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Co-integration Analysis of Market Prices of Edible Oil in Rural and Urban Markets of Niger Delta Region in Nigeria

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A R T I C L E I NFO

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ABSTRACT

Co-integration technique was applied to determine the level of integration between rural and urban markets' prices of edible oil in the Niger Delta region. It also established the price causality and transmission in edible oil marketing. Primary data were generated from 432 edible oil marketers composed of wholesalers and retailers from three States in the region. Secondary data on rural and urban markets prices of palm oil and vegetable oil were sourced from the Central Bank of Nigeria (CBN) bulletin. Results of the vector error correction model (VECM) applied to measure the short-run dynamics among rural and urban edible oil markets indicate that a 1% increase in rural price of vegetable oil would in the long run increase its urban price by 4% but not same with palm oil. Estimated short-run coefficients for edible oil rural and urban markets' prices were negative and statistically significant at the 5% level. Adjustment towards the long-run equilibrium in the short-run also revealed that the price changes in the vegetable oil rural and urban markets were transmitted to other markets at a rate of 26% and 38% respectively within a week. The direction of causality between urban and rural prices of vegetable oil showed that urban prices of the vegetable oil manifested a two-way causation with its rural price at 5% while that of palm oil was at 1% level of significance. Capacity building workshops is recommended for marketers on strategies in marketing and business conduct to help equip them on how to access price and other related market information.

Introduction

Edible oils are oils extracted from plants which are good for human consumption and they include palm oil, groundnut oil, soya oil, olive oil, sunflower oil, coconut oil, palm kernel oil, almond oil, corn oil, carrot oil and others. Edible oils in addition to domestic use (as food) are applied to a wide variety of uses including the manufacture of candles, soaps, margarine, fats, drugs and several others. These contribute to the high demand of the edible oil and the consequent need to increase production and therefore marketing. Hence, there are enormous potential gains that will be realized from efficient marketing of edible oil. Edible oil marketing focuses on all the activities that are responsible for delivering the edible oil from the producers to the consumers.

Edible oil in the context of this study is categorized into two, namely palm oil which is red in color and extracted from oil palm and vegetable oil which is extracted from a variety of plants like soybean, groundnut etc. and it is a light or nearly colorless transparent oil.

Palm oil is world's second major edible oil after soybean oil. In 2019/2020, palm oil consumption in Nigeria amounted to about 1.56 million metric tons. In 2021, the production of palm oil in Nigeria was estimated to be 1,015 thousand metric tons, remaining stable compared to the previous year. Nigeria is one of the leading five producers of palm oil worldwide (Statista, 2021;

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Simona, 2021; Igiri, Arigor, Bassey and Edet, 2015). The Southern part of Nigeria is the Oil Palm belt which supplies most of the palm oil consumed in the South and also in the North (Ezealaji, 2012). In Nigeria, the demand for palm oil is very high and remains relatively constant all through the year. Hence this has triggered off shortages in supply in some periods in the year. Diverse oil-bearing seeds are produced in Nigeria from which vegetable oil are separated and they play the same role as palm oil in food preparation, hence, both are substitutes. There are several brands of vegetable oils marketed in Nigeria.

FAO (2020) had noted the contribution of edible oil in agri-food trade in the African Continental Free Trade Area (Afcfta); that Africa's participation in the global market for agri-food products has steadily expanded in the last half century, with exports growing by 4 percent and imports by 6 percent per year. Among the agri-food imports are vegetable oils (sunflower oil) imported from Europe and palm oil from Asia (FAO, 2020).

An efficient marketing system is that which ensures the flow of commodity and services at minimum price acceptable by all participants. The producers are able to break even and earn income; the various middle men (marketers) earn income from the margins while consumers are not exploited. Many persons and institutions are involved in marketing of edible oils in the Niger Delta, thus a better understanding of the market is moving towards better delivery of standard of living of the many persons, households and institutions involved in marketing. Marketing delivers goods and services from place of production to final consumers. Appropriate market information with regards to availability, price and others for edible oils in both urban and rural markets in the area is a task performed by myriads of persons (marketing functions). How these information are handled and how they impact on edible oil prices in urban and rural markets of the Niger Delta region becomes a challenge. Thus a clear understanding of the co-integration of the rural and urban markets prices of edible oils in Niger Delta will positively impact on a significant proportion of Nigerian population who are stakeholders involved in marketing edible oil. This study applied co-integration technique to determine the level of integration between prices in rural and urban markets of edible oil in Niger Delta region and thus tested the hypothesis that Rural and urban markets' prices of edible oil (palm oil and vegetable oil) are not integrated.

Establishing the price causality and transmission in edible oil marketing will guide the key players in the edible oil industry including the marketers to make knowledgeable choices on the products.

This study will serve as a source of perspective record for analysts who set out on investigations of the equivalent or related sorts in other parts of the country. It is also envisaged to generate valuable information on edible oil (palm oil and vegetable oil) marketing that would assist policymakers in designing appropriate policies for intervention. Findings on the level of market integration will show researchers and students where further studies can be conducted.

Materials and Methods

Study Area: Niger-Delta region is the study area and it sits on the Gulf of Guinea on the Atlantic Ocean in Nigeria. It incorporates the six States of the South-South geopolitical zone, Ondo State from South West and Abia and Imo States from South East geopolitical zones. All Niger Delta States are crude oil-producing except Cross River. The area is a thickly populated locale sometimes called the Oil Rivers since it was a major producer of palm oil. The territory was known as British Oil Rivers Protectorate between 1885 and 1893, before it became expanded and turned into Niger Coast Protectorate. The Niger-Delta occupies about 70,000 km^2 (27,000 sq. mi) which approximates 7.5% of Nigeria's land mass and is inhabited by 31 million people (NPC, 2006).

Sampling and Data Collection: The study population comprised all the palm oil and vegetable oil marketers in the nine Niger Delta States. A multistage random sampling procedure using the table of arbitrary numbers was adopted for selecting the sample. In stage I, three States comprising Delta, Edo and Rivers were randomly chosen. In stage II, six Local Government Areas (LGAs) were randomly sampled from each of the selected three States of the region; two LGAs from each of the three agricultural zones of the selected States and this gave a total of 18 LGAs. Two markets (1 in urban area and 1 in rural area) were sampled from each of the selected LGAs, and this gave a total of 36 markets comprising of 18 markets in urban areas and 18 markets in rural communities. Urban areas in the context of this study refer to major towns in the particular LGA with population densities above 150 inhabitants per square kilometer and higher business activities compared with other towns in the same LGAs; while the rural areas refer to population densities below 150 residents per square kilometer and lower commercial activities equated with other areas within the same LGA (OECD 1994). In most cases, markets in the selected local government headquarters formed the urban markets.

Three wholesale and three retail palm oil marketers as well as three wholesale and three retail vegetable oil marketers were randomly sampled from each of the 18 markets in urban area. This gave a total of 108 palm oil marketers (54 wholesalers and 54 retailers) and 108 vegetable oil marketers (54 wholesalers and 54 retailers). This gave a total of 216 palm oil and vegetable oil marketers that were sampled from urban markets. In the context of this study, wholesalers are marketers who purchase edible oil straight from the producers in large quantities and volumes like a lorry load of the edible oils

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containing hundreds of litres of the oils in tens of gallons and they sell the products in smaller tens of litres in units of gallons to retailers, then retailers are those who sell to the final consumers in small units of litres (OECD 2014). Proportionate random sampling was applied to replicate the selection of palm oil wholesalers and retailers and vegetable oil wholesalers and retailers from markets in rural areas and this generated a sample of 216 palm oil and vegetable oil marketers from markets in rural areas. Primary data were collected for the study using semi-structured questionnaires that were given to the respondents; wholesalers and retailers of palm oil and vegetable oil using trained enumerators. Secondary data on rural and urban markets prices of palm oil and vegetable oil were gotten from Central Bank of Nigeria (CBN) Statistical Bulletin.

Measurement of Variables

Unit root test: A co-integrating relationship exists between non-stationary series if there is stationary linear mixture among them. Therefore there is need to test stationarity of the time series first. Augmented Dickey-Fuller (ADF) ascertained whether or not the series are stationary. The testing procedure for the ADF was as follows:

$\Delta Xt = \beta_o + \beta_2 X_{t-1} + \beta_i \Sigma X_{t-i} + \Sigma_i$

Where,

Xt = individual explanatory variables at time, t;

β_o = constant

Δ = the difference term.

The unit root test was then undertaken for the null hypothesis, $t \neq 0$.

$$ADF_t = \frac{\hat{U}}{SE\left(\hat{U}\right)}$$

The computed value test statistic was compared with the pertinent critical value for the ADF_t. If the statistic is greater (in absolute value) than the critical value at 5% or 1% level of significance, then the null hypothesis of $\mu \neq 0$ would not be accepted and no unit root is present. Once this is established, the test for co-integration would be carried out.

A typical regression model to test for market integration between two markets under the traditional static method is specified as follows:

MI = f (POrp + POup + VOrp+ VOup)

Where:

MI = Market Integration

POrp = Palm oil price series for rural market

POup = Palm oil price series for urban market

VOrp = Vegetable oil price series for rural market

VOup = Vegetable oil price series for urban market

Granger causality model: This determined the price causality in the rural/urban marketing of edible oil. The model can be expressed as follows;

POrp = f (POup)

POup = f (POrp)

VOrp = f (VOup)

VOup = f(VOrp)

Where;

POrp = Palm oil price in rural market

POup = Palm oil price in urban market

VOrp = Vegetable oil price in rural market

VOup = Vegetable oil price in urban market

The following causality relationships were tested by placing the appropriate limitations on the model and using the F-test for statistical significance. The result of the analysis would take any of these forms;

(a) Independence causality i.e. no causality

(b) Bilateral causality also known as feedback causality

The study of Obayelu and Salau (2010) on Application of Co-Integration and Error Correction Model to examine the response of agriculture to price and exchange rate in Nigeria reported that markets were poorly integrated and there was also the presence of some form of price leadership in the market system. They also revealed that the major sources of poor integration and inefficiency in Nigeria markets include poor price formation transmission channels, too many intermediaries and the high cost of transportation, as well as the sources and validity of price data. It was also noted that price co-movements and price transmission are heavily affected by government intervention.

The work of Adakaren, Arene and Chidebelu (2013) on Application of Co-integration and market integration to Raphia palm wine markets in Niger Delta Area of Nigeria revealed that the prices of raphia palm wine in all the markets in area showed evidence of integration in the long run and there was interdependent and bi-directional causality between urban price and the rural price of raphia palm wine.

Results and Discussions

Market integration of edible oil (vegetable oil and palm oil): Establishing extent of integration of rural and urban markets' prices of edible oil in Niger Delta region involved the use of co-integration and error-correction model. The use of co-integration procedure involves some steps. The first of the steps is carrying out a unit root test on the data.

Unit root test: Average monthly time series data for urban and rural market prices for both vegetable oil and palm oil spanning from 1995 to 2018 was generated from Central Bank of Nigeria data base. First, the unit root test result of logged price series data at levels and at first differences using the Augmented Dickey Fuller (ADF) Test are as presented in Tables1 and 2.

As shown in Table 1, the result indicated that all edible oil price series in the model were non-stationary at both 1% and 5% levels of significance. This is because the absolute values of critical statistic were greater than the absolute values of the t-statistic and hence contains unit root and are non-stationary that is 1(0). This prompted the test of stationarity of the first difference.

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After the differencing, the price series attained stationarity because the absolute values of the t-statistic were greater than critical values and hence, all the variables were integrated to order one, 1(1) (Table 2). Thus, the null hypothesis of unit root was accepted at levels but rejected at first difference for all the price series both at 1% and 5% levels of significance. The reason for this process according to Okoroafor *et al* (2010) as reported by Nwankwo (2018) was to avoid the consequences of regressing non-stationary time series data with the attendant problem of spurious results due to inflation and seasonality. This finding concur with earlier findings and conclusion that food commodity price series are mostly stationary of order one i.e. 1(1) (Okoroafor *et al*, 2010).

Co-integration result: Co-integration test was carried out to determine whether there were long-run relationships between the markets. The presence of co-integration between two series is an indication of their inter-dependence and its absence reflects market segmentation. Co-integration was tested with the aid of Johansen's maximum likelihood procedure using two test statistics, namely the trace (λ-trace) and eigenvalue (λi-max.). The result of the co-integration analysis on vegetable oil and palm oil is presented in Tables 3 and 4.

The result as shown revealed that the two tests statistics-the maximum eigenvalue and trace tests were absolutely harmonized during the period as to the number of co-integrating vectors at the conventional 0.05 probability level. Both the λ-trace and eigenvalue statistic exceeded the critical value at 5% level for null hypothesis of r = 0 and r = 1, therefore the null hypothesis of no co-integrating relationships is rejected at the 0.05 level. Hence, edible oil markets are integrated.
The implication of the outcome of the overall analysis shows the existence of inter-dependence between edible oil in Niger Delta region of Nigeria. The markets operated as unified market which is an indication that most of the markets adjusted significantly to price changes. This implies that vegetable oil and palm oil markets were strongly linked together and therefore, the long-run equilibrium is stable. Hence, if there are shocks (deficit or surplus) from any of the States, it will quickly be transferred until equilibrium is re(established).

As observed by Mafimisebi (2012), the arbitrage activities of marketers, who ship commodities between low and high price locations, will raise price in some markets whilst lowering them in others until price differentials equal transfer costs and all opportunities for earning excess profit have been exhausted. In other words, prices of edible oil in one market do not significantly differ from that of the corresponding market within the study area. There is a tendency for the prices in both vegetable oil and palm oil rural and urban markets to converge in the long run according to a linear relationship, and that in the short run, the prices may drift apart, as shocks in one market may not be instantaneously transmitted to other markets due to delays in transport. This discovery as reported by Nwankwo (2018) may be attributed to free flow of information on prices within and across the States of the study.

Vector error correction model (VECM) showing the short and long run price dynamics: The vector error correction model (VECM) was applied to measure the short-run dynamics among rural and urban edible oil markets. The linear VECM results for vegetable oil and palm oil are presented tables 5, 6, 7 and 8. The VECM results as shown indicates that a 1% increase in the rural price of vegetable oil would in the long run increase its urban price by 4% (Table 5) unlike palm oil (Table 7). The result also showed that all the estimated short-run coefficients for vegetable oil rural and urban markets' prices were negative and statistically significant at the 5% level. Adjustment towards the long-run equilibrium in the short-run also revealed that the price changes in the vegetable oil rural and urban markets were transmitted to other markets at a rate of 26% and 38% respectively, within a week. In other words, 26% distortion in the rural prices of vegetable oil was corrected within a week. This implies that it took approximately 38 days for rural price of vegetable oil to return to equilibrium. This invariably suggests that the transmission of price changes from one market to another at the time interval was weak. Adjustment towards the long-run equilibrium in the short-run was slow. Also, the speed with which the system will adjust to shocks and restore equilibrium for the urban price of vegetable oil was 38% which was however faster than the vegetable oil rural price. Based on the results, it is concluded that vegetable oil rural and urban markets are not well integrated in the short run.
Finally, when vegetable oil is compared with palm oil, it was observed that increase in the rural price of vegetable oil led to an increase in urban price, while any increase in the rural price of palm oil decreased its urban price. The reason was that vegetable oil market prices followed the same trend while palm oil prices follow different trends. Also, the speed of price adjustment of palm oil in the short run was faster than that of vegetable oil. The presence of co-integration between vegetable oil and palm oil market prices implied that the prices do follow the same long-run trend (presence of integration). As a result, the market price of either vegetable oil or palm oil would not drift above or below each other in the long run.

Price causality and transmission in edible oil marketing: The direction of causality between urban and rural prices of vegetable oil is presented in table 9. The result showed that urban prices of the vegetable oil manifested a two-way causation with its rural price at 5% level. This implied that no vegetable oil market was exclusively given the leadership position in the study area. An increase in the past urban price of vegetable oil caused that of the current rural price to increase whereas

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increase in the past rural price did not Granger cause the current urban price.

The direction of causality between urban and rural prices of palm oil in the Niger Delta region is presented in table 10. The null hypothesis of no causality was rejected. In the first market pair, rural price of palm oil Granger caused its urban price at 1% level of significance. This is an indication of strong causality, that is, the rural market dominated price formation with urban market. The result indicated that rural price of palm oil Granger caused the urban price; whereas the urban price of palm oil did not Granger cause the rural price. In other words, an increase in the rural price of palm oil brought about an increase in the urban price while increase in the urban price did not lead to increase in rural price. This finding is in tandem with the works of Ike (2014) on structure, causality and price transmission tests in the marketing of *Irvingia* seed (Ogbono) in Enugu State, Nigeria and Nwanko (2018) who established a similar relationship in the marketing of palm wine in the urban and rural markets of south east Nigeria.

Conclusion and Recommendation

The study concludes that there is presence of co-integration between vegetable oil and palm oil market prices as the prices follow the same long-run trend. Also there is an established Granger causality among urban and rural prices of palm oil in the Niger Delta region as the rural market ruled price formation at the urban market. The study therefore recommends an appropriate policy measure whereby capacity building workshops are organized for marketers from time to time on strategies in marketing and business conduct. This will help to equip them on how to access price and other related market information.

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Table 1: ADF Unit root test for edible oil market prices at level

Series	ADF @ t-statistic	5% critical value	P value
Vegetable oil rural price	-0.443115	-2.087561	0.7581
Vegetable oil urban price	0.457107	-2.055870	0.9245
Palm oil rural price	-0.537271	-2.05568	0.6378
Palm oil urban price	-0.602924	-2.05559	0.5687

Table 2: ADF Unit root test for edible oil market prices at first difference

Series	ADF @ t-statistic	5% critical value	P value
Vegetable oil rural price	-12.03452	-2.087561	0.000
Vegetable oil urban price	-8.94576	-2.055870	0.000
Palm oil rural price	-11.67321	-2.05568	0.000
Palm oil urban price	-9.26174	-2.05559	0.000

Table 3: Co-integration test result for vegetable oil markets

Hypothesized No of CEs	Trace Test Statistics	5% Critical Value	Maximum Eigenvalue	5% Critical Value
None	56.65**	15.49	51.90**	14.26
At most 1	17.77**	3.84	32.74**	3.84

**Significant at 0.05 level

Table 4: Co-integration test result for palm oil markets

Hypothesized No of CEs	Trace Test Statistics	5% Critical Value	Maximum Eigenvalue	5% Critical Value
7None	86.64**	15.49	51.90**	14.26
At most 1	32.74**	3.84	32.74**	3.84

**Significant at 0.05 level

Table 5: Long-run estimates of rural and urban market prices of vegetable oil

Regressors	Long-run Estimates	Standard Error	t-value
Constant	-5432.786		-126.097
Rural	1.0000		
Urban	4.006261	0.5525877	7.250000

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Table 6: Short-run estimates of rural and urban market prices of vegetable oil

Error Correction	D(Rural Price)	D(Urban Price)
Constant	-3.200511	-0.518179
Conteq 1	-263572	-0.385229
t-value	-3.018	-7.13
D(rural price(-1)cf	0.726603	0.285949
t-value	-7.39	3.12
D(rural price(-2)cf	-0.495901	0.208683
t-value	-4.09	3.42
D(urban price(-1)cf	0.353905	0.525629
t-value	2.701	4.38
D(urban price(-2)cf	0.352351	0.165765
t-value	0.29	0.58
R^2	0.546784	0.578702

Table 7: Long-run estimates of rural and urban market prices of palm oil

Regressors	Long-run Estimates	Standard Error	t-value
Constant	-267.786		-126.097
Rural	1.0000		
Urban	-0.309468	0.12874	2.403821

Table 8: Short-run estimates of rural and urban market prices of palm oil

Error Correction	D(Rural Price)	D(Urban Price)
Constant	0.239363	-0.913845
Cointeq 1	-2.76059	0.775762
t-value	-8.2018	3.13
D(rural price(-1)cf	0.481101	-0.470545
t-value	3.09	2.93
D(rural price(-2)cf	0.298979	-0.207355
t-value	1.82	-1.49
D(urban price(-1)cf	-0.453905	-0.625629
t-value	-3.801	5.49
D(urban price(-2)cf	-0.252351	-0.465765
t-value	-1.29	-4.18
R^2	0.546784	0.578702

Table 9: Pairwise Granger causality test of vegetable oil in Niger Delta region

Null Hypotheses	Observation	F-Statistic	Probability
Rural price of vegetable oil does not Granger cause the urban price	144	2.435125	0.1793
Urban price of vegetable oil does not Granger cause the rural price	144	7.79352**	0.02

** Significant at 5% level

Table 10: Pairwise Granger causality test of palm oil in Niger Delta region

Null Hypotheses	Observation	F-Statistic	Probability
Rural price of palm oil does not Granger cause the urban price	144	12.76924***	0.000
Urban price of palm oil does not Granger cause the rural price	144	3.220122	0.2492

*** Significant at 1% level

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Analysis of Impact of Financial Inclusion on Rural Farming Households in Nigeria: A Review

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ABSTRACT

The smallholder agricultural sector in Nigeria occupies a substantial position in the country's economy. Available evidence indicates that rural farming households who have remained in the vicious cycle of poverty constitute about 90% of the farming population. Thus, the rural farming households require financial interventions to improve their agricultural production and overall welfare. However, this agricultural segment is seemingly facing a challenge regarding inaccessibility to the required finances with which to obtain the necessary input for attaining the desired farm boost and yield. Therefore, this review is focused on investigating the how financial inclusion could impact positively on rural farming households in Nigeria. Literature search was conducted systematically to collect recent research evidence to support the study. Summarily, it was found that financial inclusion has significant potential to enhance agricultural performance and welfare among rural farmers.

INTRODUCTION

The bourgeoning global population and subsequent upsurge in the demand for food will apparently remain on the increase. This trend has culminated in a focus on food security, advancement in agricultural activities, and the role of financial institutions in increasing farmers' access to finance (Omali, 2021). Intensifying smallholder agriculture through financial inclusion of the rural farmers and their access to wide range of financial services and support will apparently increase the speed at which farm productivity and food security is boosted and poverty is alleviated. In this regards, financial inclusion has piqued the interest of scholars, policymakers, and development practitioners because of its potentialities to impact positively on economic growth and the accomplishment of long-term development goals (Klapper, 2016; Demirgüç-Kunt et al., 2020).

Financial Inclusion (FI) is a process or scenario that facilitates members of the economy's access to, availability of, and use of formal financial systems (Kama and Adigun, 2013). In other words, it a process in which all members of the economy can easily open bank accounts, afford to obtain credit, and use financial system products or facilities with ease. Of

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course, adults achieve financial inclusion when they have simple access to a wide choice of financial products that are tailored to their specific requirements and are available at reasonable prices (Central Bank of Nigeria [CBN], 2012). The concept of financial inclusion has evolved since 2003, when United Nations (UN) Secretary-General Kofi Annan stressed the importance of establishing an inclusive financial sector to provide underprivileged individuals with access to sustainable financial services such as savings, credit, and insurance, and viewed financial inclusion as a necessary prerequisite for shared prosperity (United Nations, 2006). Financial inclusion is now commonly seen as a right of all people to social inclusion, improved quality of life, and a tool for enhancing the poor's economic ability and capacities in a country (Banco Centraldo Brazil, 2010). In fact, the World Bank Group proposed the global goal of universal access to basic transaction services as a key step toward full financial inclusion in October 2013—a world where everyone has access to and can use financial services, but must also take advantage of opportunities and reduce vulnerability (World Bank, 2013).

Although discussions regarding financial inclusion tilts more to account ownership, financial inclusion goes beyond account ownership (Centre for Inclusive Growth, 2016; Demirgüç-Kunt *et al*., 2020). To enhance development and achievement of the sustainable development goals (SDGs), individuals require direct link, and most importantly, adoption of a wide range of financial services and products. These financial products and services, for example, include payments, savings, credit and insurance. Of course, three factors influence the level of financial inclusion including usage, obstacles (quality), and access (Camara and Tuesta, 2014).

Despite the fact that the usage of formal account is the major thrust of financial inclusion, the share of people who do not have official accounts and financial services and who instead rely on cash payments is still substantial globally and high in developing countries. Many accounts globally are dormant and not in use. About 13.7 percent of account in financial institutions globally were inactive in 2017 (World Bank, 2018). About a billion adults globally still make utility payments using cash even when they have formal accounts (Demirgüç-Kunt *et al*., 2020). In Nigeria, the situation is worse and far below the government target as regards usage of financial services. According to available data, 38 percent, 36 percent, 3 percent, 2 percent, and 5 percent of Nigerian adults had access to payments, savings, credit, insurance, and pension services in 2016, compared to 56 percent, 46 percent, 29 percent, 25 percent, and 26 percent in 2017 respectively (EFlnA, 2020). Nigeria may not achieve the financial inclusion strategy targets if the low level of account usage persists. If financial inclusion targets are not achieved, economic development and some SDGs such as End excessive poverty (SDG 1), Lower hunger and promote food security (SDG 2) linked to financial inclusion may not be achieved in Nigeria.

Usage of account and hence financial inclusion is lowest among smallholder farmers despite their role in food production and achievement of food security in Nigeria. The majority of these farmers reside in rural areas where only 34 percent of the population are banked while 44 percent are financially excluded (EFInA, 2020). Only 26 percent of smallholder farmers in Nigeria are financially included, 48 percent are financially excluded while only 18 percent reported that they have used their bank account for farm business transactions (Anderson *et al*., 2017; EFlnA, 2020). Besides, over 97 percent of those who receive their income in cash are both small-scale farmers and entrepreneurs (farming, non-farming, and services) (EFInA, 2018). Given the importance of financial inclusion in building resilient and productive livelihoods, the fact that 80% of farmers in Nigeria are considered as smallholders and that they produce 99% of food consumed in the country (Anderson *et al*., 2017), enhancing the usage of financial accounts and thus financial inclusion of smallholder farmers would help enhance agricultural productivity, food security, economic development and achievement of the SDGs. Therefore, to expedite the achievement of financial inclusion and hence economic development and the SDGs, this review paper looked into what previous research efforts on the impact of financial inclusion on rural farming households in Nigeria.

DETERMINANTS OF FINANCIAL INCLUSION

Relatively few studies have explored the variables that impact financial inclusion in Nigeria. Akatun (2018) estimated the factors of financial inclusion and its influence on poverty in rural Nigeria. Probit and Multinomial logit (MNL) models, propensity score matching (PSM) method and endogenous switching regression (ESR) were applied. The findings revealed that the likelihood of formal financial inclusion is higher with receipt of financial advice, ownership of mobile phone, desire to learn new technologies, money management habit, and secondary and higher education. The researcher further reported that FI made positive and significant impact on poverty reduction among the rural farmers. Average treatment effect on the treated (ATT) from PSM was ₦12,608.34 Naira (41.34 USD). ESR result was consistent with

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that of PSM and shows that FI significantly reduces poverty. The study recommended the deployment of financial advice through mobile phone messages, strengthening of agent banking in rural sector, enhancing investment in education, and provision of off-farm economic opportunities to rural people to enhance financial inclusion and poverty reduction/alleviation.

In a study on the conducive environment for financial inclusion, the Economist Intelligence Unit (EUI) of the United States of America (2019) reported that the 2019 Global Microscope examined the strategies employed by governments and regulators across the whole world to improve financial inclusion among their people. The index was solely concerned with regulatory and policy context, and did not take into account financial inclusion results. The EUI (2019) Global Microscope report added a gender lens to assist policymakers fully appreciate just how various financial inclusion measures affect women as well as how policymakers might address the financial inclusion gender disparity. Despite the fact that total connectivity to the financial system has improved, the World Bank's Global Findex (2015) indicated that the gender gap in financial account access has widened in Microscope nations over the last ten years. In this version of the Microscope, 11 different gender-focused metrics were introduced to investigate how nations are encouraging financial inclusion for both men and women. Legal constraints have restricted women's access to financial services. Based on the World Bank's Women, Business, and the Law 2019 report, women in the average economy have three-quarters of the entitlement that men have. Many of these legal disparities, along with de facto hurdles connected to facilitators like national IDs, the Internet, and mobile phones, were examined in the 2019 Global Microscope.

Customers' increased awareness and excellent financial infrastructure, for example, had a favourable impact on financial inclusion, according to Bayero (2015). According to Babajide et al. (2015), financial inclusion is a crucial predictor of the economy's overall unit of production. David-West (2016) investigates Nigeria's route to computerized financial inclusion through the use of Firstmonie, First Bank's mobile money app, to acquire a greater knowledge of the limitations of mobile money activities in Nigeria. According to Odior and Banuso (2012), a cashless policy benefits the Nation’s economy. Although substantial headway has been achieved in enhancing Nigeria's financial inclusion, Kama and Adigun (2013) found that poor financial education, insufficient infrastructure, and poor financial technology employed by financial institutions are the key obstacles to complete financial inclusion in Nigeria. Adeola and Evans (2017) looked at the influence of financial inclusion and advancement on Nigeria's economic heterogeneity from 1981 to 2014. They discovered that financial inclusion offered a favourable and considerable influence on economic diversification when assessed in terms of financial access and consumption. These researches indicate that Nigeria experiences certain difficulties in reaching total financial inclusion, and there is conflicting information on the economic impact of financial inclusion.

EFFECTS OF FINANCIAL INCLUSION ON AGRICULTURE

Fawowe (2020) measured the impact of financial inclusion on agricultural productivity using nationwide representative data in recent research on smallholder farmers in Nigeria. The research discovered that financial inclusion has a favourable and statistically remarkable influence on agricultural productivity, regardless of how it is measured.

Olaniyi (2017) captured the long- and short-run variations of the link involving financial inclusion and agriculture in Nigeria in his study, which used annual data from 1981 to 2014 and the ARDL bounds testing approach. The findings disclosed that financial services used had substantial short- and long-term implications on agriculture, showing that boosting financial inclusion is crucial for long-term agricultural development in rural regions. Access to finance, on the contrary, has a negligible influence on agricultural growth. While providing access to money to peasant farmers may offer numerous advantages, the message was that it was more important to consider how the money was used in rural settings and how it affected the outcomes that mattered to us. According to the study, more conventional and un-conventional financial service companies need to return to the land and invent in the Nigerian agricultural arena to increase financial inclusion while simultaneously significantly alleviating poverty and fostering agricultural growth in Nigeria.

Obisesan and Adeyonu (2018) looked into smallholder arable crop farmers' financial inclusion in Nigeria. For the aim of the research, primary data was gathered. The Logit regression model was employed in this investigation, as well as descriptive statistics. The mean age of the participants was 43.67 years, and males heavily involved in food crop cultivation more than females, according to the findings. Despite the fact that 64.16 percent of respondents live in a

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community with banks, only 27.65 percent are banked. The main barriers to opening a bank account are dread of insolvency (90.57 percent), dearth of needed forms of identification (31.13 percent), long process (29.72 percent), and proximity to the closest bank (50.94 percent). The co-operative is a key source of credit also as a means of saving. Although farmers were unaware of the agricultural insurance program, over a half of them were eager to enrol. Age, labour expenses, and the planting of improved varieties had an adverse and substantial influence on desire to engage, whereas awareness, years of formal education, credit access, and membership in an association all had a major positive consequence. As a result, the study recommended that financial institutions contemplate expanding its operations to arable crop farmers and creating an atmosphere that allows Nigerian farmers to become financially included.

Rural farmers benefit from financial inclusion because it allows them to effortlessly obtain finances, save money, and collect remittances, all of which can be invested in profitable ventures. (Akotey and Adjasi, 2016; Beck et al., 2008; Demirg€uç-Kunt et al., 2008; Honohan, 2008). As a result, financial inclusion is a driver for realizing the Sustainable Development Goals (SDGs) and shared prosperity, especially in wake of the latest global appeal to leave no one behind. Agricultural activities include financial services as part of the value chain. As a result, access to finance allows rural farmers to not only obtain timely delivery of inputs, but also to expand their utilization of inputs and partake in profitable investments and technological uptake. (Olaniyi, 2017). Financial inclusion enhances exposure to financial services such as loans, savings, insurance, and other non-financial goods, allowing farmers to satisfy consumer and social necessities (food, health care, school fees, and burial expenditures) without resorting to redirect cash from agricultural investments (Adeola and Evans, 2017). This procedure has the ability to invest the required capital in agriculture, resulting in enhanced output and capacity. Due to improved exposure to financial services, several of the cash-strapped farmers who monopolise the rural scenery appear to be more ready to embrace productivity-enhancing measures, this might result into high-return, above-subsistence-oriented production techniques that could diversify rural livelihood strategies and enhance rural livelihood strategies (Olaniyi, 2017). Farmers can also borrow at cheap interest rates, undertake prompt investment judgments, optimally deploy productive resources, and grow their productive potential in an inclusive financial system (Adeola and Evans, 2017; Evans and Lawanson, 2017; Olaniyi, 2017; Sarma and Pais, 2011).

In the period 2010–2014, Anifowose and Ladanu (2015) examined the contribution of commercial banks in agricultural growth. That was their contribution to the agricultural sector's overall development. Agriculture is a vital part of the Nigerian economy, and the research study looked into the impact of commercial banks in agricultural growth. The research looked at the work and opinions of eminent academics. Their points of view were varied; some agreed with others, while others disagreed. Some scholars recognized the importance of the agricultural sector in economic development, but they were blind to the reality that it was crucial to expand it. Academics considered the agricultural sector's role, problems, and importance, and concluded that it must be developed if it is to contribute to economic growth. These researchers proceeded to identify important variables, catalysts, or prerequisites for the sector's development, allowing for other elements such as technology and research. The research further looked at the influence of commercial banks as safe-keepers and channelers of finances to underserved industries such as agriculture. Finally, under the regulations of the highest regulatory authority, the central banks, commercial banks were found to be actively involved in farm finance. To support the study's hypothesis that when any of the primary variables that benefit the agricultural sector, namely commercial bank credit, is channelled into this prospective sector, it would expand, improve production, and play a more effective role in economic development.

Adeoye (2018) looked into the state of financial inclusion and gender disparities among a group of Nigerian smallholder horticultural farmers. Financial inclusion of smallholder horticultural farmers in Nigeria, according to the study, is critical for horticultural metamorphosis and value chain development. Women small-scale farmers on the other hand, face greater financial exclusion than their male colleagues, limiting their involvement to the industry. The smallholder household survey conducted by the Nigeria Consultative Group to Assist the Poor (CGAP) in 2016 was used as secondary data. Descriptive statistics and the Blinder-Oaxaca decomposition approach were utilized to analyse the data. According to the results, 30 percent of smallholder horticultural farmers were financially included, with male smallholder horticultural farmers having a higher rate of inclusion (36 percent vs. 23 percent) than females. The Chi2 test revealed that at 1%, there exist a significant gender disparity in financial inclusion.

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Account ownership in Bank Financial Institutions had the highest absolute gap (12.81%), while account ownership in Non-Bank Financial Institutions had the smallest (1.55%). (NBFI). At a 5% level of significance, the Blinder-Oaxaca Decomposition revealed that gender endowments account for the majority of the mean gender gap (0.12). The decomposed coefficients and the interaction of endowments and coefficients, on the other hand, had a greater impact on narrowing the gender disparities in financial inclusion. Because it is simpler for women smallholders to open accounts at NBFIs, the study recommended that NBFIs, such as Village Savings and Loan Associations (VSLAs), be linked to Bank Financial Institutions to improve financial inclusion.

Udeorah and Vincent (2018) looked into the impact of government and deposit money bank financing on the performance of Nigeria's agricultural sector. The existence of unit root was observed from data available from the Central Bank of Nigeria (CBN). Hence, the outcomes from estimated error correction regression models were adopted. The findings revealed that while government investment through the agricultural credit guarantee scheme fund (ACGSF) had a substantial favourable influence on overall average agricultural yield, crop outcome, and livestock output, government systemic spendings on the agricultural sector had a detrimental impact. On the other hand, bank financing proved insignificant in predicting output from the aggregate agricultural sector, and other examined agricultural sub-sectors. The research also advised devoting greater time and resources to the ACGSF, as well as an intentional decrease in agricultural recurrent spending. A shift in deposit money institutions' attitudes toward agriculture, as well as the development of programs modelled after the ACGSF or perhaps an upgrading of the ACGSF, were also advocated.

Kalu et al. (2018) looked into financial inclusion in Nigeria's agricultural industry. The study was based on survey data collected from 600 retrieved questionnaires delivered to farmers in Nigeria's rural and urban locations. The study used the pecking order theory to design the adequacy gap index and the timeliness gap index to quantify the penetration gap index theory of financial inclusion. Because small scale farmers rely on rain-fed agriculture, the appropriateness and timeliness gap metrics indicated that various formal lending organizations were incapable of satisfying their credit demands, resulting in credit being delivered insufficiently and late. The penetration gap index revealed that financial inclusion in the agricultural sector in Nigeria is still limited. It was advised that the government strengthen its attempts to address the credit needs of farmers in order to guarantee financial inclusion (adequacy and timeliness). Michael (2016) studied whether farmers having more access to financial services may assist Nigeria achieve long-term development. As a consequence, the study gathered and assessed the opinions of 105 farmers in Ogun State, Nigeria, using a survey research design. According to the report, financial inclusion in the Nigerian agriculture industry may be utilised to promote long-term growth. More financial institutions should be placed in rural regions, as well as financial discipline, according to the report, as methods to promote financial inclusion in the agricultural sector.

INFLUENCE OF FINANCIAL INCLUSION IN RURAL SOCIETIES

Employing a descriptive study and content analysis, Nwankwo and Nwankwo (2014) investigated the long-term viability of financial inclusion for Nigerian living in remote areas. The study discovered that the long-term viability of financial inclusion for Nigeria's rural dwellers remained the mainstay of any country's economic growth. Furthermore, the study discovered that absence of adequate implementation of financial inclusion in rural regions, Nigeria's economy will not be able to expand swiftly. According to the findings, partnership involving DMBs, MFBs, and telecommunication service operators for improved financial services arbitration should be promoted; to ensure the accomplishment of the CBN's financial inclusion objective, rural residents must be enlightened on the necessity of banking; also, considering certain rural residents opt to hold their funds in their homes, it is necessary to educate them on the importance of banking.

Oluwatayo (2013) conducted research on Banking the Unbanked in Rural Southwest Nigeria: Showcasing Mobile Phones as Mobile Banks among Farming Families. According to the study, the use of information and communication technology has transformed the Nigerian economy. The latest development is the advent of wireless and e-banking into the financial sector, which has made banking more accessible to numerous previously unbanked Nigerians. The study looked at how wireless telephones have improved financial activities in remote southwest Nigerian farming households. A representative selection of 360 agricultural families in Ekiti and Osun provided the statistics for the research. According to a descriptive assessment of statistics on participants' demographic status, farmers are getting older (mean lifespan 55 years) and yet just one-third (34.7 percent) have a postsecondary study. Purchase of recharge voucher that are afterwards turned into

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money was the top popular service among respondents who used services conducted on their mobile phones. Age, decades of academic schooling, cooperative affiliation, family number, and political influence are all relevant predictors of wireless telephone adoption as mobile banks (electricity).

In the rural communities of Benue State, Nigeria, Ocholi and Amodu (2013) compared the performance of Deposit Money Banks, Banks of Agriculture, and Microfinance Banks from 2010 to 2012. Information was gathered from 180 respondents through a multiple stage selection strategy. A standardized questionnaire was presented to randomly chosen participants that had received farm loans from these institutions. The dataset was analysed using descriptive techniques. The data indicated a substantial degree of engagement with regards to savings deposits gathered and loans provided. With respect to savings mobilization, the Deposit Money Bank was the most successful (11,825,000). Following that were the Bank of Agriculture (3,471,000) and the Micro Finance Bank (429,000). Deposit Money Bank received the most funding for rural agriculture (54.24 percent), trailed by Bank of Agriculture (45.18 percent), and Micro Finance Bank received the least (0.58 percent). Increased financial resources should be made available to Rural Banking Institutions by the State and Donor Agencies resuscitate operations, particularly amid their adverse money flow periods, according to the study. Rural financial establishments need to focus on aggressively mobilizing deposits and retrieving debts in order to achieve self-sustaining.

EFFECTS OF FINANCIAL INCLUSION ON ECONOMIC GROWTH

Pertaining to Onaolapo (2015), comprehensive financial arrangements are emerging a policy problem among advanced and underdeveloped nations because they are seen as a viable instrument for poverty reduction and economic expansion. The study investigated the influence of financial inclusion on Nigeria's economic advancement (1982-2012). The information for the study came mostly through auxiliary sources such as the Central Bank of Nigeria's (CBN) Statistical Bulletins, the Federal Office of Statistics (FOS), and the World Bank. Regional Network, Credit to Rural Region, Request Deposit, Liquidity Margin, Asset Adequacy, and Gross Domestic Product are among the bank parameters used. The Ordinary Least Square (OLS) method was employed to link information extracted over a thirty-year interval, between 1982 through 2012 (STATA 10). Loan to Rural Areas (LRA) Agricultural Guaranty Fund (ACGSF) was found to be significantly related to Per Capital Income (PCI) (at 5%) (tstat2.82, p>t=4.85), whereas Financial Deepening (FDI) and Broad Money (FD2) were as well found to be remarkedly related to Economic Growth (Using GDP) with t-stats=3.61, 4.85, p>t=0.0013 and 0.000, independently. Loans to Rural Areas (LRA) and Small-Scale Enterprise (LSSE) as substitute for financial broker influenced Deposits from Rural Areas (DRA) as a proxy for financial inclusion, with t-stats=2.2 and 2.9 and p-values=0.03 and 0.007. The cumulative outcomes of the regression analysis showed that inclusive Bank financial actions strongly impacted poverty alleviation (R^2=0.74) but fractionally ascertained national economic advancement and Financial Intermediation via improved Bank Branch Networks, Loan to Rural Areas, and Loan to Small Scale Enterprises, provided about 50% connectedness among factors on either flank of the formula. These findings are used to make policy recommendations.

Nkwede (2015) used Nigeria as a practical scenario to explore the impact of financial inclusion on African economic expansion. The analysis used inferred time series financial inclusion statistics from Nigeria, which covered the years 1981 through 2013. In order to estimate the contributions of the variables, multiple regression models based on the Ordinary Least Square approach were used. Even after adjusting for additional macroeconomic external factors, financial inclusion has demonstrated a considerable detrimental effect on Nigerian economic development throughout the years. As a consequence, the findings were ascribed to a significant incidence of financial exclusion among bankable adult residents in Nigeria and Africa as a whole, according to the research. However, the study recommended a highly inclusive financial structure in Nigeria (and Africa), placing emphasis on the rural folks, as “growth is good, sustained high growth is better, and sustained high growth with financial inclusion is the best of all,” particularly in emerging economies.

Between 1980 and 2012, Mbutor and Uba (2013) studied the influence of financial inclusion on Nigerian fiscal policy. As a result of the study's findings, which were based on descriptive analysis and a log-linear model based on OLS, it was concluded that increasing financial inclusion would increase fiscal policy efficacy. The coefficient for the amount of bank divisions, on the other hand, has the incorrect indication, which is described by the reality that when banks open divisions, they are more concerned with profit than with financial inclusion, which is a legislative goal, resulting in underused hubs of

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branches and multiple spots that are deemed unfavourable to stabilize sheets.

Between 1982 and 2012, Onaolapo (2015) investigated the impact of financial inclusion on Nigerian economic advancement. The study's data was mostly gathered from secondary sources like the Central Bank of Nigeria's (CBN) Statistical Bulletins, the Federal Office of Statistics (FOS), and the World Bank. Regional Network, Credit to Rural Region, Request Deposit, Liquidity Margin, Asset Adequacy, and GDP were among the bank parametric data used. The Ordinary Least Square (OLS) method was adopted to link data extracted over a 30-year period, from 1982 to 2012. Loan to Rural Areas (LRA), Agricultural Guaranty Fund (ACGSF), and per capital income (PCI) were equally noteworthy at the 5% threshold, according to the study's findings. Economic growth was also influenced by financial deepening (FDI) and broad money (FD2). Loans to rural areas (LRA) and small-scale enterprise (LSSE) as proxies for financial intermediation influence deposits from rural areas (DRA) as a proxy for financial inclusion. Furthermore, the overarching outcomes of the regression analysis indicated that comprehensive Bank financial operations hugely affected poverty eradication and yet minimally defined national economic expansion and financial facilitation via augmented bank division systems, credit to remote regions, and credit to small sized ventures, owing to approximately 50percent interdependency among factors on either hemisphere. As a result, the study recommended that low-cost deposit and borrowing windows be established for the poor and other income groups previously labelled "unbankable."

In their study, Joseph and Varghese (2014) looked at the impact of financial inclusion on the growth of developing countries. In order to analyse the current status of financial inclusion and associated influence on the growth of the Indian economy, they examine at five government-owned bank organizations and five non - government banks. For the period under consideration of their study, descriptive statistics were used to analyse bank proliferation trend in regards of amount of bank locations, offsite and onsite ATM, debit card and credit card usage. Secondary data was primarily gathered from reports, tabloids, scientific papers, journal articles, electronic-Journals, books, and periodicals. According to their findings, debit card usage has expanded dramatically throughout the research timeframe, with banks concentrating primarily on rural and semi-municipal regions. They observed, nevertheless, despite many decades following the country's inclusive banking measures, such as cooperative activity, bank nationalization, and the establishment of geographic rural banks, the number of individuals who have access to the banking system's goods and services remained highly restricted. They concluded from their research that financial inclusion adds significantly to the development of emerging economies and that there is still room for more inclusive expansion.

In their study "Relevance of Financial Inclusion for Developing Nations- an Analytical Study," Sharma and Kukreja (2013) stated that financial inclusion provides the route to inclusive development. Financial inclusion needs not begin or stop with the establishment of no-frills bank accounts; rather, conventional financial entities need gain the poor's confidence and compassion through developing solid partnerships alongside community-based financial businesses and cooperatives. Financial inclusion has not produced the anticipated outcomes, and there is still a significant way to go, yet it is undeniably important and has a positive impact.

IMPACT OF FINANCIAL INCLUSION ON INCOME AND POVERTY

Notwithstanding years of remarkable gains in decreasing poverty and increasing affluence, a huge segment of the world's poorest inhabitants, notably in Asia, Africa, Latin America, and the Caribbean, continues to struggle to reach a minimal quality life (Omar & Inaba, 2010; 2020). Advancement in eliminating severe poverty appears to be inconsistent in various regions due to the spatial and region-specific variables. Well over 50 per cent of the globe's poorest people live in Sub-Saharan Africa, according to the World Bank (2019). Asia is home to 42.7 percent of the planet's underprivileged, despite the fact that the continent as a whole has a solid track record of reducing overall poverty thanks to enormous development in developing big economies. Latin America and the Caribbean have the world's second-largest proportion of improvised people (4.4 percent). In Nigeria, 69 percent of the population is poor, with daily earnings of below $1.90. Poverty reduction in rural communities is slowing due to the prevalence of excessive revenue disparity, which is seen as a major barrier to economic growth. o that purpose, the World Bank established targets to eradicate absolute poverty before 2030 and increase equitable affluence among the lowest 40% of each nation 's population by lowering revenue disparity (Inaba, 2020).

As a result, due to its ability to disrupt the poverty pattern and reduce income disparity, financial inclusion has climbed on the worldwide

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transformation agenda and attracted attention. Because actual-world banking institutions are beyond egalitarian, a greater focus on financial inclusion is being placed, reflecting its radical revolutionary capacity to speed inclusive development. Financial inclusion is a key topic for the World Bank because of its wide-ranging implications. Financial inclusion is a statutory priority and a fundamental goal in the United Nations member countries' development agendas (Sahay et al. 2015).

Vulnerable groups can improve their economic situation if they have complete access to finance. Disparities in access to finance, according to Karpowicz (2014), are a predictor of revenue disparity. As additional individual get access to credit, banks' density decreases, lowering intermediation costs and allowing the poor to obtain credit at a lower cost. People can also provide for their own basic needs as they earn more money. Honohan (2004) argues that extensive banking networks are associated with decreased poverty levels. Appropriate financial services may increase the livelihoods of the poor by improving the supply of productive services, creating savings possibilities, and facilitating capital building within the impoverished. Furthermore, access to finance through a formal institution protects lower-income groups from informal moneylenders. As a result, well-functioning microcredit programs are required to assist the poor in increasing their income.

According to Omar and Inaba (2020), financial inclusion is a fundamental component of social involvement, and it is notably effective in eliminating poverty and earnings disparity by allowing disadvantaged people to advance. The study investigated the effect of financial inclusion on poverty reduction and earnings disparity reduction, as well as causes and contextual impacts of financial inclusion in 116 third world nations. The research was conducted utilising uneven yearly panel data from 2004 to2016. A novel metrics of financial inclusion was created for this purpose, based on a wide range of financial sector community engagement metrics, and it was discovered that per capita revenue, internet subscriber proportion, age reliance proportion, rising prices, and earnings disparity all have a substantial influence on the degree of financial inclusion in emerging nations. Furthermore, overall outcomes of the study showed that financial inclusion in emerging economies improves poverty levels and earnings disparity.

Babajide et al. (2014) attempted to figure out how Foreign Direct Investment (FDI) affects economic growth in low-income African nations. with reduced per capita income. Panel data was utilized for 39 African nations, with 20 of them being poor. The findings revealed that FDI has a major influence on host African nations' economic growth by increasing host sector development and progressively lowering dependency on foreign capital, resulting in higher per capita earnings, quality education, lifestyle conditions, and overall economic welfare. However, the study recommended that host economies guide the FDI influx sector and guarantee regulations are in existence to promote domestic investment development in these areas. As a result, existing proactive factors will gradually close, resulting in economic development.

With a focus on 37 developing Asian economies, Park and Mercado (2015) investigated the variables that influence financial inclusion as well as the importance of financial inclusion in decreasing poverty and earnings disparity. They discovered that higher per capita earnings, code of conduct, and demographic features all improved financial inclusion, whereas a greater age-reliance proportion dramatically decreased it. Primary school graduation and literacy levels in underdeveloped Asia have little influence on financial inclusion. Furthermore, Furthermore, there is proof that financial inclusion diminishes poverty and earnings disparity where additional explanatory variables are considered.

By establishing a novel financial inclusion metric for 151 economies, Park and Mercado (2018) employed basic factor assessment and a cross-sectional methodology to analyze overall cross-country effect of financial inclusion on deprivation and earnings disparity throughout national income classes. According to the findings, more financial inclusion is linked to stronger economic development and reduced poverty levels, albeit primarily for premium and intermediate income nations, never for intermediate and poor economies. They found no substantial influence of financial inclusion on earnings disparity in any income class, however.

IMPACT OF FINANCIAL INCLUSION ON FOOD SECURITY

The share of persons who are omitted or neglected by the formal banking system is concentrated in low- and middle-income nations rural areas, where poverty is also concentrated (Demirguc-Kunt et al., 2015). Remote households in these nations earn a living through a variety of agricultural and non-agricultural economic activities (Barrett et al., 2001). Considering the rural perspective which includes elevated payment prices in environments with poor population size as well as difficulty of analysing the vulnerability

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portfolio of agrarian clientele, formal banking establishments have found it challenging to offer their services to rural populations on a long-term basis with their current business model. As an outcome, local financial businesses are still divided, with multiple unofficial financial resource players coexisting, and informal financial service providers tending to dominate due to their informational advantages (FAO, 2016).

The establishment of the Maya Declaration in 2011 was a significant step forward in making financial inclusion a policy focus in numerous emerging regions, particularly for the poor and vulnerable. Financial inclusion is characterised as "secure and equal access to financial services" by the 2030 Agenda for Sustainable Development, which recognizes it as a "powerful enabler" for eradicating starvation, establishing food security, enhancing nutrition, and supporting long-term development (Baborska et al., 2018). Food security was formally acknowledged as a fundamental right by the United Nations in the Universal Declaration of Human Rights more than half a century ago (1948). “Food security exists when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life,” according to the Rome Declaration on World Food Security (1996). We believe that individuals will judge their tangible and economic accessibility of food based on their ability to utilize suitable banking services and ways this will impact their earnings and meal intake.

Financial services are instruments that might possibly aid in the management of family revenue for holdings and expenditures. The efficiency with which this can be accomplished may be determined by their unique characteristics as well as the household's ability to access an adequate suite of financial services. This might improve family members' food security by giving them more trust in their financial means to get food when they desire it. Utilising financial services, on the other hand, may entail large expenditures for the family, which may be difficult to maintain and may eventually result to a worsening in the household's food security position. Household members, for example, save for a life-threatening blow at the price of any successful ventures, or, after the shock has come, resort to a highly expensive crisis borrowing remedy (Demirguc-Kunt et al. 2017).

Baborska et al., (2018) evaluated the influence of utilizing solo, pairings, and the complete spectrum of three institutional banking services; cash reserves, loans, and purchases on individual food security in 88 low- and intermediate economies. It drew on the Global Findex repository as well as the Food Insecurity Experience Scale (FIES), both of which were all part of the 2014 Gallup World Survey, which captures data at the personal basis and compares it globally. The person’s likelihood of suffering food insecurity due to challenges in obtaining food, as measured by FIES, was the outcome variable of interest. The study employed a range of pairing strategies to examine the consistency of anticipated impacts, including entropy levelling, pairing on propensity ratings, and completely interactive horizontal pairing. Depending on the type of service used, the results indicated mixed food security effects. Savings account usage declined dramatically, whereas credit usage climbed tremendously, and the adoption of institutional payment systems had no influence on the chance of suffering food poverty.

CONCLUSION

The review revealed that some appreciable efforts have been made by researchers to look into the influence of financial inclusion on rural farmers. Particularly, efforts have been made to look at the causal effects of financial inclusion on agriculture, poverty and food security status of rural farming households. However, in the Nigerian context, there is still a gap in literature on the subject matter. The key policy concern remains how smallholder farmers could benefit more from financial inclusion, the complementary products (credit, savings and insurance) which is very crucial. Overall, government policies aimed at promoting financial inclusion should be holistic in nature by expanding the scope of the use of financial services and also advocate for designs that offer complementary schemes or bundles of financial services to the rural farming households in Nigeria.

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Analysis of Price Instability and Determinants of Price Difference of Tomato in Nigeria

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A R T I C L E I NFO

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ABSTRACT

This study analysed price instability and price difference of tomato in Nigeria. Specifically, the study determined the degree of instability of prices of tomato; measured the speed of tomato price adjustment process to the long-term multipliers; and examine tomato price differences and their drivers in Nigeria. This study employed time series data on monthly prices per kilogram of fresh tomato in different states from January 2016 to December 2020 obtained from the National Bureau of Statistics (NBS). Descriptive statistics, Cuddy-Della Valle index and fully modified least square were used to achieve the objectives of the study. The results revealed that Cross River state had the highest tomato price in Nigeria followed by Rivers state and Lagos state. While tomato price in Bauchi was the cheapest in Nigeria followed by Taraba state and Kaduna states. The value of the Cuddy Della Valle index of 89.22 shows that the tomato prices across Nigerian markets were highly unstable. The absolute tomato price difference in Nigeria tomato markets was ₦156 per one kilogram of tomato. The fully modified least square result revealed that population, distance and transportation cost had a positive and significant influence on tomato price differences while self-sufficiency and telephone had a negative and significant effect on tomato prices difference in Nigeria. To reduce the instability in tomato markets and reduce the price difference, there is a need for effective and mukquate means of transporting tomato from the producing states to the demanding states.

1.0 Introduction

The price of agricultural commodities and its stability is a continuous issue among policy-makers and all other actors along the food supply chain because of its crucial role in the pace and direction of agricultural production and marketing system. Poor marketing system and function leads to several setbacks in agricultural production and casues price fluctuation (Mukaila et al., 2021). It consequently forced farmers to sell at any available price due to perishable nature of agricultural product which posed them to risk. A perfect pricing system will encourage the production of commodities thereby resolving some failed conditions in the economy. A major feature of Nigeria's agricultural markets is the inter and intra-priced disparities between its metropolitan and rural retail markets caused by demand and supply forces (Adenegan & Adeoye, 2011). Therefore, a possibility exists that a price change in one market would result in a series of price responses spreading across contiguous market areas.

These price shifts, in this case, may not have reflective results on distant markets, which make it a mirage to achieve an integrated food market system (Akintunde et al., 2012). Thus, recognizing the movement of market prices of agricultural commodities is one way of encouraging flexibility in the use of farm resources. It is also a means of curbing some of the vices of the

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spill over, such as unemployment, and inflation, among others. These concerns about fluctuations in commodity prices have led to widespread intervention (such as Price Control Act, regulation of tariff, tax and import) by national governments in commodity policy in order to achieve price stability.

Prices constitute the readiest and most accurate information available which serve as a guide to farmers planting decisions. These decisions depend on expected gains which are dependent on expected future crop prices. As a result, prices are seen as an important instrument in economic analysis of markets (Moshood & Momoh, 2013). Price influences food availability. Price increases as food supply relatively decreases due to demand (e.g., low production and limited food imports). The prices tend to fall as supply increases (e.g., period of bumper harvest). Many agricultural commodities in Nigeria including tomato continue to have price instability. Akpan et al. (2014) stated that instability of agricultural commodity price is a common phenomenon in Nigerian markets. The instability is attributed to such conditions as seasons, variations in prices of materials, output, marketing technologies and consumer preferences (Akanni, 2013). Price instability affects vegetable crops marketing and consumption.

Vegetables play significant roles in sub-Saharan Africa countres including Nigeria as it contributes to nutrition and food security, livelihoods, economic status of people especially rural population who produce it and urban areas where the products are being marketed (Mukaila et al., 2021). Tomato is among the highly valued vegetables whose prices in Nigeria are highly unstable between seasons. In different markets, separated by a few kilometres, consumers pay different amounts for the same commodity. Adenegan (2012) reported that tomato prices were not stable across seasons and states in Nigeria. Although government enacted policies to stimulate production and returns to farmers, tomato output in Nigeria is still short of local demand with a shortfall of 1.2 million tonnes valued at about $2.5 billion annually (CBN Governor's speech, Feb., 2020 during tomato factory launching in Kaduna).

Due to the perishable nature of tomato, there are frequent variations in tomato price and trade between regional markets depending on their supply position. Tomato farmers in Nigeria mostly sell their products in unorganized markets. And as such, the prices of tomatoes are not stable; most farmers cannot sell by weight rather they sell in baskets. The tomato price in Nigeria is somewhat volatile as a 60kg basket of tomato can sell for ₦5,000 sometimes and may sell for ₦25,000 in another period (Veggiegrow, 2021). Despite Nigeria being one of the biggest tomato producers, it buys about 80% of tomato paste from China (George, 2018). In 2017, a new tomato policy was announced by the Federal Government to increase domestic production. The major goal of the policy is to discourage tomato concentrate importation by increasing its tariff from 5% to 50% and introducing USD1,500 levy per tonne (GROWAFRICA, 2018).

Given the importance of tomato crop and the effect of price stability in stimulating production, efficient marketing and income to farmers, and also to facilitate government policy interventions, there is a need to understand the price instability and causes of price difference. Several previous studies on price fluctuation of agricultural commodities markets concentrated on cereal, roots and tuber crops (e.g., Goletti et al., 1995; Moshood & Momoh, 2007; Akpan et al., 2016; Adeoye *et al.*, 2013; Taru, 2014; Zakari *et al*., 2014; Ayinde et al., 2016; Etuk & Effiong, 2016; Moses, 2017; Sadiq *et al.*, 2018; Onubogu and Dipeolu, 2019). While vegetable crops such as tomato which provide income to many households, serve as means of livelihood in developing nations and which are faced with the problem of price instability received less attention, especially in the area of price analysis. The few studies on tomato (e.g. Adenegan, 2012; Shrestha et al., 2014; Baiyegunhi *et al.*, 2018) examined the level of market integration.

Based on the foregoing, the tomato price instability and the factors underlying the large variations in their prices need to be examined. Therefore, the present study intends adding to existing literatures and filled the gap by identifying drivers of price differences in Nigeria tomato markets. Thus, the following research questions necessarily arose:

1. What is the degree of instability of tomato prices?
2. What is the absolute tomato price difference?
3. What are the factors influencing tomato price differences in Nigeria?

2.0 Methodology

2.1 The Study Area

The research was conducted in Nigeria. Nigeria comprises of 36 states and the Federal Capital Territory, Abuja which were grouped into six geopolitical zones (North West, North East, North Central, South West, South East and South-South). Nigeria lies about latitude $2^{0}40^{1}$ to $15^{0}45^{1}$ east of Greenwich meridian and from a longitude of $4^{0}15^{1}$ to $13^{0}55^{1}$ north of the equator (World Map, 2015). The

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country is located in West Africa on the Gulf of Guinea with a total land area of 923,768 km^2. The country shares borders with Cameroon and Chad in the east, the Republic of Benin in the west and Niger in the north. Nigeria is an agrarian nation endowed with rich natural resources, suitable weather conditions for agricultural production (Mukaila et al., 2021). Agriculture contributes greatly to Nigeria economy and employs about 70 percent of the workforce (Obetta et al., 2020). One of the major vegetable crops produced in Nigeria is tomato. Nigeria is the 11th largest producer of tomato in the world, 2nd in Africa and 1st in sub-Sahara Africa (FAOSTAT, 2020). Tomato is grown in almost all the states in Nigeria but predominantly produced in the northern part of the country. Most states in the northern Nigeria, for example, Bauchi, Benue, Gombe, Jigawa, Kaduna, Katsina, Kano, Plateau, Kebbi, Sokoto, Nasarawa, Zamfara, Taraba and Kogi state have large tomato plantations. These states accounted for the largest proportion of the 3.9 million tonnes tomato output in the country. Regardless of the level of production, tomato is marketed in all states of the federation.

2.2 Data and Source

To have a good representation and considering the fact that tomato is marketed and consumed across the country, all the six geopolitical zones in Nigeria were used for this study. Twelve states and the Federal Capital Territory, Abuja, were used for the study. This makes a total of 13 locations for this study.

This study employed secondary data. Time series data on monthly prices per kilogram of fresh tomato in different states from 2016 – 2020 were obtained from the National Bureau of Statistics (NBS). This was long enough to measure the instability in price as it gives sixty data points or observations. This is, however, considered a large sample and acceptable to conduct research on market integration and price analysis (Baiyegunhi *et al.*, 2018). Data on other variables were also sourced from NBS.

2.3 Data Analysis Techniques

Descriptive statistics was used to present the results and inferential statistics was used to analyse the data. Cuddy-Della Valle index was used to determine the degree of instability in the prices of tomato, descriptive statistics was used to examine tomato price difference and a fully modified least square model was used to identify determinants of tomato price differences in Nigeria.

Augmented Dickey-Fuller (ADF) Model

Before proceeding on analysing any time series data there is a need to check for the stationarity level of the series to adopt appropriate model in a view to avoid spurious regression (Mukaila, 2021). This would allow understanding the behaviour, nature and order of integration of the series (Mukaila, 2021). To test for the unit root properties of the variables ADF test was employed as it was used by Makama and Amruthat (2016).

This is specified as:

$$\Delta\gamma_t = X_t\,\beta + \delta\gamma_{t-1} + \alpha_i \sum_{i=1}^{p} \Delta\gamma_{t-i} + \varepsilon_t \quad (3.1)$$

Where:

Δ = difference operator

γ_t= vector of the n variables (price of tomatoes from difference markets)

X_t= are optional exogenous regressors

β= coefficients

$\sum$ = summation

ρ = number of lags

ε_t= error term

Cuddy Della Valle index (CDVI)

To measure the degree of instability in the price of tomatoes CDVI was used. It is specified as:

CDVI = CV$\sqrt{x}$

Where, X = 1 -$\underline{R}^2$,

CV = coefficient of variation,

$\underline{R}^2$ = adjusted coefficient of determination.

The ranges of CDVI (Sihmar, 2014) are given as follows:

Low instability = 0 to 15,

Medium instability = 16 to 30

High instability = above 30

Tomato Price differences

Following Varela *et al*. (2012), price difference is the average tomato price over the period. This was measured by taking the difference between price of tomato in a state against all other states. It is represented as:

$$TPD = state_i - state_j$$

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Where,

TPD is the tomato price differences

$state_i$ is the price of tomato in state *i*.

$state_j$ is the price of tomato in state *j*.

The formula was applied to all the markets used for this study. This was done to examine the absolute tomato price difference and was used as regressand to identify the drivers of tomato price differences across Nigeria.

Fully Modified Least Square Model

The fully modified least square model was used to identify the determinants of tomato price difference across tomato markets in Nigeria. The fully modified least square has the advantage of accounting for serial correlation and endogeneity in the regressor. The average tomato price difference across the markets in Nigeria was regressed against some explanatory variables. This is to explain divergences from law of one price (Varela *et al.*, 2012). It is specified as:

$$TPD = \beta_0 + \beta_1 Trancost_{1i} + \beta_2 Tele_{2i} + \beta_3 Dist_{3i} + \beta_4 Cont_{4i} + \beta_5 Pop_{5i} + \beta_6 Self_{6i} + \varepsilon_i$$

Where,

TPD is the tomato price difference

Trancost is the transportation cost. This measures the level of infrastructural facilities such as good road network, a low transport cost suggests a good transportation network while a high transportation cost suggests a poor transportation network.

Tele is the telephone density. It is a proxy for availability of information.

Dist is the distance from one state to the other.

Cont is the contiguity (1 if the state shares a border, 0 if not). This will measure additional cost involved in tomato marketing cost.

Pop is population (number of people living in the state).

Self is self-sufficient in tomato (1 if a major tomato producer, 0 otherwise). This measures the level of tomato production in terms of meeting the state demands.

β_0= constant

ε_i = Stochastic error term

Results and Discussion

Descriptive Statistics of Tomato Price Difference in different Nigeria Markets

Table 1 presents the descriptive statistics of tomato prices in different markets in Nigeria. Cross River state had the highest tomato average price in Nigeria followed by Rivers state and Lagos state. This could be because the states were major demanding states of tomato in Nigeria. Tomato price in Bauchi was the cheapest in Nigeria followed by Taraba state and Kaduna states which were due to large scale tomato production in the states. As shown in Table 1, tomato prices in the demanding states were higher than tomato prices in supplying states. The higher price of tomatoes in the demanding states could be because of the transportation cost incurred to move tomato from the producing or supplying states to the consumption and demanding states.

Table 1: Descriptive statistics of tomato price in different Nigeria states

States	Mean	Media	Max	Min	Std dev.
Bauchi	173.45	170.10	281.64	96.28	50.01
Taraba	202.22	190.03	405.89	110.94	61.68
Benue	256.38	251.58	397.62	142.52	47.88
Plateau	231.53	217.99	394.46	162.77	53.97
Sokoto	226.38	223.23	397.92	105.92	77.84
Kaduna	222.90	214.71	395.70	54.98	69.75
Lagos	379.92	380.28	592.51	208.65	107.07
Ondo	283.53	277.71	437.12	142.73	67.50
Enugu	329.85	298.39	956.53	195.93	137.04
Anambra	348.83	327.12	811.90	200.66	117.61
Rivers	436.04	425.45	606.22	239.65	76.37
Cross river	442.63	424.45	770.23	313.97	87.25
Abuja	259.18	252.28	438.35	184.52	55.11

Source: Data analysis, 2021

Unit Root Property of Tomato Price

The unit root property of tomato prices across spatially separated markets in Nigeria were presented in Table 2. The results revealed that tomato prices in Bauchi, Benue, Sokoto, Kaduna, Lagos and Ondo states were not stationary in the level form. They, however, became stationary after the first difference. This means that the variables are order one. While tomato prices in Taraba, Plateau, Enugu, Anambra, Rivers, Cross River states and Abuja (FCT) were stationary at level form. This implies that these variables are order zero.

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Table 2: Unit root property of tomato price

Variables	Level	First Difference
Bauchi	-0.803226 (0.8093)	-5.85478 (0.0000)
Taraba	-2.765427 (0.0695)	8.2863 (0.0000)
Benue	-2.549004 (0.1094)	-7.81098 (0.0000)
Plateau	-2.876504 (0.0542)	-7.865429 (0.0000)
Sokoto	-1.77882 (0.3873)	-8.930966 (0.0000)
Kaduna	-1.61370 (0.4692)	-11.8404 (0.0000)
Lagos	-2.28944 (0.1787)	-10.29302 (0.0000)
Ondo	-2.5269 (0.1144)	-7.52985 (0.0000)
Enugu	-4.8996 (0.0002)	-6.4889 (0.0000)
Anambra	-3.50798 (0.0111)	-7.128149 (0.0000)
Rivers	-2.72809 (0.0754)	-9.45669 (0.0000)
Cross River	-3.61088 (0.0084)	-6.72578 (0.0000)
Abuja	-3.13119 (0.0268)	-9.30195 (0.0000)

Note: *, ** and *** denote rejection of the null hypothesis at 10%, 5% and 1% significant levels respectively based on the Mackinnon critical values. P-values of test statistics are in parenthesis.

Source: Data analysis, 2021

Degree of Instability of Prices of Tomato in Nigeria

The degree of instability of prices of tomato in Nigerian markets was presented in Table 3. The value of the Cuddy Della Valle index was 89.22. According to Sihmar (2014), the Cuddy Della Valle index greater than 30 indicates a higher level of instability. Thus, the Cuddy Della Valle index of 89.22 implies that the tomato price across Nigerian markets was highly unstable. In addition, the mean value of tomato price (₦289.27) per kilogram in Nigerian markets with a standard deviation of 118.45 suggests a wide variation in the tomato prices in Nigerian markets. This result supports the finding of Adenegan (2012) that tomato prices in Nigerian markets were not stable.

Table 3: Degree of instability of prices of tomato

Variable	Coefficient of variation	Adjusted R-Square	CDVI	Inference
Tomato prices	244.20	0.8665	89.22	High instability

Source: Data analysis, 2021

Tomato Price Differences And Their Drivers In Nigeria

The absolute tomato price difference in Nigeria tomato markets was ₦156 per one kilogram of tomato. This implies that tomato price in spatially separated tomato markets in Nigeria differs by ₦156 per one kilogram.

Determinants of tomato price different in Nigeria

Table 4 presents the determinants of tomato price differences in Nigeria. The result revealed that distance, population, self-sufficiency, telephone and transportation cost were the significant factors that influenced tomato price differences in Nigeria.

The coefficient of distance positively influences tomato price differences in Nigeria. This implies that the longer the distance covered from one tomato market to another, the higher the price difference. This could be as a result of the cost incurred from moving the tomato from the producing states to the demanding states. Thus, the tomato price difference reduces as the distance covered reduces. Goletti et al. (1995) reported a similar finding that distance increased rice price difference in Bangladesh

The population also had a significant and positive effect on tomato prices different in Nigeria. This implies that the population in a location increased the tomato price different. This could be because a location with a high population will have a high demand for tomato, *ceteris paribus*, which will command high prices tagged to tomato. While a location with a low population will have low demand for tomato which will command a low-price tag to tomato, *ceteris paribus*. These will, in turn, result in different tomato prices.

Self-sufficiency had a negative and significant effect on tomato prices different in Nigeria. This implies that being self-sufficiency in tomato production will reduce the tomato price difference in the market spatially located. This could be because being able to produce tomato in all states at a sufficient level will maintain almost the price as all states are likely to incur the same cost of production. Self-sufficiency may also increase the output of tomato in the country. An increase in output will, in turn, reduce price differences (Varela et al., 2012).

The telephone had a negative and significant influence on tomato price differences. This result implies that the presence of the telephone in different locations reduced the tomato price difference in Nigeria. This could be because the telephone enhances the means of

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communication and transmission of tomato prices across the country.

The transportation cost had a positive and significant influence on price differences. This implies that an increase in transportation costs will increase the price difference in spatially separated markets. This is because transportation cost is a major cost in tomato marketing to move tomato from producing states to demanding states. Thus, a low transportation cost will lead to a low tomato price difference while a high transportation cost will lead to a high tomato price difference.

Table 4: Determinants of tomato price difference in Nigeria

Variables	Coefficient	Standard error	t-statistics	Prob.
Contiguity	-0.585935	0.827172	-0.708360	0.5104
Distance	0.004619***	0.000702	6.577409	0.0012
Population	1.52E-06**	5.15E-07	2.944464	0.0321
Self sufficiency	-6.573598***	0.957999	-6.861803	0.0010
Telephone	-9.52E-07**	2.84E-07	-3.357927	0.0202
Transportation cost	0.030003***	0.006473	4.635088	0.0057
Constant	-17.60886	4.211989	-4.180652	0.0086

Source: Data analysis, 2021

Conclusion

This study analysed price instability and price difference of tomato in Nigeria. The results revealed that Cross River state had the highest tomato price in Nigeria followed by Rivers state and Lagos state. This could be due to the low production of tomato in these states. While tomato price in Bauchi was the cheapest in Nigeria followed by Taraba state and Kaduna states which could be due to large scale tomato production. The Cuddy Della Valle index (89.22) shows that the tomato price across Nigerian markets was highly unstable. It can be inferred from this study that tomato prices in the demanding states were higher than tomato prices in supplying states. Distance, transportation cost and telephone played a significant role in the tomato price difference. Distance between the producing states and demanding states influenced tomato price difference positively; thus, the longer the distance covered, the higher the tomato price difference. Meanwhile, the higher the telephone concentration, the lower the tomato price difference.

To reduce the instability in tomato markets and reduce the price difference, there is a need for effective and adequate means of transporting tomato from the producing states to the demanding states. This could be achieved by constructing new roads and/or renovate the existing ones to enhance the movement of tomato and reduce the time tomato spent in transit. Construction of rails from the major producing states to the major demanding states would go a long way to reduce the transportation cost incurred during the distribution of tomato. Furthermore, provision of rural mass transit, by the government, that will carry tomato from the producing states to the consuming states at sibsidizised rate is needed to reduce the transportation cost. These would consequently reduce tomato spoilage during transportation. Due to the perishable nature of tomato, the provision of modern processing facilities and storage facilities will reduce the price difference in tomato markets. This would enable storing of tomato during the production season to the offseason.

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Effects of E-Banking Service Qualities on Customer Satisfaction among Agripreneurs in Obio/Akpor Local Government Area of Rivers State, Nigeria

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A R T I C L E I NFO

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ABSTRACT

Customer satisfaction in any business is very essential for sustainability and growth of the enterprise. Hence, customers are regarded as cardinal points in every business. To this effect, this study accessed the effect of e-banking service qualities on customer satisfaction among agripreneurs in Obio/Akpor Local Government Area of Rivers State, Nigeria. Two-stage sampling technique was used to select 90 agripreneurs. Data were analysed using descriptive statistics and Ordinary Least Square Regression model. SERVQUAL Model was used to estimate the e-banking service qualities. The result from the socioeconomic characteristic showed that 53.3% of the respondents were male and 46.7% were female. Commonly used e-banking products were ATM and POS. The study identified the benefits of E-banking services as convenience in transaction, easy online remittance and shopping, swift transactions. Reliability and responsiveness were the service qualities that were significant in influencing customer satisfaction. Constraints to electronic banking were identified as hacking of customers' accounts and long queue at the ATM. The study recommends that banks should train their staff on how to show courtesy to their customers, convey trust and confidence, and learn how to give individual attention to customers since Assurance and Empathy as service quality variables were not significant.

1.0 Introduction

In recent times, banking institution and other sectors including the agricultural sector have experienced drastic technological development with measurable compensation to make available suitably acceptable services to the customers electronically. The use of information technology techniques, policies, and implementation strategies to banking services has become a topic of critical relevance and concern for all banks, as well as a requirement for both local and global banking. According to Oyedijo (2012), one of the recent developments in management organization with adoption of information technology is that banks have been in the fore front to improve their product and services. Banks have recognized that, rather than traditional banking systems, the banking of the future demands more computerised financial transactions. In other words, electronic transactions are gradually replacing paper transactions. The degree to which a bank invests in IT and uses it creatively determines whether or not it will be successful.

E-banking, according to Shahriari (2014), is the automated distribution of new and traditional banking products and services to customers using electronic, interactive communication channels. E-banking is defined differently among academics in terms of thinking and viewpoints; hence, it refers to a number of e-channels for conducting financial transactions via the internet, telephone, mobile, and computer (Hammoud, Bizri and Baba, 2018).

Agricultural techniques, production processes and procedures have greatly changed due to contemporary modifications in the agro-allied sectors which has mounted so much support to the agricultural industry. As a result, famers are provided banking services in electronic formats to ensure their satisfaction with current banking business strategies.

Customer satisfaction is critical for every organization's long-term sustainability around the world. (Toor, Hunain, Hussain, Ali & Shahid, 2016). Customer satisfaction has the potential to boost the

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customer base of an organization as well as increase the adoption of new ideas by subscribers and also increase the reputation of a firm.

In today's industry, customer satisfaction is a highly prized commodity. Customers want more than just a good deal; they want technology that is functional, dependable, and consistent. Banks have used e-banking to improve service delivery, decongest banking hall, aid international payment and remittance, transfer deposit to a third party account, allow customers to withdraw cash 24 hours a day, and track personal banking transactions. Despite the banks' efforts to ensure that consumers are satisfied with the benefits of e-banking, customers continue to voice their dissatisfaction.

As it has been adopted, electronic banking offers various advantages, but the limits make it impossible to achieve its goals. In terms of risk exposure, the advent of electronic banking has posed significant hurdles to the banking industry Ekienabor et al (2018). They further stressed that one of the biggest obstacles to e-banking is the erosion of good value principles, and that corruption is the leading cause of increased cyber-crime among Nigerians. Another difficulty with e-banking is the capacity to adapt global technology to local needs (Ekienabor et al, 2018).

Since, benefits and constraints contribute to electronic banking service quality with respect to customer satisfaction; it becomes essential in the presence of competitive banking atmosphere to provide excellent service to customers.

1.1 Service Quality Model

Service Quality (SERVQUAL) model is a dimension of measurement of service quality developed by Parasuraman, Zeithaml and Berry, in 1988. The model, as a paradigm to this study, considers five areas of measuring service quality from the customer's view point. This model is shown in figure 1, while the explanation is shown in Table 1 below:

Table 1: Dimensions of SERVQUAL Model

Dimensions	Explanation
Tangibility	These are the buildings, equipment, employees, and communication materials.
Reliability	It refers to a firm's ability to deliver on its promises consistently and precisely.
Responsiveness	It refers to a service provider's willingness to assist customers and deliver prompt service.
Assurance	It has to do with employees' ability to convey trust and confidence through their knowledge and courtesy.
Empathy	It refers to providing customers with compassionate and personalized service.

Source: Sang-Lin & Seung (2004)

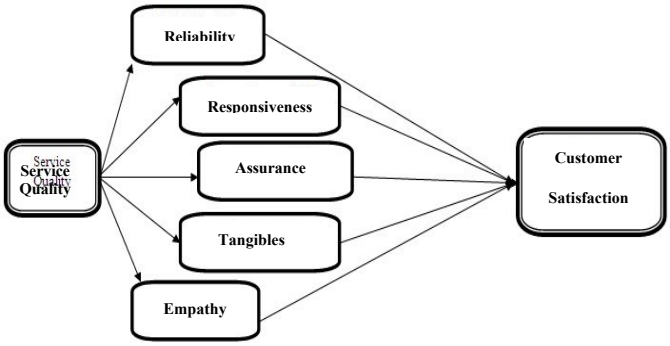

Figure 1: SERVQUAL MODEL
Source: Worku *et al,* (2016)

One of the most difficult aspects of internet banking is striking the right balance between convenience, speed, and security. The challenge is to create products that strike a mix between competitive pricing and functionality while also keeping up with changing client needs and innovation. However, the problem of customer satisfaction with e-banking services in relations to agripreneurs has been adopted to improve the banks service delivery, manage long queues in the banking arena, facilitate international transactions (payment and remittance) among agripreneurs, easy cash withdrawal - 24/7, monitoring of personal transactions through online and mobile banking statement. While the banks work so hard to meet the utility status of the customers via internet banking, customers are in turn faced with functionality problems from network, Automated Teller Machines (ATMs) malfunctioning or unavailability of fund in the ATM, internet fraud, etc. (Ogunlowore & Oladele , 2014). Hence, this study is designed to examine if customers are satisfied with e-banking services.

1.2 Objectives of the Study

The specific objectives of the study were to:

i. describe the socio-economic characteristics of agripreneurs in Obio/akpor Local Government Area.
ii. identify the commonly used E-banking product and services in the study area
iii. identify the benefits of E-banking from customers' point of view
iv. evaluate the effect of E- banking service qualities on customer satisfaction among agripreneurs in Obio/Akpor Local Government Area.
v. identify the constraints to E-banking among agripreneurs in the Study Area.

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1.3 Hypothesis of the Study

Ho: There is no significant relationship between e-banking service qualities and customer satisfaction among agripreneurs in Obio/Akpor LGA.

2.0 Research Methodology

The Study Area was Obio/Akpor Local Government Area (L.G.A.) of Rivers State, Nigeria. Obio/Akpor is located in the metropolis of Port Harcourt and it is one of the major centres of economic activities in Rivers State as well as Nigeria, and one of the major cities of the Niger Delta. The population of study comprised all the agripreneurs in Obio/Akpor Local Government Area of Rivers State, Nigeria. Two stage sampling procedure was adopted; the first stage was a purposive selection of six communities. The selection is based on high concentration of economic activities which are agro based and availability of financial institutions. Second stage was a purposive selection of 15 agripreneurs from each of the communities, making a total of 90 agripreneurs for entire the study. Ordinary Least Square Multiple Regression model was applied in the examination of service quality dimensions on customer satisfaction in e-banking.

Model Specification

The SERVQUAL Model was used in the regression analysis to determine if there is significant effects of the individual's independent variables for assessing customer satisfaction in e-banking. The basic model that is used to estimate customer satisfaction on service quality developed by Parasuraman, Zeithaml, and Berry (1988) was adopted as follows:

$$CS_{EB} = \alpha + ß_1X_{RY} + ß_2X_{RS} + ß_3X_{AS} + ß_4X_{TN} + ß_5X_{EM} + e$$

Where, CS_{EB}= Customer Satisfaction in E-Banking (pooled)

α = constant
ß =Estimated Coefficients
SERQUAL (Reliability, Responsiveness, Assurance, Tangibility and Empathy were achieved by pooling statements)
X_{RY}= Reliability
X_{RS}= Responsiveness
X_{AS}= Assurance
X_{TN}= Tangibility
X_{EP} = Empathy
e= error term

The relationship between the dependent and each of the independent variable was examined by using the four functional forms, Linear, semi-log Exponential and double–log

Linear function:

$$CS_{EB} = \alpha + ß_1X_{RY} + ß_2X_{RS} + ß_3X_{AS} + ß_4X_{TN} + ß_5X_{EM} + e$$

Exponential function:

$$CS_{EB} = \alpha + ß_1LogX_{RY} + ß_2LogX_{RS} + ß_3LogX_{AS} + ß_4LogX_{TN} + ß_5LogX_{EM} + e$$

Semi-log function:

$$LogCS_{EB} = \alpha + ß_1X_{RY} + ß_2X_{RS} + ß_3X_{AS} + ß_4X_{TN} + ß_5X_{EM} + e$$

Double-log function:

$$LogCS_{EB} = \alpha + ß_1Logß_1X_{RY} + ß_2Logß_2X_{RS} + ß_3Logß_3X_{AS} + ß_4Logß_4X_{TN} + ß_5Logß_5X_{EM} + e$$

The criteria that were used in selecting the lead equation that was best fit for regression are Highest R^2 value, highest number of significant variables, highest F-value and conformity to apriority expectations of the coefficient.

3.0 Results and Discussion

3.1 Socio-economic characteristics of farmers

From table 2, it shows that 53.3% of the respondents were male while 46.7% of the respondents were females. Among the age range, the study revealed that 1.1% of the respondents were in the age bracket of 15-20 years, 12.2% falls within 21-25 years, 2.2% is between the ages of 26-30 years, 38.9% ranges between the ages of 31-35, about 38.9% is between the ages of 36-40 and 32.2% are above 40. A greater percentage of the respondents falls within the age brackets of 31-35 years. This indicates that they are in their middle active ages of production.

In terms of the educational level of the respondents; 7.80% of the respondents had First School Leaving Certificate, 46.70% had Senior School Certificate, 15.60% had Ordinary National Diploma, 24.40% had Bachelors Degree, and 5.60% had no formal education. This means that most of the respondents were Senior School Certificate Holders (46.70%).

The distribution of the household size of the respondents indicated that 24.40% of the respondents had a household size of 1-3 persons, 55.60% had a household size of 4-6 persons, 18.9% had a household size of 7-9% and 1.1% had a household size of above 9 persons. The implication of the result is that majority of the respondents had a household size of 4-6 persons.

Based on the type of agribusiness, 30.0% of the respondents were crop farmers, 24.4% were crop

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marketers, 23.3% were livestock keepers and 22.2% were livestock marketers. This implies that most of the respondents were crop farmers.

On the basis of years of business experience in agribusiness, 35.6% of the respondents have spent 1-5 years in agribusiness, 47.8% have spent 6-10 years in agribusiness, 15.6% have spent 11-15 years and 1.1% have spent 21-25 years in agribusiness.

The income distribution of the respondents indicated that 51.1% had an estimated annual income of 100,000 – 500,000 Naira, 34.40% had an estimated annual income of 501,000 – 1,000,000 Naira, 4.40% had an estimated annual income of 1,001,000–1,500,000 Naira and 10.0% had an estimated annual income of 1,501,000–2,000,000. The implication of this result is that majority of the respondents had estimated annual income of 501,000–1,000,000 Naira.

The distribution of banks utilized by respondents in the study area are; about 18.9% of the respondents access e-banking services from UBA, 21.1% of the respondents access e-banking services from ACCESS BANK, ECOBANK is being used by 7.8% of the respondents, POLARIS BANK being used by 2.2% of the respondents, FIRST BANK is being used by 16.7% of the respondents, about 3.3% of the respondents access e-banking from FCMB, FIDELITY BANK is being used by 7.8% of the respondents, GTB is being used by 14.4% of the respondents, ZENITH BANK is being used by 3.3% of the respondents and STERLING BANK is being used by 4.4% of the respondents. The implication of this result is that a greater percentage of the respondents use ACCESS BANK for E-Banking transactions.

On the duration of access to e-banking services, about 31.1% of the respondents have used E-banking services for 1-3 years, 55.6% of the respondents have used E-banking services for 4-6 years, 12.2% of the respondents have used E-banking services for 7-9 years and 1.1% of the respondents have used E-banking services for 10-12 years. This implies that 55.6% of the respondents which is the greater percentage have used E-banking services for 4-6 years.

Based on the preferred electronic banking method, 10.0% preferred using the internet for e-banking, 44.4% preferred using the ATM, 35.6% preferred using the POS and 10.0% preferred using USSD for e-banking transactions.

Table 2: Distribution of socio-economic characteristics of agripreneurs in the study area

Variable	Frequency (N=90)	Percentage (%)
Gender		
Male	*48*	53.3
Female	*42*	46.7
Age		
15 – 20years	1	1.1
21 – 25years	11	12.2
31 – 35years	2	2.2
36 – 40years	35	38.9
Above 40years	12	13.3
Educational Level		
No Formal Education	5	5.6
FLSC	7	7.8
SSC	42	46.7
OND	14	15.6
BSc.	22	24.4
Household Size		
1 - 3 persons	22	24.4
4 – 6 persons	50	55.6
7 – 9 persons	17	18.9
Above 9 persons	1	1.1
Type of Agribusiness		
Crop farmers	27	30.0
Crop marketer	22	24.4
Livestock keeper	21	23.3
Livestock marketer	20	22.2
How Long Have You Been in Agribusiness?		
1-5 years	32	35.6
6-10 years	43	47.8
11-15 years	14	15.6
21-25 years	1	1.1
Estimated annual income		
100,000NGN - 500,000NGN	46	51.1
501,000NGN - 1,000,000NGN	31	34.4
1,001,000NGN - 1,500,000NGN	4	4.4
1,501,000NGN - 2,000,000NGN	9	10.0
Bank accessed		
UBA	17	18.9
Access Bank	19	21.1
Eco-Bank	7	7.8
Polaris Bank	2	2.2
First Bank	15	16.7

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Variable	Frequency (N=90)	Percentage (%)
FCMB	3	3.3
Fidelity Bank	7	7.8
GT Bank	13	14.4
Zenith Bank	3	3.3
Sterling Bank	4	4.4
How long have you been using electronic banking services?		
1-3 years	28	31.1
4-6 years	50	55.6
7-9 years	11	12.2
10-12	1	1.1
Preferred electronic banking services		
Internet	9	10.0
ATM	40	44.4
POS	32	35.6
USSD	9	10.0

Source: Field Survey, 2021.

Commonly Used E-Banking Product in the Study

Agripreneurs in the study area were identified accessing the following e-banking products and services; internet, ATM, POS and USSD. The electronic banking product and services as presented in figure 1 were identified as the commonly used financial products among Agripreneurs which the ATM was identified as the most frequently used at 44.5% followed by POS at 35.6%. The customers using internet and USSD share the remaining 20% at 10% each. This finding corroborates with report of Ugwuja and Adesope (2021), which states that ATM was majorly accessed by female heads of household in Southern Nigeria.

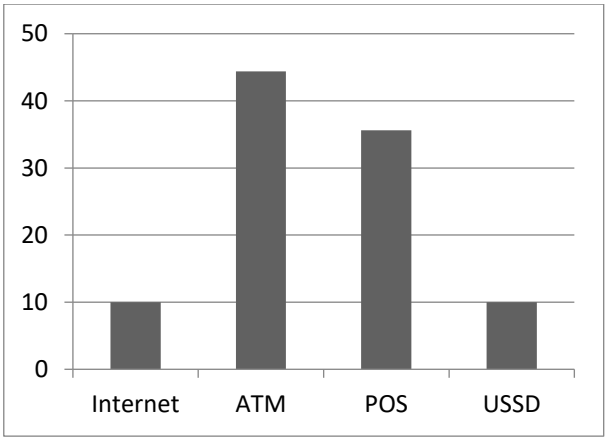

Figure 1: A chart showing the commonly used e-banking products and services in Obio/Akpor Local Government Area.
Source: Field Survey, 2021.

Benefits of E-banking from customers' point of view

Table 2 shows the benefits of E-banking from customer point of view. The result indicates that among the benefits of E-banking from the customer perception are; customers do not have to visit the banking hall if not for large cash amounts or serious complaint about a transaction with acceptance response of 96.7%, the platform is secure with acceptance response of 88.9%, E-banking is a convenient 24/7transaction with acceptance response of 88.9%, customers do transaction in some seconds instead of hours with acceptance response of 91.1%, Electronic banking services are many with an acceptance response of 96.7%, easy online remittance and shopping using E-banking platforms with an acceptance response of 95.6% and customers see their account balance after each transaction with an acceptance response of 81.1%. This implies that bank customers enjoy all the benefits of E-banking.

Table 3: Distribution of Benefits of E-banking from customers' point of view

Variable	Frequency (N=90)	Percent (%)
I don't have to visit the banking hall if not for large cash amounts or serious complaint about a transaction.		
Yes	87	96.7
No	3	3.3
The platform is secure.		
Yes	80	88.9
No	10	11.1
Convenient 24/7transaction.		
Yes	80	88.9
No	10	11.1
I do transaction in some seconds instead of hours.		
Yes	82	91.1
No	8	8.9
Electronic banking services are many.		
Yes	87	96.7
No	3	3.3
Easy online remittance and shopping.		
Yes	86	95.6
No	4	4.4
I see my account balance after each transaction.		
Yes	73	81.1
No	17	18.9

Source: Field Survey, 2021.

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Effect of Electronic Banking Service Qualities on Customer Satisfaction among Agripreneurs in Obio/Akpor Local Government Area

The effect of electronic banking services in the study area was evaluated based on SERVQUAL model. Customer satisfaction as a dependent variable was regressed with respect to five independent variables which includes: reliability, assurance, tangibility, empathy and responsiveness. The table 4 below shows the significant relationship between the variable used in the measurement.

The four functional forms presented in Table 4, explains the significant relationship between customer satisfaction and the independent variables. The double-log functional form was selected as the lead equation because it presents the highest R^2 value (0.451) and bears more significant coefficients as well as highest F-ratio of 4.283 which is significant at 1%, and conformed to the proposition of the regression coefficients theoretically.

The coefficient of Reliability (X_{RY}) was positive and statistically significant at 1%. This implies that customers are more likely to be satisfied with electronic banking having the capacity to deliver services as promised. The coefficient of Responsiveness (X_{RS}) was positive and significant at 10%, implying that customers who accessed electronic banking products and services were more likely to be satisfied with prompt delivery of services in electronic banking. This finding agrees with the work of Ugwuja and Ogbo (2019) who reported that Responsiveness was a significant variable in service quality delivery in electronic banking among farmers in Eleme Local Government Area of Rivers State.

Table 4 Regression result for customer satisfaction on electronic banking service quality

Variables	Linear	Semi-log	Exponential	Double-log
Constant	13.619(3.087)	2.698(20.386)	-14.15(-1.098)	1.507(3.920)
Reliability X_{RY}	0.496 (2.461)**	0.021(3.549)***	8.032(2.153)**	0.345(3.103)***
Assurance X_{AS}	0.063 (0.654)	0.003(0.884)	1.702(0.702)	0.063(0.872)
Tangibility X_{TN}	0.083 (0.153)	0.004(0.912)	1.453(0.531)	0.079(0.965)
Empathy X_{EP}	-0.016(0.093)	0.000(-0.124)	0.132(0.063)	0.010(0.166)
Responsiveness X_{RS}	0.086 (0.085)	0.004(1.431)	2.931(1.285)	0.120(1.765)*
R^2	0.308	0.425	0.331	0.451
F-value	1.758	3.709***	2.070**	4.283***

Source: Field survey, 2021 ***Significant at 1% level, **Significant at 5% level, *Significant at 10% level, Values in parenthesis are the t-value.

Constraints to E-banking among agripreneurs

Table 5 shows the constraints to E-banking among agripreneurs in the study area. The result indicates that the constraints to E-banking in the study area are; E-banking services are risky due to increasing cyber-crimes with an acceptance response of 91.1%, the bank accounts of customers have been hacked before with an acceptance response of 88.9%, high rate of bank charges with an acceptance response of 76.7%, high cost of electronic banking gadgets with an acceptance response of 82.2%, customers have misplaced their phone or ATM cards with an acceptance response of 52.2%, long queue at the ATM gallery with an acceptance response of 98.9%, it takes long time for unsuccessful fund transfer to be refunded with an acceptance response of 75.6%, internet connection is often poor, making electronic banking difficult with an acceptance response of 67.8%, POS is difficult to acquire with an acceptance response of 58.9%, payments made via POS but the transaction was not approved yet my bank account was debited with an acceptance of 76.7%, USSD does not render complete service with an acceptance response of 62.2%, delayed transaction delivery because of network with an acceptance response of 80.0% and complicated application procedures for electronic banking errors with an acceptance response of 74.4%.

On the other hand, the following; no formal education so I cannot read and write, with a rejection response of 73.3%, I do not know how to use the ATM, with a rejection response of 60%, I see my account balance after each transaction, with a rejection response of 76.7%, my ATM card is always getting stuck inside the ATM, with a rejection response of 76.7% and mobile transfers are always unsuccessful with a rejection response of 66.7% in the study area.

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Table 5: Distribution of Constraints to E-banking among agripreneurs

Statements	Frequency	Percentage
No formal education so, I cannot read and write.		
Yes	24	26.7
No	66	73.3
Risky because of increasing cyber-crimes.		
Yes	82	91.1
No	8	8.9
My bank account has been hacked before.		
Yes	80	88.9
No	10	11.1
High rate of bank charges.		
Yes	69	76.7
No	21	23.3
High cost of electronic banking gadgets.		
Yes	74	82.2
No	16	17.8
I don't know how to use the ATM.		
Yes	36	40
No	64	60
I see my account balance after each transaction.		
Yes	21	23.3
No	69	76.7
I misplaced my phone or my ATM card.		
Yes	47	52.2
No	43	47.8
Long queue at the ATM gallery.		
Yes	89	98.9
No	1	1.1
The ATM does not dispense cash 24/7.		
Yes	74	82.2
No	16	17.8
My ATM card is always getting stuck inside ATM.		
Yes	21	23.3
No	69	76.7
Mobile transfer always unsuccessful.		
Yes	30	33.3
No	60	66.7
It takes long time for unsuccessful fund transfer to be refunded.		
Yes	68	75.6
No	22	24.4
Internet connection is often poor, making electronic banking difficult.		
Yes	61	67.8
No	29	32.2
POS is difficult to acquire.		
Yes	53	58.9
No	37	41.1
I made payment via POS but the transaction wasn't approved, yet my bank account was debited.		
Yes	69	76.7
No	21	23.3
My bank USSD banking code is complex		
Yes	37	41.1
No	53	58.9
USSD does not render complete service		
Yes	56	62.2
No	34	37.8
Delayed transaction delivery because of network.		
Yes	72	80.0
No	18	20.0
Complicated application procedures for electronic banking errors		
Yes	67	74.4
No	23	25.6

Source: Field Survey, 2021.

4.0 Conclusion

With the advancement in technology, the nature of banking has changed radically as a result of bringing convenience to the customers through electronic banking services. The results from the finding revealed that the most commonly accessed electronic banking product is ATM card, Majority of the Agripreneur customers agreed that one of the benefits of electronic banking is conducting transaction without visiting the banking hall. Reliability and Responsiveness were the two service quality variables that were significant. This means that customers are more likely to be satisfied with electronic banking having the capacity to deliver services as promised and more likely to be satisfied with prompt delivery of services respectively. The study also revealed that the major constraints to electronic banking is hacking of customers account and long queues at ATM Gallery. The study recommends that banks should adopt modern encryption technique to minimize risk associated with electronic banking in terms of hacking customers' accounts. The study also recommends that

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banks should train their staff on how to show courtesy to their customers, convey trust and confidence, and learn how to give individual attention to customers since Assurance and Empathy as service quality variables were not significant

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Marketing Margins and Efficiencies of Smoked Fish in Kainji Lake Basin, Nigeria

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A R T I C L E I NFO

Key words:

Marketing margins,

efficiencies,

smoked fish

ABSTRACT

The study analyzed the marketing margins and efficiencies of smoked fish in Kainji Lake Basin Nigeria. Specifically, the study examined the socio-economic characteristics of smoked fish marketers, estimated the cost and returns, profit margins and efficiency of smoked fish marketing, evaluated the effects of socio-economic and institutional determinants of net-income of smoked fish marketers and examined the challenges of smoked fish marketers. A 2-stage sampling procedure was used to select 60 wholesale marketers of smoked catfish from a population of 107 catfish marketers. Primary data were collected with the aid of questionnaires administered through interview schedule. Data were presented with descriptive statistics such as percentages and 4-point Likert rating scale. Also, net marketing margin, net profit margin, marketing efficiencies and two-stage least square regression analysis were used to analyze data. Results showed that majority (55 %) of the fish marketers were men with a mean age of 40 years while 36.67 % had experience of 11-15 years. Marketing of smoked catfish is profitable with a net profit margin of 3.49 % and marketing efficiency of 189.79 %. Also, the significant socio-economic and institutional determinants of net-income were age, years of experience and levy while the major challenges of fish marketing were poor pricing ($\bar{x}$=3.88), high cost of transportation ($\bar{x}$=3.28) and access to capital ($\bar{x}$=2.80). It is based on these findings the study recommends that there should be effective price regulations by market unions to stabilize prices of fish in major market centers.

1.0 Introduction

The fishery sector is one important food sector of the Nigerian economy which provides food and employment to a sizeable number of the Nigerian population. This is because fish is one of the major sources of animal protein in Nigeriaandit's available in different forms such as; canned, frozen, smoked, dried, cooked and fried (Girei, Ndanitsa and Ogezi, 2021). These forms are made available due to the perishability nature of fresh fish; however, fish smoking is the principal method used in processing and preserving fish in Nigeria (Alabi, Olaoye, George, Adeola, Alabi and Ojebiyi, 2020). Fish smoking preserves the shelf-life of the fish for a long time, improves flavor and increases consumption of the fish thereby reducing wastage (Upadhyay, Singh, Pandey, Singh and Pal, 2021). Fishes that are smoked usually passes through various points or markets before it gets to the final consumer through an efficient marketing and distribution systems.

Marketing is an integral part of the food chain since production is said to be complete when the commodity produced finally reaches the consumers. Consequently, an efficient marketing system is one which ensures that goods and services are available all year round with little or no variation in prices thereby making sure that the producers and consumers are better off (Adedeji, Osundare and Ajiboye, 2019). Fish marketing provides the means in which the gap between producers and consumers is bridged. Market performance on the other hand, comprise of gross margin, marketing margin and marketing efficiency as it relates to individual market participants such as

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producers, wholesalers and retailers (Girei, Ndanitsa and Ogezi, 2021). Fish marketing is not limited to these market actors but includes other players or actors in the distribution channels who are mostly the middlemen. Consequently, the prices of fish increase as it passes through these middlemen before it gets to the final consumers (Bello, Sani, Bukar and Rabiu, 2017).

The major players in fish marketing are women because they lack the access to productive resources to engage in other nodes of the fishery value chain (Ike-Obasi and Ogubunka, 2019). According to Girei, Ndanitsa and Ogezi, (2021), females dominate in the marketing of smoked fish; thus, contradicting Nwabeze, Faleke, Tanko and Malgwi (2019) who opined that smoked fish marketers are dominated by the males. Irrespective of the findings of these scholars, the fact remains that the men and the women are keys players in the marketing of fish in Nigeria. Hence, it is imperative to analyze fish marketing with key interest on the economic returns, margins and marketing efficiencies.

Studies have shown that smoked fish marketing is profitable. Adedeji et al. (2019) reported that the gross margin received in smoked fish marketing in Ondo State Nigeria was ₦38, 101.36, while Girei et al. (2021) result showed that the net benefit cost ratio of smoked fish marketing in Toto Local Government Area of Nasarawa State, Nigeria was 1.57. Hamid (2020) on the other hand, reported that the net-income received by smoked fish marketers in Mubi North Local Government Area of Adamawa State, Nigeria was ₦29, 173. Although these studies affirmed that smoke fish marketing is profitable, there seems to be insufficient information on the profits in relation to marketing margins and efficiencies of smoked fish marketing in Kainji Lake basin, Nigeria. Also, there is a dearth in knowledge on the effects of socio-economic and institutional variables on the net-income of smoked fish marketers. Socio-economic variables are important factors which influence the revenue realized by enterprises. Age and years of experience have been found to be positively related to net-income *ceteris paribus* (Omeje et al., 2021; Adeosun, Ume and Ezugwu, 2019). It is based on this limited knowledge the study analyzed the marketing margins and efficiencies of smoked fish in Kainji Lake Basin. Specifically, the study;

1. Examined the socio-economic characteristics of smoked fish marketers;
2. Estimated the cost and returns, profit margins and efficiency of smoked fish marketing;
3. Evaluated the effects of socio-economic and institutional determinants of net-income of smoked fish marketers; and
4. Examined the challenges of smoked fish marketers.

2.0 Methodology

The study was conducted in kainji Lake Basin, an area located between Niger and Kebbi State, Nigeria. The area is located within Latitudes 9^0 50' and $1^0$55' North and Longitudes 4^0 23' and $4^0$51' East (Omeje, Achike, Arene, Ifejika and Ifejika, 2020). The lake provides livelihood opportunities to fisher folks as well as aquaculture development. Currently, aquaculture is a major occupation of the people which provides steady income to the various fishery value chain actors such as processors and marketers.

The study adopted a 2-stage sampling procedure in selecting respondents who market smoked catfish fish at wholesale level. The first stage involved the purposive selection of 13 communities based on the preponderance of wholesale fish marketers. The communities include; Monai, Malale, New Bussa, Kokoli, Tungan Alhaji Danbaba, Yauri, Wara, Cover dam, Tungan Nailo, Shagunu, Mahuta, Gafara and Wawu. The second stage involved the proportional random selection of six wholesale marketers of smoked catfish from Monai, five each from Malale, New Bussa, Kokoli, Tungan Alhaji Danbaba, Yauri and Wara; and four each from Cover dam, Tungan Nailo, Shagunu, Mahuta, Gafara and Wawu making a total of 60 wholesale marketers of smoked catfish selected from a population of 107 catfish marketers. The sample frame was retrieved from the registered members of fish marketer's association in the area. Primary data were collected with questionnaires that were administered through interview schedule.

Data were presented using descriptive statistics such as percentages and 4-point Likert-type rating scale. Also, Profitability and marketing efficiency indicators as well as two-stage least square regression analysis were used to analyze data. The models were specified below;

2.1 Likert-type scale rating technique

A 4-point Likert-type scale rating technique was employed to achieve objective (iv) in this study. Respondents gave qualitative responses which were rated as Very Serious Challenge (VSC), Serious Challenge (SC), Mild challenge (MC) and Not Serious Challenge (NSC) with corresponding values of 4, 3, 2, and 1 respectively. The mean score of the respondents based on the 4-point rating scale was computed as specified below;

$$\frac{4+3+2+1}{4} = 2.50 \qquad 1.1$$

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A 2.50 cut off point using the interval scale of 0.05 was adopted; the upper limit cut-off point was 2.50+0.05 = 2.55 while the lower limit cut-off point was 2.50-0.05 = 2.45. Based on this, any score below 2.45 (MS< 2.45) was taken as a weak factor and not considered while those with mean score of above 2.55 (MS> 2.55) were taken as strong factors and considered.

2.1 Profitability and marketing efficiency indicators

Profitability indicators such as; Net Income, Net Profit Margin, Return on Investment (ROI) and marketing efficiencies models were used to achieve objective (ii) of the study and the models were specified as thus;

i. Profitability indicators

a. Net Income (NI)

NI= *Revenue-Total expenses* *1.2*

Where:

Revenue=Unit Price* Quantity supplied;

Revenue=Consumer purchase price; and

NI=Net Marketing Margin.

b. Net Profit Margin

$$\text{Net Profit Margin}=\frac{Net\ Income}{Revenue}*100 \quad 1.3$$

c. Return on Investment

$$\text{Return on Investment}=\frac{Net\ income}{Total\ Expenses}*100 \quad 1.4$$

ii. Marketing efficiency

$$\text{Marketing efficiency}=\frac{Value\ Added}{Total\ Marketing\ Cost\ (TMC)}*100 \quad 1.5$$

Where:

Value added=Consumer purchase price-Cost of processed fish

Total marketing Cost=Total Expenses-Cost of processed fish

Where: Cost of processed fish=Producer selling price

iii. Shepherd's efficiency

$$\text{Shepherd's efficiency}=\frac{Consumer\ purchase\ price}{Total\ Marketing\ Cost\ (TMC)}$$

iv. Acharya's efficiency

$$\text{Acharya's efficiency (MME)}=\frac{Producer\ selling\ price}{TMC+Net\ Marketing\ Margin}$$

Where MME=Modified measure of marketing efficiency

2.3 Two-stage least square regression analysis

Two-stage least square regression analysis was used to estimate the socio-economic and institutional determinants of net-income. The technique was used to achieve objective (iii) of this study. The model is specified as thus;the structural equation is specified below;

$$Y=\beta o+\beta_1X_1+b_2X_2+\beta_3X_3+\beta_4X_4+\beta_5X_5+\beta_6X_6+\beta_7X_7+\varepsilon \quad 1.6$$

Where; Y=net-income (₦), X_1=age (Years), X_2= Experience (Years), X_3=Years in school (Years), X_4= initial capital (₦), X_5=household size (number), X_6=Commodity price (₦), X_7=Levy (₦) and ε=error term

However, X_1 is endogenous because it correlates with an immeasurable variable "ability" which is accounted for by ε. An instrumental variable "parents' income" was uncorrelated with ε. This satisfied the condition for two-stage least square regression analysis as stipulated by Qian (2014). The instrumental variable was used for the estimation of the reduced form of the equation as specified below;

Reduced form of the equation

$$X_1=\pi_o+\pi_1Z_i+\pi_2X2+\pi_3X_3+\pi_4X_4+\pi_5X_5+\pi_6X_6+\pi_7X_7 \quad 1.7$$

Where; Z_i =parents' income and $\pi_1\neq0$

3.0 Results and Discussion

3.1 Socio-economic Characteristics of Wholesale Fish Marketers

The result for the socio-economic characteristics of the wholesale fish marketers is presented in Table 1. The result shows that 6.67 % of the wholesale fish marketers in Kainji lake basin were within the age category of 21-30, 50.00 % were within the age category of 31-40 years and 36.66 % were within the age bracket of 41-50 years. The mean age of the wholesale fish marketers was 39.95 which imply that wholesale fish marketing in the area is dominated by "young people" or those within their youthful age. This is in accordance with the description of Hamid (2020) that fish marketers within the age bracket of 20-40 years are within their youthful age. Hence, one can see that wholesale fish marketing is quite an attractive enterprise for the young people. Also, the result shows that 55.00 % of the wholesale fish marketers were men, 15.0 % were women and 30.00 % were youths. The result indicates that about 85 % of wholesale fish marketing in Kainji Lake basin is dominated by the men and youths. Even though this result agrees with Hamid (2020), it contradicts the results of Adedeji et al. (2019) and Girei, Ndanitsa and Ogezi (2021) that fish marketing is dominated by women. Their claims can best be understood if they were explicit in describing the marketing chain the women dominate, as one could perceive that women's participation in the fish marketing chain is high in the retail business. Furthermore, the result shows that 25.00 % of the wholesale fish marketers had experience of 1-5 years, 30.00 % had 6-10 years of experience in wholesale fish marketing, 36.67 % had 11-15 years of experience and 8.33 % had 16-20 years of experience in wholesale fish marketing. The mean years of experience was 11.68 which agrees with the result of Nwabeze et al. (2019) that fish marketers in Kainji Lake Basin had experience in fish marketing for more than 10 years. The number of years an entrepreneur is in business is an indication of the maturity of the business and a study by Njogu (2017) has shown that on the job experience is positively

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related with performance of the business. Moreover, the result shows that 55.00 % of the wholesale fish marketers spent 6-10 years in school, 33.33 % spent 11-15 years in schooland 11.67 % spent 16-20 years in school. The mean year in school was 10.12. This shows that the fish markers have attained some form of educational qualifications that will enable them enhance their level of interaction with clients from other climes. Hamid (2020) reported that fish marketers have at least one form of education which enhances the ease of adopting improved technology. Finally, the result shows that 43.33 % of the wholesale fish marketers had household size of 1-5 persons, 43.33 % had household size of 5-10 persons and 13.34 % had household size of 11-15 persons. The mean household size was 6.55 which indicate that the fish marketers in Kainji Lake Basin have relatively large household sizes. The result is slightly consistent with the result of Gerei, Ndanitsa and Ogezi (2021) that the majority of fish marketers in Toto local government area of Nasarawa state have household size of 6 persons. The large household size can be a good source of family labour; however, it could connote to high household demands in terms of feeding, education, health etc. The task of meeting large household needs may lead to poor management of the business, tampering with business capital and investment.

Table 1: Socio-economic characteristics of wholesale fish marketers

Variables	Percent	Mean
Age		39.95
21-30	6.67	
31-40	50.00	
41-50	36.66	
>50	6.67	
Gender		
Men (male > 35 years)	55.00	
Women (female >35 years)	15.00	
Youths (male/female <35 years)	30.00	
Experience		11.68
1-5	25.00	
6-10	30.00	
11-15	36.67	
16-20	8.33	
Years in school		10.26
6-10	55.00	
11-15	33.33	
16-20	11.67	
Household size		6.55
1-5	43.33	
6-10	43.33	
11-15	13.34	

Source: field survey, 2020

3.2 Cost and Returns, Profit Margins and Efficiency of Smoked Fish Marketing per Month

The result of the cost and returns, profit margins and efficiency of smoked fish marketing per Month is presented in Table 2. The result showed that total revenue of ₦5,294,432.18 was received from the sale of big, medium and small cartons of smoked catfish fish. The total expense incurred was ₦5,109,442.93 with a total marketing cost of ₦206,002.18. The net-income realized was ₦184,989.26 which implies that the wholesale fish marketers realize an amount in excess of total cost. This shows that smoked fish marketing is profitable, hence affirming the result of Adedeji et al (2019) and Hamid (2020). Also, the value added to smoked fish was ₦390,991.44 which shows the economic benefit derived through value addition in agricultural products such as fish. Furthermore, the net-profit margin was 3.49% which means that to every ₦1 of sales, the smoke fish marketers earned the sum of 3 kobo as profit while the return on investment (ROI) was 3.62% which implies that to every ₦1 invested, the smoked fish marketers realized a sum equivalent to 4 kobo. The marketing efficiency on the other hand, was 189.79 % which shows that smoked fish marketing is efficient. Similarly, Osundare and Adedeji (2018) reported that fish marketing is highly efficient. This was further confirmed by Shepherd's and Acharya's efficiency ratios of 25.7 and 12.54 respectively.

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Table 2: Cost and Returns, Profit Margins and Efficiency of Smoked Fish Marketing per Month

Variables	Unit	Outcome
Revenue		
a) Qty of Big Carton	Number	27.71
b) Qty of Medium Carton	Number	56.57
c) Qty of Small Carton	Number	68.52
d) Price of Big Carton	₦	56622.05
e) Price of Medium Carton	₦	38323.23
f) Price of Small Carton	₦	22731.33
g) Revenue Big Carton=a*d	₦	1568808.36
h) Revenue Medium Carton=b*e	₦	2168072.87
i) Revenue Small Carton=c*f	₦	1557550.96
Total Revenue=g+h+i	₦	**5294432.18**
Expenses		
Cost of processed fish	₦	4903440.74
Cost of packaging materials	₦	22061.31
Transportation cost	₦	152800.00
Wages	₦	22407.63
Labour (loading and Offloading)	₦	7640.00
Depreciation	₦	593.25
Tax/levy	₦	500.02
Total Expenses	₦	**5109442.93**
Total Marketing Cost	₦	**206002.18**
Value Added	₦	**390991.44**
Net Marketing Margin	₦	**184989.26**
Net-Profit Margin	%	**3.49**
Return on Investment	%	**3.62**
Marketing Efficiency	%	**189.79**
Shepherd's Efficiency	Ratio	**25.7**
Acharya's Efficiency (MME)	Ratio	**12.54**

Source: computation from field survey, 2020

3.3 Socio-economic and institutional determinants of Net-income of smoked fish marketers

The result of the socio-economic and institutional determinants of net-income of smoked fish marketers is presented in Table 3. The result showed that age, experience and levy were the significant socio-economic and institutional variables on net-income of smoked fish marketers. The variable "age" had a positive sign and was statistically significant ($P<0.05$) which implies that an increase in the age of the fish marketers will result to an increase in net-income. According to Omeje et al. (2021), age is a significant determinant of the amount of profit realized because age is an indication of the level of maturity in day-to-day business management. Also, experience was positive and statistically significant ($P<0.10$) which means that the years of experience is positively related to the profit realized by smoked fish marketers. The result is consistent with the findings of Offor, Okpara and Ibeagwa (2017) that years of experience is a significant determinant of net-income of fish marketers. Hence, it implies that the longer the years of experience in smoked fish marketing, the higher the amount of net-income realized *ceteris paribus*. Finally, the variable "levy" was negative and statistically significant ($p<0.05$) on net-income of wholesale marketers. This implies that an increase in levies charged on wholesale marketing of smoked fish will result to a decrease in net-income of wholesale fish marketers. Similarly, Kabwe and Zulu (2017) reported that an increase in levies increased production cost as well as the cost of trading. This result is plausible since levy is accounted for as cost in business accounting.

Other variables such as; years in school, household size, initial capital and commodity price were statistically not significant ($p<0.05$ or $p<0.1$), hence not considered as significant determinants of net-income of wholesale fish marketers.The R-squared was 0.5032 which implies that about 50% variation in net-income of wholesale fish marketers is influenced by the socio-economic and institutional variables. Also, the prob>Chi^2 was statistically significant at 1% level implying that one of the coefficients of the socio-economic and institutional characteristics is not equal to zero; thus, correctly influencing the variation of net-income of actors in the aquaculture value chain.

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Table 3: Socio-economic and institutional determinants of Net-income of smoked fish marketers

	OLS Estimates		2SLS Estimates	
Variables	Coef.	t	Coef.	T
Age	0.0727	2.98	0.8305	2.02**
Experience	0.3931	2.42	0.8133	1.94*
Years in school	0.0479	0.80	0.0014	0.11
Household size	0.0039	0.38	0.0056	0.36
Initial capital	0.0088	0.06	0.0368	0.23
Commodity price	0.3120	1.24	0.3583	1.33
Levy	-0.0251	2.48	-0.0290	-2.50**
R-squared	0.6078		0.5032	
Adj R-squared	0.5550			
Wald Chi-Square			74.03	
Prob>Chi^2			0.00	

Source: computation from field survey, 2020 **=sig. at 0.05; *=sig. at 0.10

3.4 Challenges of wholesale fish marketing

The challenges of wholesale fish marketing are presented in Table 4. The result showed that poor pricing ranked first ($\bar{x}$=3.88) as a very serious challenge in wholesale fish marketing. This is because most fish marketers expect good prices for their products; however, due to the presence of middlemen in major market centers, the prices are usually negotiated at a rate below the expectations of the wholesale fish marketers. It was based on this bottleneck the marketers proposed a tradeoff on price regulation by market unions. This will enable market unions set an acceptable price for the product that will be quite rewarding to both wholesale marketers and middlemen. Furthermore, high cost of transportation ranked second as a serious challenge with a mean score of $\bar{x}$=3.28. High cost of transportation increases the marketing cost of fish which adds to production cost as reported by Kabwe and Zulu (2017). However, the wholesale fish marketers pointed out that rising cost of fuel used for transport was the major factor behind the rise in transportation cost. Hence, subsidy on petrol/diesel or other alternative of low-cost petrol/diesel supply such as; government regularized price control on local refining of crude oil should be implemented. Finally, access to capital ranked third with a mean score of $\bar{x}$=2.8. Wholesale fish marketing requires large amount of capital because of the lofty cost of purchasing large volume of processed fish that will be packed in cartons for transport to market centers. This result is consistent with Agbebi and Adetuwo (2018) that inadequate capital as well as access to credit is a major constraint faced by fish marketers. According to Hamid (2020), in order to finance smoked fish marketing, timely access to low interest rate credit facilities is required to facilitate and sustain efficient and effective marketing processes.

Table 4: Challenges of wholesale fish marketing

S/N	Challenges	Mean	Rank	Inference	What can be done to solve this problem
1	Access to Capital	2.80	3rd	SC	Provide easy platforms for accessing formal credit facilities at low interest rate
2	Lack of regulations guiding enterprise	2.15	4th		
3	Shortage of packaging materials	2.03	5th		
4	Poor pricing	3.88	1st	VSC	There should be a tradeoff on price regulation by market unions
5	High cost of transportation charges	3.28	2nd	SC	Provide subsidy on petrol/diesel or make alternatives for low cost petrol/diesel
6	Excessive association levies	1.50	7th		
7	Insufficient transportation channels	2.03	5th		
8	Poor demand of fish in major markets	1.82	6th		

Source: computation from field survey, 2020

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4.0 Conclusion and Recommendations

The study showed that wholesale marketing of smoked catfish is profitable with high level of marketing efficiency. Also, the major socio-economic and institutional determinants of net-income were age, years of experience and levy while the major challenges of fish marketing were poor pricing, high cost of transportation and access to capital. It is based on these findings the study recommends that there should be effective price regulations by market unions to stabilize prices of fish in major market centers.

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Additive Effects of *Vernonia amygdalina* and *Ocimum gratissimum* on the performance and Egg Quality Parameters of laying Hens

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A R T I C L E I NFO

Keywords:

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and performance.

ABSTRACT

Sixteen (16) weeks feeding trial was conducted to determine the additive effects of dietary inclusion of Vernonia amygdalina (bitter leaf) and Ocimum gratissimum (scent leaf) leaf meals, performance and egg quality parameters on 150 ISA Brown layers. The bitter leaf (BL) and scent leaf (SL) were analyzed to contain 91.87% and 90.03%; 13.52% and 15.52%; 12.22% and 10.39%; 8.55% and 10.55%; 8.18% and 6.73%;1.34% and 1.18%; 6.00% and 3.60%; 2.08% and 1.96%; 0.148mg/dl and 0.096 mg/dl; and ++ and +++ for dry matter, crude protein, crude fibre, ether extract, ash, alkaloid, tannin, flavonoid, steroid and saponins respectively. Five isonitrogenous diets were formulated to contain BL and SL, 0%:0% which is the control (T1); 0%:0% with antibiotics (T2); 75%:25% (T3), 50%:50% (T4) and 25%:75% (T5) respectively. Each of the dietary treatments were replicated thrice, with ten birds per replicate, in a completely randomized design. The pullets (8 weeks) were first maintained on the control diet, up to 12 weeks of age, and were randomly distributed for the administration of the experimental pullets' diets containing approximately 2500Kcal/Kg ME and 14% crude protein. At 14 weeks of age, the birds were administered the experimental diets for a period of 4 months. Data were collected on some performance characteristics and egg internal and external qualities parameters. The results obtained indicated that at the combination level of 25%BL and 75% SL, reduced feed intake, feed efficiency, percent hen day and final body weight. Similarly, at 25% BL and 75%SL, a corresponding increase in the eggshell thickness, yolk colour, yolk weight, haugh unit and egg shape were recorded. Conclusively, laying birds can be fed 25% BL and 75% SL inclusion level to obtain good performance and acceptable egg quality.

1.0 Introduction

The decrease in acceptability to solely rely upon conventional medication (drugs), for a therapeutic approach to animal health, is intensifying. As the global human population continues its upward mobility, we are inevitably faced with the challenges to ensure our access to safe, nutritious, and healthy food. Globalization and the incident of rapid travel, have made transboundary diseases a great concern for food safety and food security (Garcia, et al, 2020). It cannot be overemphasized that transboundary diseases are highly transmittable animal diseases that result in high morbidity and mortality in animals. In an attempt to solve the concomitant animal and human infections due to pathogens, the awareness that antibiotic resistance is a global health challenge leaves us with a strong need to escape this ominous threat to life. Larsson and Flach (2022), observed that evolutionary events that lead to the emergence of new resistance factors in pathogens are rare and difficult to predict, but may be associated with vast ramifications. Ziggers, (2012), reported that more people in hospitals are becoming infected with resistant bacteria that doctors cannot treat with antibiotics, whereas in Europe around 25,000 people die yearly because of this. He further stressed that because of the long and intensive use of antibiotics in animal husbandry, these bacteria have become resistant to most antibiotics used in hospitals. Consumers are always thinking or concerned about the residual effect of antibiotics in poultry products, such as eggs. Muaz, et al (2018) reported that antibiotics may cause the beneficial gut microbiota not to function effectively, and as well increase drug resistance among harmful microorganisms in poultry. Consequently, nutrition is being more widely used as a practical solution for maintaining animal health. To develop a beneficial

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nutrition-based health strategy, it is necessary to consider the basic interactions between health and nutrition, challenge the current concepts of nutrition and challenge the current concepts of nutritional requirements based on avoidance of deficiency symptoms. Feed components and nutrients influence health in many different ways. By manipulating or selecting them, feed quality may be maintained and the rise of mycotoxin contamination may be reduced. Nutritional components have a positive effect on maintaining the gastrointestinal tract and alleviating the threat of enteric diseases. They influence many non-infectious diseases through the control of oxidative stress. It is now a common reflection in raising animals for food, that nutrition is all there is for a holistic production. Therefore, a nutrition-based health strategy must play a major role in the conventional development of animal production.

Poultry scientists are becoming interested in how poultry production can run without using antibiotics and other drugs because of the criticism and argument on their uses. Pandey et al (2019), stated that animals having an optimum growth performance, need to operate on high health status, of which the use of proper additives is a popular argument in such cases. They further opined that with the upgraded standards in the industry, and consumer awareness, as well as demand for healthy animal-based food products, there is increased pressure on the industry for more phyto-based and non-residual alternatives, than the conventional feed additives which are losing popularity. Some herbs, spices and extracts have been found to stimulate feed intake and endogenous secretions or possess antimicrobial coccidiostats or anthelminthic activities (Hossain, 2009); Karimi *et al* (2010) suggested that these herbal products may serve as environmentally friendly alternatives to the antibiotic growth promoters commonly used in animal and poultry feed. The expected mode of action of herbal products is attributed to their antimicrobial characteristics, oxidative-resistant activity, immune system boost, and concomitant improvement in overall poultry performance. Recent studies that involved the use of such herbs as bitter leaf and scent leaf in poultry feed have given profound results in production performance. Thus, the objective of this study was to determine the additive effects of bitter leaf and scent leaf on the productive performance and egg quality parameters of laying hens.

2.0 Materials and Methods

This experiment was conducted at the poultry research unit of Delta State University, Asaba Campus. The bitter leaf and scent leaf were the test ingredients used for this study and were procured from Asaba and the immediate neighbourhood. They were air-dried at room temperature and later milled for subsequent inclusion at specified levels in the diets of growing pullets and laying pullets.

One hundred and fifty (8 weeks old) pullets, managed on deep litter, were used for this trial. There were five dietary treatments with three replicates per treatment and ten birds per replicate. A completely randomized design was used and the experimental rations were administered at twelve (12) weeks of age. Ration 1, which had no bitter leaf and scent leaf, served as the control. Ration 2 had no bitter leaf and scent leaf meals but had antibiotic inclusion. Rations 3 to 5 had bitter leaf and scent leaf meals inclusion at these respective levels, 75% BL + 25% SL, 50% BL+ 50% SL, and 25% BL+ 75% SL (Tables 2 and 3). Proximate analysis and phytochemical constituents were carried out on the bitter leaf and scent leaf meals respectively as shown in Table 1.

Table 1: Proximate Composition and Phytochemical Constituents of Bitter Leaf (BL) and Scent Leaf (SL)

Parameters	BL	SL
Dry matter (%)	91.87	90.03
Crude Protein (%)	13.52	15.52
Crude Fibre (%)	12.22	10.39
Ether Extract (%)	8.85	10.55
Ash (%)	8.18	6.73
Nitrogen free extract (%)	49.10	46.84
Phytochemicals		
Alkaloid (%)	1.34	1.18
Tannin (%)	6.00	3.60
Flavonoid (%)	2.08	1.96
Steroid (mg/dl)	0.148	0.096
Saponins (+)	++	+++

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Table 2: Composition of Experimental Diets (g/Kg) for growing pullets

Inclusion Levels (%)	**0BL 0SL**	***0BL *0SL**	**75BL 25SL**	**50BL 50SL**	**25BL 75SL**
Treatments					
Ingredients	**1 (Control)**	***2**	**3**	**4**	**5**
Maize	374.00	374.00	350.00	350.00	350.00
Full fat soybean	30.00	30.00	34.00	34.00	34.00
Groundnut cake	18.0	18.00	18.00	18.00	18.00
Fish meal	15.00	15.00	15.00	55.00	15.00
Wheat Offal	505.00	505.00	505.00	505.00	505.00
Bitter Leaf (BL)	0.00	0.00	15.00	10.00	5.00
Scent Leaf	0.00	0.00	5.00	10.00	15.00
Antibiotic +	-	+	-	-	-
Palm oil	√	√	√	√	√
Bone Meal	20.00	20.00	20.00	20.00	20.00
Oyster Shell	30.00	30.00	30.00	30.00	30.00
Salt	2.00	2.00	2.00	2.00	2.00
Premix**	3.00	3.00	3.00	3.00	3.00
Methionine	2.00	2.00	2.00	2.00	2.00
Lysine	1.00	1.00	1.00	1.00	1.00
Total	**1000.00**	**1000.00**	**1000.00**	**1000.00**	**1000.00**
Calculated Analysis					
Crude Protein (%)	14.09	14.09	14.08	14.10	14.09
Metabolizable Energy (Kcal/Kg)	2,495.62	2,495.62	2,490.62	2,490.62	2,490.62

Antibiotic (Tyl- dox extra wsp: Tylosin Tartrate 20g, Doxycycline Hyclate 15g)
+ Antibiotic added only to treatment 2
***** Vitamin-mineral premix provided the following vitamins and minerals per kg of diet. Vit A, 15,000 I.U; Vit D3, 3000 I.U; Vit E, 30 I.U; Vit K, 2.5mg; Vit B12, 0.2mg; Niacin, 40mg Pantothenic acid; Folic acid, 1.0mg; Biotin, 0.08mg; Choline, 500mg; Mn, 6mg; Fe, 24mg; Cu, 6mg; I, 1.4mg; Se, 0.25mg; Co, 0.4mg; Antioxidant, 125mg.***

Table 3: Composition of Experimental Diets (g/Kg) for layers

Inclusion Levels (%)	**0BL 0SL**	***0BL *0SL**	**75BL 25SL**	**50BL 50SL**	**25BL 75SL**
Treatment					
Ingredients	**1 (Control)**	***2**	**3**	**4**	**5**
Maize	452.00	452.00	427.00	427.00	427.00
Full fat soybean	160.00	160.00	165.00	165.00	165.00
Groundnut cake	40.00	40.00	40.00	40.00	40.00
Fish meal	30.00	30.00	30.00	30.00	30.00
Wheat Offal	205.00	205.00	205.00	205.00	205.00
Bitter Leaf (BL)	0.00	0.00	15.00	10.00	5.00
Scent Leaf	0.00	0.00	5.00	10.00	15.00
Antibiotic +	-	+	-	-	-
Bone Meal	30.00	30.00	30.00	30.00	30.00
Oyster Shell	75.00	75.00	75.00	75.00	75.00
Salt	2.00	2.00	2.00	2.00	2.00
Premix**	3.00	3.00	3.00	3.00	3.00
Methionine	2.00	2.00	2.00	2.00	2.00
Lysine	1.00	1.00	1.00	1.00	1.00
Total	**1000.00**	**1000.00**	**1000.00**	**1000.00**	**1000.00**
Calculated Analysis					
Crude Protein (%)	17.03	17.03	17.01	17.01	17.00
Metabolizable Energy (Kcal/Kg)	2,524.40	2,524.40	2,504.40	2,504.40	2,504.40

Antibiotic (Tylo-dox extra wsp: Tylosin Tartrate 20g, Doxycycline Hyclate 15g)
+ Antibiotic added only to treatment 2
***** Vitamin-mineral premix provided the following vitamins and minerals per kg of diet. Vit A, 15,000 I.U; Vit D3, 3000 I.U; Vit E, 30 I.U; Vit K, 2.5mg; Vit B12, 0.2mg; Niacin, 40mg Pantothenic acid; Folic acid, 1.0mg; Biotin, 0.08mg; Choline, 500mg; Mn, 6mg; Fe, 24mg; Cu, 6mg; I, 1.4mg; Se, 0.25mg; Co, 0.4mg; Antioxidant, 125mg.***

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The diets and water were given *ad libitum* to the birds for the four months the experiment lasted. The initial and final weights of the birds per replicate were taken at the beginning and at the end of the experiment, respectively. Feed intake was measured weekly while egg production records were taken daily.

All eggs collected from each replicate group were used in estimating the average egg weight of the eggs using the Labtech^{R} 1400 electronic platform scale. After weighing, two eggs from each replicate were broken out into a flat, white plate and with the aid of vernier callipers, the albumin heights were measured for the calculation of Haugh unit values according to the formula of Oluyemi and Roberts (1979) as follows:

$HU = 100 \log (H + 7.57 - 1.7 W^{0.37})$

Where: HU = Haugh unit,

H = observed albumen height in millilitres

W= weight of the eggs in grams

The yolk height and weight were measured for the calculation of the yolk index. Yolk colour was rated by matching it with pH coloured paper strips. The shells were dried for three days and weighed per replicate. The shell thickness was measured using the vernier callipers.

From the primary data collected other data such as feed conversion efficiency, feed cost per kg egg and per cent hen-day production were generated. All data were subjected to the analysis of variance (steel and Torrie, 1980) and the significance between treatment means was separated using Duncan Multiple Range Test (Duncan, 1955 as contained in the SPSS (2010)).

3.0 Results and Discussion

The results of the proximate composition and phytochemical analysis of the BL and SL, the test ingredients and nutrient composition of the diets fed, the performance of the pullet layers and egg quality are presented in Tables 1, 2, 3, 4 (a and b) and 5 respectively. The result of the proximate composition and phytochemical constituents showed that BL and SL respectively, have a fairly high level of crude protein (13.52% and 15.52%) crude fibre (12.22% and 1039%) and ether extract (8.85% and 10.55%) Alkaloid (1.34% and 1.18%),

Table 4a Performance Characteristics of Pullets (14–30 weeks) Fed Experimental Diets.

Inclusion levels (%)	**OBL OSL**	***OBL *OSL**	**75BL 25SL**	**50BL 50SL**	**25BL 75SL**	
	Treatments					
Ingredients	**1 (Control)**	***2**	**3**	**4**	**5**	**SEM**
Initial weight (Kg)	0.65	0.64	0.71	0.69	0.65	0.23
Final weight (kg)	1.86	1.86	1.89	1.93	1.88	0.01
Weight gain (kg)	1.22	1.22	1.19	1.23	1.23	0.02
Feed intake (Kg)	5.12^{a}	5.08^{ab}	4.98^{bc}	4.98^{bc}	4.96^{c}	0.02
Feed conversion ratio	2.20	2.32	2.20	2.25	2.23	0.03

Antibiotic: (Tylo-dox extra wsp :Tylosin Tartrate 20g, Doxycycline Hyclate 15g)
BL : Bitter leaf SL ; Scent leaf

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Table 4b Performance Characteristics of Pullet Layers Fed Graded levels of Bitter Leaf and Scent Leaf Meals

Inclusion levels (%)	0BL 0SL	*0BL *0SL	75BL 25SL	50BL 50SL	25BL 75SL	
	Treatments					
Ingredients	1 (control)	*2	3	4	5	SEM
Feed intake (g/bird/day)	91.33[a]	90.67[ab]	89.00[bc]	89.00[bc]	88.67[c]	0.33
Feed efficiency (Kg/egg/kg/feed)	2.20	2.32	2.30	2.25	2.23	0.03
Hen-day Production (%)	80.16[a]	73.81[a]	76.67[a]	76.19[a]	73.81[a]	0.94
Total egg Production	42.67[a]	39.60[a]	42.93[a]	40.80[a]	41.60[a]	0.57
Total egg production/week	5.33[a]	5.17[a]	5.17[a]	5.33[a]	5.17[a]	0.59
Total egg weight (Kg)	2.33[a]	2.19[a]	2.30[a]	2.21[a]	2.24[a]	0.03

a, b, c, within each row, Means with the same superscripts are not significantly different (P > 0.05).
****Antibiotic: (Tylyo-dox extra wsp: Tylosin Tartrate 20g, Doxycycline Hyclate 15g)***
SEM = Standard error of the mean **BL: Bitter leaf SL: Scent leaf**

Table 5: Egg Quality Characteristics of Pullet Layers Fed the Experimental Diets

Inclusion levels (%)	0BL 0SL	*0BL *0SL	75BL 25SL	50BL 50SL	25BL 75SL	
	Treatments					
Ingredients	1 (Control)	*2	3	4	5	SEM
Egg weight (g)	55.78	53.68	53.74	53.84	55.42	0.60
Egg shell thickness (mm)	0.45[ab]	0.42[ab]	0.41[b]	0.46[ab]	0.47[a]	0.01
Egg shell weight (g)	6.00	5.03	5.26	5.61	5.95	0.16
Egg shell weight (% egg wt)	10.79	9.35	9.67	10.43	10.72	0.27
Albumen weight (g)	32.30	32.60	30.82	30.63	30.85	0.53
Yolk weight (g)	14.98[b]	15.40[b]	16.43[ab]	16.70[ab]	18.14[a]	0.39
Albumen weight (% egg wt)	57.88	60.60	57.30	56.25	55.74	0.74
Yolk weight (% egg wt)	26.87[c]	28.72[bc]	30.62[ab]	31.02[ab]	32.68[a]	0.68
Haugh unit	76.43[b]	79.03[ab]	86.13[a]	86.16[a]	86.85[a]	1.52
Yolk index	0.26	0.29	0.26	0.28	0.28	0.01
Shell Surface Area (SSA)	68.25	66.54	66.58	66.67	68.12	0.51
Egg Shape Index	0.78	0.76	0.77	0.76	0.78	0.01
Yolk colour score	5.23	4.87	5.20	5.03	5.00	0.06

a, b, c, within each row, Means with the same superscripts are not significantly different (P > 0.05).
****Antibiotic: (Tylo-dox extra wsp: Tylosin Tartrate 20g, Doxycycline Hyclate 15g)***
SEM = Standard error of the means **BL: Bitter leaf SL: Scent leaf**

Tannin (6.00% and 3.60%), Flavonoid (2.08% and 1.96%), Steroid (0.148% and 0.096%) and Saponin (++ and +++). Feed intake was found lowest in birds fed 25%BL + 75%SL level of inclusion (treatment 5). This can be explained as being due to the astringent taste of the feed, having a higher percentage of SL with high saponin level, which would have affected the aroma and palatability of the feed, and palatability

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plays an important factor in feed intake (Gazwi et al, 2022). However, weight gain was found high in birds fed treatment 5. This is an indication of good utilization of the feed at that level of inclusion of the test ingredients. Bawa *et al* (2003) had argued that it is not the absolute value of protein and energy in the diets of laying hens that is important but the quality and bioavailability of the protein and energy that is of paramount importance.

Per cent hen-day production though not significantly ($P>0.05$) difference was found least in treatments 2 (0% BL + 0%SL, with antibiotics) and 5 (25%BL + 75% SL), and the latter inclusion level (treatments 5), the birds were able to utilize the feed efficiently. Birds fed treatments 1 and 5 came into lay within six (6) days interval, of which the former (control) had the first lay. However, the birds in all the other treatments groups came into lay within twenty-eight (28) days interval from that of the control. This notable variation at the age of the first egg between the control group and the other treatments groups 2, 3 and 4 may suggest that treatment 5 had a better inclusion level and combination of the test ingredients.

The relatively small size of the first laid eggs recorded for the treatment groups 1 and 5 may be connected with their relatively earlier age at lay compared with other treatment groups. The average egg weight indicated a positive response in laying birds fed the test ingredients which compared well with the control. The weight gains recorded for the birds fed all the dietary treatments is an indication of a positive nutrient balance. The similarity in the egg weights, total egg produced and feed efficiency from all treatment groups, further attest to the nutritional adequacy of the diets, thereby signifying the test ingredients as possible additives in layer diet.

Egg shell quality is of particular importance in commercial table eggs production to reduce wastage from egg breakage in the cages. Data on egg qualities presented in Table 5 showed shell thickness to be most superior when the test ingredients were used at 25% BL and 75% SL inclusion, which varied significantly ($P<0.05$) to that of 75% BL and 25% SL inclusion level. Perhaps some intrinsic factors associated with the inclusion levels may be responsible. Belyavin (1988) stated that shell thickness and weight, shell surface area (SSA) and egg shape index (ESI) are important indices for measuring shell strength. These parameters with the exception of shell thickness, were similar among the treatments. Furthermore, no shelless egg was laid. All these are positive indications that adequate minerals required for egg shell formation were available from the diets supplemented with bitter leaf and scent leaf meals. These findings agree with the report of Odunsi *et al* (2002) when they fed layers with *gliricidia sepium* leaf meal.

Haugh limit, an index of protein utilization, was high in eggs laid in all the treatment groups, though that of control was significantly ($P<0.05$) lower than that of treatments 3, 4, 5. This indicates that dietary proteins provided by the different dietary treatments irrespective of the level of inclusion of test ingredients were effectively utilized by laying chickens. The Haugh unit values obtained in this study agreed with the standard values of each other workers including Oluyemi and Roberts (2000).

Yolk colour is of commercial importance (Belyavin and Marango, 1989). The comparable yolk colour obtained for this study is a positive indication that bitter leaf and scent leaf meals could be used as feed additives in the diet of laying chickens without affecting the consumers' preferred egg yolk colour. This report is in agreement with the egg yolk colour result of Esonu *et al* (2013), who fed a few stages cooked *Canavalia plagion sperma* (Piper) seed meals as a feed ingredient in layers diets. Yolk weight was found highest in the diet containing 25% BL and 75% SL which varied significantly from that of control and treatment 2 (0% BL + 0% SL, with antibiotic). This shows that the test ingredients are good in egg yolk pigment, and as well exhibit synergic nutritive values. The non-significant ($P>0.05$) difference in the albumin weight was also indicative of the high nutritive rating of bitter leaf and scent leaf in the diets of laying chickens.

4.0 Conclusion

Conclusively, BL and SL can be fed at 25% and 75% level respectively for optimum performance in terms of production and egg quality parameters. Moreover, it is recommended that poultry farmers should endeavour to cultivate both plants in their neighbourhood, to reduce the cost of production (synthetic drugs) and, also to increase their profit margin.

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Agroforestry Adaptation for Climate Resilient Economy in Lowland Rainforest Ecological Zone of Delta State, Nigeria

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A R T I C L E I NFO

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forest ecosystem,

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soil organic carbon,

sustainable livelihood

ABSTRACT

Forest ecosystems provide ecological services as sink for environmental wastes and greenhouse gases while supplying agriculture with essential nutrient-rich soil and biodiversity to support growth. Unfortunately, the skewed management approach to bias indicator for either economic or environmental development often results in conflict and bane to thwart full realization of well-articulated policy framework in the environmental and agricultural sectors. Agroforestry types as a multiple land use mechanism, integrates critical trade-offs in both sectors to achieve sustained yield management objective in forest management and sustainable food production. Forest litters and agricultural component residues in the agroforestry system interact to reduce influx of in-organic chemicals at source fertilization and disposals as sequestered carbon as well as other GHGs in the environment. This paper examined the potential benefit in developing policy thrust from practical approach of Taungya (agricultural crops and trees) as agroforestry tool for stemming further forest degradation, food insecurity and enrolment in carbon credit schemes for climate change mitigation and adaption in the lowland rainforest zone to resuscitate forest regeneration and short-term incomes from annual agricultural crops.

INTRODUCTION

Climate change in the last two decades has significantly led to critical cross cutting issues globally, with Nigeria at the brink of serious socio-economic and ecological challenge due to inadvertently tried inept approaches, especially deforestation and forest degradation for myriad land-based ecosystem-dependent agricultural programs in different ecological zones. Increasing temperature and precipitation with attendant pests, diseases, frequent rainfalls and floods have accounted for decline in agricultural productivity, rural household income and erosions (Mujeed and Sylvia, 2017; Peter and Elizabeth, 2015; Ogboi, 2011).

Agroforestry presents an inverse practice of shifting cultivation, as systemic interphase between agriculture and forestry, for enhanced multiple land-use services, to accommodate environmental, social and economic needs (Sale and Olujobi, 2013; Ordonez *et al*, 2010). Varying models as scattered farm trees, Taungya farming (crops and trees), shelterbelts, alley cropping, live fence,

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agrosilvopastoral (crops, pasture and trees) and aquaforestry reportedly by interaction between components of agroforestry ameliorate temperature, raise groundwater, moisture content for enhanced productivity as well as influence micro-climates to reduce the incidences of drought and diseases (Fischlin *et al*, 2007; Carrol *et al*, 2004). Thus, multiple alternatives and opportunities of agroforestry in improving farm production and income for sustainable livelihood enhance significant potential for food security, environmental conservation, employment and income opportunities (Tiwari *et al*, 2017).

The choice of forest ecosystem for establishment of land-based agriculture has been linked to the rich soil resource associated with forest litters decomposition to supply nutrients for early growth and development of agricultural crops. Even in aqua-forestry, agricultural crops rely significantly on inter planted forest trees species in the watershed to pull water, in addition to the upper forest floor moisture, to support crop growth in scattered tree farms and agro-silvo-pastoral systems, especially in drought situations. Therefore, agroforestry models create readily available buffer for an improved income stream which could serve as attraction for the poor interest in private forest development due to long gestation period.

However, the conflict between forest conservation and utilization for agriculture has continued to impinge on sustainable use, especially in the face of global warming, climate change and food insecurity (Melissa *et al*, 2017). The vast forest resources naturally bequeathed developing nations are potentials for industrial growth for economic development that encompasses green utilitarian values. But poor perception of conservation and utilization as both sides of the same coin has denied developmental feats by erecting almost irreconcilable frictions between these critical sectors of the economy.

Consequently, programs that have been outlined to benefit most third world countries with relatively intact forest ecosystems have eluded Nigeria. The nature-for-debt exchange program by UNDP/UNEP was conceived as a panacea to manage the inability of enrolled third world nations in the tropics to balance forest resources exploitation for quick-fix economic measures at the expense of environmental resources. This increased carbon sink capacities and microclimatic contribution to the overall global pursuit of benign climate. Recently, the carbon credit scheme was initiated as a more robust and all-inclusive program to globally pursue carbon decapitalization in view of global warming vis-à-vis climate change using the standing forest (Law and Williams, 2021).

Delta State was unable to qualify in the last forest assessment conducted for selected States for the carbon credit scheme due to the high fragmentation of available forest across three-quarter of the ecological zones as a result of ill-integrated agricultural practices that accounted for over 70% forest loss. The scenario has not changed as the conflict in the past one decade has accounted for approximately 100% (323ha) de-reservation of Iyiocha Forest Reserve without appropriate legislation to cultivate *Elaeis guineensis* (Palm) plantation while over 60% of Ogwashi-Uku Forest Reserve for agriculture.

The competition between agriculture and conservation for forest land still undermine strategic programs and policies which portends a great challenge in the face of current global climate change. The situation is more precarious in Delta State as a littoral State and much more for low-lying regions in the lowland rainforest ecological zones that could be more prone to emergent climate challenge of flood from irregular rainfalls and sea-level rise. This paper therefore articulates agroforestry as an *ad hoc* adaptation approach to compliment forest sink mitigation while aggressively providing support for rural households through income generation and employment in this critical ecological zone of Delta State.

Lowland rainforest ecological zone

Delta State is a low-lying land area that stretches parallel to the Atlantic Sea and have been edaphically fortified with wide range of indigenous forest trees species upland, to act against various forms of degradation, in the lowland rainforest ecological zone. These ecological features of the zone which occupies the northern half of Delta State, with the remnant forest found in forest reserves and riparian environment not very suitable for agriculture (Table 1).

Temperature and humidity of lowland zone is often variable compared to the other ecological zone due to high deforestation that has taken place in the region. NiMet (2016) reported a critical three banded temperature ranges for the zone due to high rate of forest loss in the region.

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Table 1: Ecological and socioeconomic characteristics of Lowland rainforest zone of Delta State

Population - Males - Females	 85,305 86,583
Elevation	>200m
Average temperature - Maximum - Minimum	 30.0°C 23.0°C
Predicted average temperature change	+0.0226ºC/year
Average rainfall	2762mm/annum
Predicted aggregate rainfall change	+ 4mm/day
Proximity to River Niger/ other rivers (<10km) Level of vulnerability	59.8% Moderate vulnerability
Land-use in communities – Farming – Housing – Forest reserves – Fishing	 68.5% 55.0% 12.3% 1.70%
Presence of crude oil facilities (wells, flow-stations, pipeline)	54.5%

Source: Climate Change Department, Delta State Ministry of Environment (2017).

Impact of agroforestry on crop productivity

Forest soils have been reported as the bait for consistent influx of farming practice in high forest zones of the tropics. High yield on de-forested land used for agriculture was observed in clear felled forest areas but diminished with time due to harvest of matured agricultural crops as nutrient mining overtime.

However, in agroforestry systems, the standing forest tree species act as systemic source of nutrients, reduction of precipitation and percolation throughout the various stages of growth and development to result in better yield as well as productivity. Egwunatum (2016) reported higher yield of cassava, plantain and yam obtained for three years from farmlands under Taungya as agroforestry and non-agroforestry sites in Akehie forest community in Aniocha South LGA of Delta State showed higher productivity for the agroforestry farmland (Table 2). The yields in the agroforestry farmlands increased with years unlike the non-agroforestry sites that declined with time due nutrient resource exhaustion. This incremental yield equally implied increase in income as demonstrated by the internally generated revenue and farmers income profiles of the lowland agroforestry centres in Delta State from 2001-2017 (Table 4). The internally generated revenue (IGR) from the issuance of permits for farming and thinning of forest produce in agroforestry system was expectedly lower than the profits accruable to the farmers from sales of farm produce alongside employment generation.

Table 2: Agricultural crop yield under agroforestry plots in Akehie

Period (Taungya year)	Land-use Types	Cassava (Bags/ha)	Plantain (Bunches/ha)	Yam (Kg/ha)
2013	Taungya Non-Taungya	4.86 2.10	49 35	180 155
2014	Taungya Non-Taungya	5.13 2.30	65 40	215 165
2015	Taungya Non-Taungya	5.83 2.34	70 43	226 169

Source: Egwunatum (2016)

Comparative assessment of agroforestry system on carbon mitigation

The means of soil organic carbon under agroforestry were significantly different ($p < 0.05$) for all the agronomic crops (Table 3). Forest ecosystems have the capacity to mitigate carbon even when integrated with agricultural crops. The plantain agroforestry site recorded highest soil organic carbon mean compared to cassava and yam. This could minimize the rate of deforestation by crop intensification on such agroforestry plots since less area will be required to grow agricultural crop and together be employed in the pursue of carbon credit scheme by the same farmer. Consequently, the agroforestry system invariably qualifies the rural farmer for inclusion in the global carbon decapitalization scheme, especially with the absence of in-organic fertilization approach on the farm environment.

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Table 3: Effect of Agroforestry system on soil organic carbon (SOC) accumulation in Akehie

Crop Type	Land-use type	Mean SOC (g/kg)	T-value	P	Statistical Remarks
Cassava	Taungya Non-Taungya	106.20 65.12	2.31	0.02	significant
Plantain	Taungya Non-Taungya	1146.29 75.86	3.62	0.01	significant
Yam	Taungya Non-Taungya	93.43 45.33	1.23	0.04	significant

Source: Egwunatum (2016)

Table 4: Income stream from Lowland Agroforestry Centres in Delta State

Agroforestry Centre	No. of Centres	Period (Years)	Average Income (N)		Total Income (N)
			IGR	Farmer	
Akehie	30	2001-2015	386,280	6,851,870	7,238,150.00
Iyiocha	22	2006-2017	634,930	4,510,450	5,145,380.00
Ogwashi-Uku	18	2003-2017	487,850	3,262,300	3,750,150.00

Source: Delta State Ministry of Environment (2017)

Policy framework for agroforestry

Government must be at the fore front by developing tools and approaches that combine agriculture and improve forest ecosystem conservation with livelihood opportunities.

Tools include:

1. Remote sensing maps of parchment forests to accommodate agriculture
2. Comparative analysis of compatible tree species cum agricultural crops
3. Rotational route services to manage nutrient-use and carbon-sequestration efficiencies

Approaches include:

1. Programs to leverage support services to existing farmers
2. Erect temporal nursery schemes at households and community levels to provide seedlings
3. Review existing Forest laws on Taungya to include more agricultural crop species as well as quantity per hectare in reserves
4. Drive public private partnership to lowland rainforest reserves

Furthermore, policy of agricultural credit scheme should be all encompassing by integrating conservation framework to accommodate forest related issues that indirectly influence agriculture.

CONCLUSION

Agroforestry practice is an efficient land-based mechanism that can engage agriculture and conservation at the same time with series of benefits. Its potential during climate change remains unique as it combats food insecurity, soil thermal problems that affect root-tubers, microclimate to moderate incidences of wind throw and flooding while mitigating carbon. The need to effectively establish agroforestry conurbations in the already degraded lowland ecological zone of the Delta State cannot be overemphasized in view of a resilient climate economy.

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Profitability and Value Addition of Maize *(Zea Mays L.)* Processing in South-Eastern Nigeria.

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A R T I C L E I NFO

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Maize Processing.

ABSTRACT

This study was carried out to examine profitability and value addition of maize (Zea mays L.) processing into by-products (such as sweet corn, popcorn, corn flakes, corn meal, corn oil, corn flour e.t.c) based on the methods of processing technology being used in Imo State South-eastern Nigeria. Its specific objectives includes; the socio-economic characteristics of maize processors, source of raw maize as well as disposable of value added products of maize, methods of processing technology used, average costs and returns analysis of processing technology for value added products of maize and its profitability per week, constraints encountered by maize stakeholders. The three agricultural zones were used through the adoption of Questionnaire/interview schedule and also, purposively selected with three stage random sampling technique that give a total of 160 respondents for the study. Data were analyzed using Descriptive Statistics, Value Added/Gross Margin Analysis. The study revealed that maize (Zea mays L.) processing is profitable and has a vital value added concept. Thus, the level of profitability and value addition is higher for processors using Mechanized Processing Technology than those processors using Manual Processing Technology. This is due to reduction in processing cost, high yield of output with great efficiency at limited period of time. In view of its potential for attainment for food security and good standard of living, it is concluded that processors that currently using Manual Processing Technology should be encouraged to shift to Mechanized Processing Technology because it saves time and money that can be put into other economical use. Thus, it was recommended that more Processing centres should be established in each of the agricultural zones of South-eastern Nigeria and processors should have access to credit facilities from bank and international organizations.

INTRODUCTION

Maize *(Zea mays L.)* is also known as corn. It belongs to the Genus *Zee L.*- corn, Family *Poaceae* – Grass family, Order *Cyperales*, Class *Liiopsida* – Monocotyledons, Subclass *Commelinidae*, Division *Magnoiiophyta* – Flowering plants, Subdivision *Spermatophyta* – Seed plants, Kingdom *Plantae* – Plants and Subkingdom *Tracheobionta* – Vascular plants.

Maize is a cereal grain that was originated from Southern Mexico about 10,000 years ago. It is the most widely grown grain that has become a staple food in various parts of the world with its total production surpassing that of wheat and rice (FAO, 2014). It is ranked the fifth largest in land area cultivation, the third largest in yield and the fourth largest in output (Surinder, 2011). Maize is a major cereal food crop in West Africa that is cultivated in Sub-Saharan Africa thus, it is one of the most important grains in Nigeria. It provides food, animal feeds and raw materials for some agro-based industries in Nigeria. About 65% of it is consumed by man and animals while 35% is utilized in various industrial processes (Igbokwuwe, 2015).

Processing implies a change in form of the original produce. That is, it is the treatment given to agricultural produce after harvesting which adds value

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to the produce for consumption and satisfaction (Igbokwuwe, 2015).

Maize is processed into different products by efficient processing methods which includes sweet corn, flint corn, pod corn, popcorn, dent corn, field corn, corn meal, corn flakes, corn oil etc. This efficient processing methods is regarded as Processing Technology that comprises of two types:-

i. Manual Processing Technology
ii. Mechanized Processing Technology (Igbokwuwe, 2015).

Manual Processing Technology implies processing for consumption only in which family basis is attained. While Mechanized Processing Technology implies processing for market sales for profit maximization (Igbokwuwe, 2015).

Value Addition simply implies the process of increasing the economic worth or value of a product/commodity by transforming it into another product/commodity (AMRC). That is to say, any product that undergoes any form of operation from changing its original stage to another that has economical worth or value and attainable is refer as Value Added Product. Therefore, Maize (Corn) can be known as a value added cereal crop because it can be transformed from its original/harvested stage to by-products that has economic value and use to the society for consumption and utilization. To this effect, technical efficiency is a component of economic efficiency that reflects the ability of a farmer/processor to maximize output from a given level of inputs (Adesiyan, 2015). It can be traced back to the beginning of theoretical developments in measuring (output oriented) technical efficiency (Debreu, 1951&1959). In view of this, there is a growing literature on the technical efficiency of value addition and its profitability on agricultural products. However, this study focus on profitability and value addition of maize processing that has the following objectives; the socio-economic characteristics of maize processors, source of raw maize as well as disposable of maize value added products, methods of processing technology used, average costs and returns analysis of processing technology for value added products of maize and its profitability per week, constraints encountered by maize stakeholders.

METHODOLOGY

The study area is Imo State with a tropical climate of two distinct seasons. The annual rainfall ranges between 1,000mm to 1,500mm, temperature of about 30°c to 35°c and humidity of 35% to 60%. A three stage random sampling technique was used in selecting the sample for the study. The first stage involves random selection of the three agricultural zones (Owerri, Okigwe and Orlu) as lineated by State Agricultural Development Programme (ADP). The second stage involves a random selection of fifteen villages from each zones (ie five villages from Owerri zone, five villages from Okigwe zone and five villages from Orlu zone) using the State Agricultural Development Programme (ADP) listing as sampling frame. The three stage involves a random selection of twelve households in each villages of the three agricultural zones of the state. A total of 180 farming households were chosen but only 160 farming households were finally used for this study as some of the other households did not engage in maize processing. The source of data used for this study was basically primary that involves the use of Questionnaire/Interview Schedule with the help of Agricultural Extension Agents working in each of the selected areas. Analytical techniques used for this study involves Descriptive Statistics, Valued Added/Gross Margin Analysis.

GROSS MARGIN ANALYSIS.

The Gross Margin Analysis (GMA) is a model that is used to estimate the costs, returns, profitability or negativity of maize processing. The Total Revenue (TR) represents the value of output of maize processing from the farm/processing machine or processing industries (ie physical quantity of the crop multiplied by the unit price). The Total Cost on the other hand is made up of the "Variable and Fixed" components. Variable Cost (VC) also known as specific cost varies directly with the level of processing/value addition which include expenditure on labour, gasoline for Mechanized Machine/Grater e.t.c. Fixed Cost (FC) are known as overhead cost that do not vary with the level of output and consist of cash expenses (on repairs and maintenance etc.) and non-cash adjustment (depreciation on farm/processing tools, equipment and machinery).
The Gross Margin Analysis of Value Added Products of Maize Processing was expressed as;

$$GM = TR - TVC$$

Where GM = Gross Margin
TR = Total Revenue
TVC = Total Variable Cost

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RESULTS AND DISCUSSIONS.

Table 1: Socio-economic characteristics of Respondents.

Variable	Frequency	Percentages
Age (in years)		
< 30	38	23.7
31 – 40	41	25.6
41 – 50	54	33.8
>50	27	16.9
Total	160	100.0
Sex		
Male	57	35.6
Female	103	64.4
Total	160	100.0
Marital Status		
Single	48	30.0
Married	67	41.9
Widowed	35	21.8
Divorced	10	6.3
Total	160	100.0
Experience (in years)		
< 5	24	15.0
6 – 10	48	30.0
11 – 15	57	35.6
>15	31	19.4
Total	160	100.0
Status of Farmers		
Full-time	95	59.4
Part-time	65	40.6
Total	160	100.0
Education		
No formal education	70	43.8
Primary	44	27.5
Secondary	29	18.1
Tertiary	17	10.6
Total	160	100.0
Occupation		
Farming	76	47.5
Civil servant	42	26.3
Trading	27	15.9
Artisan	15	6.3
Total	160	100.0

Source: Field Survey, 2022.

Table 1 shows the socio-economic characteristics of the respondents. It reveals that 83.1% of the respondents are still within the productive ages mainly in the hands of females (64.4%). Majority of the respondents are married (41.9%) with 11-15 years of experience (35.6%) and no formal education (43.8%). This shows that majority of the farmers (processors) are full-time (47.5%) farmers (processors) that can make positive contribution to agricultural production and also, depends on farming for livelihood as well as raw maize for processing.

Table 2: Distribution of Respondents according to Source of Raw Maize and Disposable of Maize Value Added Products.

Source	Frequency	Percentage
Personal Farm	85	53.1
Purchased/Leased Farm	47	29.4
Cooperative Farm	28	17.5
Total	**160**	**100.0**
Disposable		
Home Consumption only	46	28.8
Market Sales only	114	71.2
Total	**160**	**100.0**

Source: Field Survey, 2022.

Table 2 shows that 53.1% of the respondents get raw maize from their personal farm, 29.4% purchased raw maize from purchased/leased farm and 17.5% acquire raw maize from cooperative farm. This implies that majority of the respondents own their harvested maize in which they gets their benefits. Also, the table shows that 28.8% of the respondents offers their various maize value added products for their home consumption. While 71.2% of the respondents offers their various maize value added products for market sales. This implies that majority of the respondents sells their various maize value added products to earn income for sustaining their standard of living in which the Coronavirus (Covid-19) Pandemic as well as insecurity outbreak brought serious havoc to the growth and development of the economy nationwide as well as worldwide.

Table 3: Distribution of Respondents according to the Processing Technology used.

Types	Frequency	Percentages
Manual Technology	72	45.0
Mechanized Technology	88	55.0
Total	160	100.0

Source: Field Survey , 2022.

Table 3 shows that 45% of the respondents use Manual Processing Technology while 55% of the respondents use Mechanized Processing Technology. This implies that majority of the respondents in the study area depends on the use of Mechanized Processing Equipment.

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Table 4: Average Costs and Returns Analysis of Processing Technology for Value Added Products of Maize per week.

	Cost (₦)	Returns (₦)
Manual Technology	46,170	91,230
Mechanized Technology	82,550	193,900
Total	128,720	285,130

Source: Field Survey,2022.

Table 4 shows the Costs and Returns of the various Processing Technology used per week. The Manual Processing Technology has an average cost of ₦46,170.00K and ₦91,230.00K as an average returns per week. While the Mechanized Processing Technology has an average cost of ₦82,550.00K and ₦193,900.00K as an average returns per week. Therefore, Total Cost (TC) per week is ₦128,720.00K and Total Returns (TR) per week is ₦285,130.00K.

Table 5: Gross Margin Analysis of Processing Technology for Value Added Products of Maize per Week.

	Cost (₦)	Percentage (%)	Returns (₦)	Percentage (%)	Gross Margin (₦)	Percentage (%)
Manual Technology	46,170	35.9	91,230	32.0	45,060	28.8
Mechanized Technology	82,550	64.1	193,900	68.0	111,350	71.2
Total	128,720	100.0	285,130	100.0	156,410	100.0

Source: Field Survey, 2022.

Table 5 shows the Gross Margin of Processing Technology for Value Added Products of Maize per week. The result revealed that Gross Costs (GC) accounted 35.9% (which is ₦46,170.00K) per week for Manual Processing Technology while 64.1% (which is ₦82,550.00K) per week was for Mechanized Processing Technology. Also, it shows that Gross Returns (GR) accounted 32% (which is ₦91,230.00K) per week for Manual Processing Technology and 68% (which is ₦193,900.00K) per week for Mechanized Processing Technology. Therefore, Gross Margin (GM) revealed 28.8% (which is ₦45,060.00K profitable) per week for Manual Processing Technology and 71.2% (which is ₦111,350.00K profitable) per week for Mechanized Processing Technology. Hence, majority of the respondents are still within the active ages and value addition of maize processing are still in the hands of married and experienced processors. However, the Total Returns (TR) of the Processing Technology for Value Added Products of Maize per week is ₦285,130.00K while the Total Cost (TC) of the Processing Technology for Value Added Products of Maize per week is ₦128,720.00K. Therefore, the Gross Margin of the Processing Technology for Value Added Products of Maize is ₦156,410.00K which implies that value Added products of maize processing is highly profitable in the study area. Also, it implies that the best Technology for value added products of maize processing in the study area is Mechanized Processing Technology which guarantee efficient viability of available resources with optimum outputs.

Table 6: Constraints encountered by Maize Stakeholders.

Constraints	Percentage (%)	Rank
Inadequate Credit Facilities	33.6	1.
Inadequate Capital	21.2	2.
Poor Storage Facilities	15.5	3.
High Cost of Transportation	12.4	4.
Poor Electricity	8.1	5.
Poor Access to Information	6.2	6.
Poor Accessible Roads	3.0	7.
Total	100.0	

Source: Field Survey, 2022

Table 6 shows the constraints encountered by maize stakeholders which includes inadequate credit facilities, inadequate capital, and poor storage facilities. High cost of transportation, poor electricity, poor access to information and poor accessible roads. Thus, efforts need to be pit in place to reduce these challenges; this will go a long way in improving the profitability and its value addition of maize processing in the study area.

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CONCLUSION.

From the above results, the level of profitability and value addition is higher for processors using Mechanized Processing Technology than those processors using Manual Processing Technology. This is due to reduction in processing cost, high yield of output with great efficiency which saves time and money that can be put into other economical use in attainment for food security and good standard of living.

RECOMMENDATION.

Despite the climatic conditions and constraints that affects the value added products of maize processing especially the Coronavirus (Convid-19) Pandemic and the high rate of insecurity, value addition of maize processing is profitable and attainable. Therefore, it is recommended that processors should focus on Mechanized Processing Technology. Also, it is recommended that Mechanized Processing Centers for Value Addition of Maize should be established specifically in each of the agricultural zones of the South-eastern Nigeria by Federal and State Governments to increase scale of operations, outputs, income (with net profit) that will boost food security as well as the Economy of South-eastern Nigeria. Finally, it is recommended that processors should have access to credit facilities for banks and international organizations.

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Impact of Covid-19 Pandemic on Livelihood of Garri Agribusiness Owners in Ukwuani Local Government Area of Delta State, Nigeria.

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A R T I C L E I NFO

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ABSTRACT

The covid-19 pandemic has had devastating effects in many countries across the World, affecting every aspect of Nigerian economy. Most countries in sub-Saharan Africa met the crises in a weak and vulnerable position. Aside from the heath/mortality effects of the pandemic in Nigeria, the seemingly clearer effect is the impact of lockdown measures on small scale agribusinesses owners and the economy at large. How people make a living and access markets is impacted by covid-19 across Ukwuani local government area and beyond. These disruptions are driven primarily by restrictions put in place to curb the spread of the virus. There are emerging signs of the negative impact of covid-19 on livelihood, income, nutrition and food security, including local food production and the informal economy's food marketing system. This article examines the impact of covid-19 pandemic on the income and livelihood of small scale garri agribusiness owners; the level of income of garri agribusiness owners before COVID-19 pandemic and; whether agribusiness owner's livelihood is positively correlated with the perceived presence of Covid-19 in personal network. Taro Yamani formula was used to determine a sample size of 399 respondents in the study area. Both descriptive and inferential statistics was used for data analysis. After analysing the generated data, the result of the study showed that before the pandemic, agribusiness owners made about ₦157,640 as profit. But during the pandemic, agribusiness owners experienced a decline in their profit (₦60,646.82).The study suggests/recommends some policy priorities; support food insecure households through direct food distribution; small-scale garri agribusiness household should collectively set up a food bank so as to assist each order in terms of need and; support vulnerable house hold to mitigate the impacts of income loss through credit access at 0% interest rate.

1.0 Introduction

Pandemics are global or worldwide epidemics occurring over a wide area, spreading across international boundaries and affecting a large number of people (Heath 2018). It can also be seen as a simultaneous global transmission of diseases or viruses that cut across boundaries and continents. The WHO declared COVID-19 as a pandemic when it was spreading rapidly across the world, affecting different countries (WHO 2020).

The COVID-19 pandemic has become one of the most serious threats to global markets and agriculture in recent times besides the threat to lives. Lockdowns, partial market closures and social distancing instituted by different countries and Nigeria government to curtail the spread of the virus have adversely affected garri agribusiness owners and their livelihood and other supply-side businesses and services (Rosamond, 2020). Nigeria, like all the nations of the world, is navigating these uncertain times. The evolving uncertainty of the emergence of COVID-19 pandemic has adversely impacted the economies and businesses. The economic and other outcomes of COVID-19 are dependent on the baseline situation of communities, countries and regions, as well as their resilience to shocks. One noticeable fact is the recognition of the significance of agriculture, its upstream and downstream activities as

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critical to the other businesses' survival despite the current restrictions enacted to stop the spread of the virus. Garri agribusiness owners have been affected by the pandemic and many have stopped operations due to lack of agricultural products supply. Many are on the verge of collapse as shops, restaurants are closed and other agribusinesses stop operation. Nigerians vulnerabilities to the impact of external shocks can be attributed to increased dependencies on global economies for fiscal revenues, foreign exchange inflows, fiscal deficit funding, and capital flows required to sustain the nation's economic activities. Barro, Ursula and Weng (2020).

The food and agribusiness sectors were affected to varying degrees with some food companies experiencing rapid increased demand for products as panic buying escalates across some countries and communities and in some cases, import competitors are restricted. The partial closure of critical food system infrastructure (rural producer markets, wholesale food markets and open-air retail food markets) led to the apparent shutting down of the traditional marketing system in Delta State as well as other parts of the country. Partial market closures by government during the covid-19 pandemic prevented transactions between producers, traders, wholesalers, retailers and consumers. With no define place for transactions, (markets opening only once in a week) supply was reduced, prices increased, livelihoods and income suffered, creating a major stress on food security. Insufficient and poor access to dry and cold-chain storage compounded the marketing problems, leading to increased food loss and waste. United Nations (2020).

This lockdown policy of the Nigerian government, even though had proven to be effective in the control of the spread of the virus, adversely triggers household crises. These crises range from hunger among agribusiness owners, shortage of food, low purchasing power and negative coping strategies. Covid-19 policies affected small scale garri agribusiness owners, the small-scale owners cannot access farmers/suppliers or sell their goods to generate money for their upkeep. These measures had destabilized small scale garri agribusiness owners household in the study area making them to adopt negative coping strategies such as skipping of meal, reducing food consumption, engaging in low-nutrient food and excessive borrowing (debt) to buy food.

Problem Statement

The outbreak of coronavirus disease in 2019 (COVID-19) in China and its spread to other countries including Nigeria has had a destructive impact on health, agriculture, agribusiness, economy and infrastructure. But the evidence in recent studies and literature (Piguillem & Shi 2020; WHO 2020) showed that more researchers, governments and major stakeholders have rather engaged in research that intends to bring a cure to the virus. Other studies have investigated the pandemics impact on violence against children and women (Pereira et al. 2020; Peterman et al. 2020), health (Berger et al. 2020; United Nations 2020; World Health Organization [WHO] 2020), economy (Eichenbaum, Rebelo & Trabandt 2020), education (United Nations 2020) and human safety (Lattouf 2020; National Domestic Violence Hotline 2020). This has created some gaps in addressing the effects of the epidemic on agriculture, agribusiness and food crises in Delta state Nigeria. However, few studies have pointed out the implications of the novel virus on agriculture (Guterres 2020; UNSCN 2020; World Food Programme (WFP) 2020). According to Food and Agriculture Organization (FAO 2020), the implications include hunger, violence against women, girl child and negative coping habits, amongst others. These implications are a threat to humanity and global peaceful co-existence as the lockdown has inflicted devastating household hardships (food shortage, low disposable income, rape, sex-for-food and skipping of meals, amongst others). (Hamza 2020; Laetitia 2020; Laura 2020; NCDC 2020; UNHCR 2020; United Nations 2020).

Keeping agribusiness enterprises running is an indispensable economic component in the ongoing battle against COVID-19, yet discussions on the outbreak have thus far devoted very little attention to the challenges facing garri agribusiness owners and the need to promote agribusiness enterprises to mitigate the recessional impact of COVID-19. The promotion of agribusiness enterprises to minimize the impact of the COVID-19 crisis on the economy is critical. This paper, therefore, assesses the immediate challenges/effects the pandemic had posed on the income, livelihood of garri agribusiness owners in the study area and suggests mitigation measures through the promotion of agricultural enterprises to ensure a sustainable sector in the post-crisis period.

Objectives of the Study

The broad objective of the study is to assess the impact of Covid-19 pandemic on livelihood of garri agribusiness owners in the study area.
Specifically, the paper is designed to provide an insight on;

- the level of income of agribusiness owners before COVID-19,
- estimate whether agribusiness owner's livelihood is positively correlated with the

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perceived presence of Covid-19 in personal network.

2.0 Methodology

2.1 Study Area

Ukwuani LGA is found in Delta state, South-south geopolitical zone of Nigeria with the headquarters of the area in Obiaruku. The LGA was created on the 4th of December 1996 from the Ndokwa West LGA. The LGA is made up of several towns and villages which include Obinomba, Obiaruku, Umutu, Umukwata, Akoku, Amai, Eziokpor, Obiarumu and Ebedei. The estimated population of ukwuani local government is put at 212,334 inhabitants with the area predominantly occupied by members of the Ndokwa ethic group. Agribusiness and trade is an important economic activity in Ukwuani local government area hosting several markets such as the Umutu- altra- modern market where a variety of commodities are bought and sold. Fishing also booms in Ukwuani LGA with the areas water bodies being rich in seafood. Other important economic activities engaged in by the people of Ukwuani LGA include, farming, lumbering and wood carving, https://www.manpower.com.ng/places /Iga/244/ukwani (2013).

2.2 Sampling Procedure

Both descriptive and inferential statistics were used for the analysis of data. Frequency distribution tables was used to analyse the socio-economic characteristics of respondents in the study area who are garri agribusiness owners. While correlation coefficient was used to estimate whether garri agribusiness owners livelihood is positively correlated with the perceived presence of Covid-19 in personal network, Independent t-test was used to compare the estimated income of garri agribusiness owners before and during the Covid- 19 crisis.

2.3 Data Collection

Data for this study was obtained from both primary and secondary sources. The primary data was obtained through the use of a questionnaire while other relevant information was generated through unpublished research works, internet, magazines, textbooks, journals etc. **Taro Yamani formula** (n= N/1+N(e)2 was used to determine the sample size of 399 respondents from the study area. The study concentrated on small scale garri agribusiness owners in the nine (9) communities of ukwuani LGA. Total number of 37 respondents were randomly selected from each of the communities except for Obiaruku community where 100 respondents were selected. The reason being that the community is the headquarter and also has a larger market as compared to other communities in Ukwuani Local government area.

2.4 Model Specifications

Pearson's correlation

The relationship between the dependent and independent variable is given as:

$$\mathbf{Y} = f(X_i).$$

The correlation matrix is mathematically denoted as:

$$r = \frac{n\sum xy - (\sum x)(\sum y)}{\sqrt{(n\sum x^2 - (\sum x)^2)(n\sum y^2) - (\sum y)^2)}}$$

Where:
r = correlation
n = number of samples variables
x = independent variables
y = dependent variables

T-test

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{S_1^2}{N_1} + \frac{S_2^2}{N_2}}}$$

Where:

$\bar{X}_1$ = mean of first set of values

$\bar{X}_2$ = mean of second set of values

S_1= standard deviation of first set of values
S_2 = standard deviation of second set of values
N_1= total number of values in first set
N_2 = total number of values in the second set.

3.0 Results and discussions

Table 1 shows the socio-economic characteristics of the respondents, the table revealed that 50.4%, of the respondents were male. While 49.6% were female. The result agrees with the study carried out by Chisom (2021), on the impact of Covid-19 on supply chain, where the males are more than their female counterpart.

The study also revealed that majority of the respondents (56.6%) in the study are between the age brackets of 41-61 years of age. This implies that most of the respondents in the study area are in the active age, meaning that at this age, they are more efficient and productive.

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Table 1: Socio- Economic Characteristics of *Respondents in the Study Area*

Variable	Frequency	Percent	Mean/mode
Gender			
Male	201	50.4	Male
Female	198	49.6	
Age			
Less than 20 years			
20 - 40 years	64	16.0	
41 - 61 years	226	56.6	41 years
62 - 82 years	104	26.1	
Above 82 years	5	1.3	
Household size			
Less than 3 persons	112	28.1	
3 - 5 persons	84	21.1	6 persons
6 - 8 persons	199	49.9	
Above 8 persons	4	1.0	
Years in business			
Less than 5 years	64	16.0	
5 - 15 years	226	56.6	11 years
16 - 26 years	104	26.1	
27 - 37 years	5	1.3	
Size of business			
Less than 2	20	5.0	
2 -5	371	93.0	5
6 – 9	7	1.8	
Above 9	1	.3	
Pandemic effect			
Yes	271	67.9	Yes
No	128	32.1	
Covid-19 awareness			
Very high	68	17.0	
High	176	4.4.1	High
Relatively high	139	34.8	
Not aware	16	4.0	

Source: (Field Survey 2022).

The study also showed that the larger proportion of the respondents have spent between 5-15 years (56.6%) in their respective agribusinesses, while 16.1% of the respondents spent 5 years and below. The study also revealed that majority (93.3%) of the respondents in the study area have a relatively small agribusinesses, this study implies that more than half of the respondents are small scale agribusiness owners, which could be the reason why they were so much affected by the pandemic. The study is in agreement with the report of Amusan and Agunya (2021), which stated that the Coronavirus disease and lockdown had been observed and found to be a contributory factor to low disposable household income and had destroyed a lot of livelihood in Nigeria. Majority (67.9%) of the respondents also affirmed that Covid -19 pandemic has affected their sources of livelihood to a great extent. Almost all the respondents were aware of the existence and danger of the pandemic on livelihood and agribusiness. Only a few (4.0%) percentage were not aware of the virus.

Table 2: Level of Income before and During the Covid-19 Pandemic

VARIABLE	FREQUENCY	PERCENT	MEAN
INCOME BEFORE			
LESS THAN 500,000	372	93.2	157,640.00
500,000 - 1,000,000	18	4.5	
1,000,100 - 1,500,000	7	1.8	
1,500,100 - 2,000,000	2	.5	
2,000,100 -2,500,000	372	93.2	
INCOME DURING			
LESS THAN 100,000	350	87.7	60,646.82
1000,000 - 300,000	19	4.8	
501,000 - 800,000	17	4.3	
801,000 - 1,100,000	3	.8	

Source: (Field Survey 2022)

Table 4.2 shows the level of income of respondents before and during the pandemic. The table clearly shows that 93. 3% which are majority of the respondents made about ***N*57,640** as profit on a monthly basis which implies that garri agribusiness owners in the study area made at least **₦5630** on a daily basis from their agribusinesses. But during the pandemic, the respondents were unable to sell their goods on a daily basis due to the lockdown and partial market closures, (they made only **₦60,646.82**) the respondents could only sell once or twice in a week, this have greatly affected their livelihood and in some cases the respondents could not continue their businesses since they have used up their initial capital to feed themselves and their families.

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Table 4.3 T-test results showing the Income of Respondents before the Pandemic and During the Lockdown.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	**Income before the pandemic**	157640.00	399	299537 .805	14995.647
	income during the lockdown	60,646.82	399	179042 .260	8963.324

Source: (Field Survey 2022)

Table 4.3 shows the level of income of respondents before the pandemic and during the lockdown in the study area. The result of the t-test further revealed that there is a significant difference between the income of respondents before the pandemic and during the lockdown, this implies that garri agribusiness owner's livelihood has been greatly affected as a result of market closure and lockdown as most of the respondents experienced a decline in their earning capacity

Correlations

		INCOME DURING THE LOCKDOWN	COVID-19 AWARENESS
Income during the lockdown	Pearson Correlation	1	.011
	Sig. (2-tailed)		.830
	N	399	399
Covid-19 awareness	Pearson Correlation	.011	1
	Sig. (2-tailed)	.830	
	N	399	399

Table 4: Correlation between Garri Agribusiness owner's livelihoods with the perceived presence of Covid-19

The Pearson correlation coefficient of income during the lockdown and covid-19 awareness (0.830; p> 10%) was positive but not statistically significant.

Table 4.4 shows the relationship between garri agribusiness owner's livelihoods with the perceived presence of covid-19. Correlation matrix was used to determine the relationship between agribusiness owner's livelihood with the perceived presence of Covid-19, the result indicated a positive relationship at **0.830; p> 10%.** This implies that the livelihoods of garri agribusiness owners was greatly impacted by the perceived presence of Covid-19 in personal network.

4.0 Conclusion and recommendations/policy implication

The result of this study showed that the outbreak of the novel virus (COVID-19) pushed governments of different countries, including

Nigeria and the study area, to implement specific safety measures (such as lockdowns, self-isolation or quarantine and social distancing). Evidence shows that these measures, especially the lockdown order and partial market closures, resulted to crises that have, and can, affect garri agribusiness owner's livelihood and their household food security. The coronavirus disease and lockdown are a threat to all the core segments of food security (availability, accessibility, affordability, stability and utility). It also revealed that the income of respondents during the pandemic was significantly higher than income during the lockdown, this is because of the market closures, self-isolation and lockdown policies. The livelihoods of garri agribusiness owners were threatened and majority of the respondents were unable to feed themselves and their families as a result of the pandemic. Thus, sources of livelihood were destroyed and huge debts was incurred my agribusiness owners in order to feed survive during the lockdown. Similarly, the study found that COVID-19 lockdowns affect accessibility of food.

The study suggests/recommends that;
Small-scale garri agribusiness household should collectively set up a food bank so as to assist each order in terms of need;
Adoption and introduction of what's app and telegram group charts (Agricultural ICT) to communicate prices and products availability.
The government should support food insecure households through direct food distribution; Support vulnerable house hold to mitigate the impacts of income loss through credit access at 0% interest rate.

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Economies of Producing Grower Pigs Fed Different Energy Based Agro By-Products

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A R T I C L E I NFO

Key words:

economics,

cost,

grower pigs,

income,

feed.

ABSTRACT

A six-week feeding trial was conducted to evaluate the economics of producing grower pigs fed different agro based energy sources. Thirty two (32) grower pigs (Large white and Landrace) were used. The experimental animals were randomly assigned to four dietary treatments (1,2,3 and 4) in a complete randomized design (CRD).Each treatment group contained four (4) replicate with two (2) pigs per replicate. In diet 1(control), maize was the energy source while diets 2, 3 and 4 with palm kernel cake (PKM), brewer's dried grain (BDG) and wheat offal (WO) served as alternative energy sources respectively. The grower pigs had access to experimental feed and water ad libitum for six weeks. The cost benefit analysis revealed that the highest cost of feed per kg (₦) was recorded in the control maize diet with ₦386 while the least was in palm kernel meal (PKM) diet with ₦297.The total cost of production (₦/pig) was also highest in the maize controlled diet with ₦32,578.4 while it was lowest (₦25,482.6) in dietary treatment 2 with palm kernel meal. The revenue/income (₦/pig) was highest in diet 2 (PKM) followed by the wheat offal, maize BDG diets (₦54,360, ₦48,2404, ₦47,880 and ₦43,920) respectively. The gross profit (₦/pig) was also highest in the PKM diet followed by diet 4 (wheat offal), 3 (BDG) and least in treatment 1 (maize) with their correspondent monetary values as ₦28,877.4, ₦20,280.2, ₦15,881.4 and ₦15,301.6 respectively. In conclusion, palm kernel meal (PKM) is adjudged to be more economically viable and effective and could be used to replace maize wholly in diets of grower pigs without any negative side effect.

1.0 Introduction

Nutrition is one of the major constraints to the survival and satisfactory productivity of man and his livestock in Africa and many parts of the world (Igene, 2022). He maintained that nutrition involves food supply for any type of internal and external uses. Generally, nutrition aims at providing all essential nutrients in adequate amounts and in optimum proportions. In the words of Igene (2022), he stated that nutrition is the scientific way food is used by human body, his livestock and other organisms. The need to increase livestock production as a way of making animal food nutrient available is very vital to humanity (Okoruwa *et al*., 2011).

The demand for animal protein origin in Nigeria is far higher than the supply (Akinmutimi and Onukwe, 2012), hence there is an acute shortage of animal protein in the diets of many Nigerians. Access to adequate or good nutrition has become a very serious issue that neglecting it may put concerted efforts towards food security needs of the country into jeopardy. On the average, 10g of animal protein is consumed per day compared to the recommended 35g (FAO, 2018). This suggests that aggressive emphasis and action must be put in place to engender animal production to bridge the wide gap. For the pig industry to remain profitable, development of feeding strategies based on low cost feedstuff which are locally available to small farm holders remains

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indispensible (Nelson *et al*., 2007; Donkoh and Zanu, 2010). Alade *et al*. (2003), noted that the problem of food scarcity continue to persist with increasing population growth worldwide.

Agro industrial by-products from wheat and maize processing are increasingly becoming available mostly in urban centres of Nigeria. Sundu *et al.* (2006), reported that the search for least cost formulation has led animal nutritionists to probe the nutritional potentials of non-conventional feed ingredients used for compounding animal rations, and to ascertain the percentage (%) of combinations of such ingredients that could bring about satisfactory performance. In tackling the world's/Nigeria's food insecurity and by extension poverty alleviation, there must be an evolution in the feed strategy, compilation and a total deviation from the conventional approach. Igene (2022) noted that most of these agro by-products could be the rescue. Of all these agro by-products, palm kernel meal, brewer's dried grain and wheat offal are prominent base on the nutrient levels after extraction of the raw products.

2.0 Materials and Methods

2.1 Experimental Site, Ingredients and Duration

The experiment was conducted at the Piggery Unit of the Teaching and Research Farm of the Faculty of Agriculture, Ambrose Alli University, Ekpoma in Esan West Local Government Area of Edo State, Nigeria. The farm is located in the tropical savanna rainforest vegetation belt in Nigeria with Longitude 6.44ºC North and 6.08ºC East with mean ambient temperature of about 29ºC and relative humidity of about 76%. All the feed (experimental) ingredients were purchased at JAPPER NIGERIA LIMITED and Animal Feed Shop, both in Benin City, Edo State. The experiment was carried out for period of six weeks.

2.2 Management of Experimental Animals and Design

A total of thirty two (32) crossbred Large white and Landrace grower pigs whose average weight was 20.8kg and aged ten (10) weeks were used for the experiment. The pigs were divided into four (4) groups based on their average initial weights and were accordingly allocated to each of the four treatment diets (1,2,3 and 4) in a complete randomized design (CRD). Each treatment group had eight (8) grower pigs with four (4) replicates of two (2) each (one male and one female).

Prior to the arrival and subsequent allocation of the experimental animals, the pens were thoroughly washed and disinfected. The surroundings were cleared to ward off poisonous snakes and other predators. Acclimatization period of five days was allowed before the commencement of the feeding trial (experiment). While the experimental animals were fed twice daily (morning and evening), water was supplied *ad libitum* throughout the duration of the experiment. Routine vaccination, medication and other management practices were carried out.

2.3 Diet Formulation

The diets consisted of the following energy sources; maize, palm kernel meal (PKM), brewer's dried grain (BDG) and wheat offal (WO). Major protein source was groundnut cake (GNC) while other ingredients consisted of bone meal, vitamins/minerals premix, lysine, methionine and salt. Diet 1, which served as the control contained maize while diets 2, 3 and 4 had palm kernel meal, brewer's dried grain and wheat offal to replace maize as source of energy on weight equalization basis. Constant values were used in inclusion of other ingredients in the respective diets before mixing.

Table 1: Composition of Experimental Diets

Ingredients %	**Diet 1** Maize	**Diet 2** PKM	**Diet 3** BDG	**Diet 4** WO
Maize (control)	44.10	0.00	0.00	0.00
Palm Kernel Meal (PKM)	0.00	44.10	0.00	0.00
Brewer Dried Grain (BDG)	0.00	0.00	44.10	0.00
Wheat Offal (WO)	0.00	0.00	0.00	44.10
Cassava	29.60	29.60	29.60	29.60
Groundnut Cake (GNC)	20.00	20.00	20.00	20.00
Blood Meal	3.50	3.50	3.50	3.50
Bone Meal	2.00	2.00	2.00	2.00
Vit/Min Premix	0.25	0.25	0.25	0.25
Lysine	0.15	0.15	0.15	0.15
Methionine	0.15	0.15	0.15	0.15
Salt	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**
Calculated:				
Crude Protein (%)	**21.40**	**22.97**	**22.79**	**21.12**
Energy (Kcal/kg)	**3062.24**	**2652.25**	**2648.02**	**2644.59**

2.4 Cost Benefit Analysis

The prices of the feed ingredients at the time of the experiment were used to calculate the cost benefit of the production namely; cost of feed per kilogram (₦), cost of feed per weight gain (₦), total production cost

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per pig (₦), total revenue per pig (₦) and profit or loss per pig (₦) while the price of pork per kilogram was put at one thousand eight hundred naira ((₦1,800).

3.0 Results

The economic position of producing growing pigs with the experimental diets is shown in Table 2. The Table explicitly revealed that the feed cost (₦) was highest in diet containing the experimental ingredients (maize) followed by treatment 4, 3 and 2 which had wheat offal (WO) brewer's dried grain (BDG) and palm kernel meal (PKM) as alternative to maize in the production of growing pigs. Their monetary values are; 386, 358, 333 and 297 (₦) respectively.

The total cost of feed consumed per pig which is also shown in Table 2 had 32,578.4, 28,038.6, 27,959.8 and 25,482.6 (₦) for diets 1, 3, 4 and 2 in that order..It is evident here that the maize based control diet had the highest monetary implication in feeding grower pig followed by diets 3, 4 and 2 respectively. This may be traceable to highest cost of maize as a result of government ban on importation, very poor production due to insecurity and unavailability for animal consumption at the local level as a major dietary energy ingredient.

Feed conversion ratio ranged from 2.90 in dietary treatment 2 to 2.40 in diet 3. The revenue per total live weight gain ranged from 43,920 in diet 3 to 54,360 in diet 2 as indicated in Table 2 below. The Table also revealed that the highest revenue was in diet 2 which had palm kernel meal (PKM) as the alternative dietary energy source. In the same vein, the gross profit per pig (₦) was recorded highest in dietary treatment 2. The profits were put at 47,880, 54,360, 43,920 and 48,240 for diets 1,2,3 and 4 respectively.

Table 2: Economies of Producing Growing Pigs as Influenced by the Treatment Diets.

Parameters	Dietary Treatments			
	1	2	3	4
	Maize	PKM	BDG	WO
Ave. initial weight /pig (kg)	20.8	21.4	20.6	20.4
Ave. final weight /pig (kg)	47.4	51.6	45.0	47.2
Ave. total weight /pig (kg)	26.6	30.2	24.4	26.8
Feed cost (₦/kg)	386	297	333	358
Total feed consumed /pig/kg	84.4	85.8	84.2	78.1
Total cost of feed consumed (₦)	32,578.4	25,482.6	28,038.6	27,959.8
Ave. cost of feed/kg live wt gain/pig(₦)	1,273.8	861.3	1,132.2	1,145.6
Revenue/total live weight gain (₦)	47,880.0	54,360.0	43,920.0	48,240.0
Gross profit (₦/pig)	15,301.6	28,877.4	15,881.4	20,280.2
Feed conversion ratio	3.30	2.90	3.40	3.20

3.1 Discussion

The economics of producing grower pig fed different energy based agro by-products revealed that palm kernel meal treatment diet (PKM) was the most cost effective. Feed cost (₦/kg), total cost of feed consumed (₦/pig) and profit/pig (₦), feed conversion ratio among others were better in the PKM diet. Feed cost (₦/kg) was shown to be highest (₦386) in the maize controlled diet and least (₦297) in the palm kernel meal treatment diet. The total cost of feed consumed per pig was highest (₦32,578.4) in pigs in the control diet while it was observed to be lowest (₦25,482.6) in the PKM diet. The higher cost incurred in the maize diet could be as a result insufficiency of maize in the market, ban on importation of agricultural products and pressure on the few available products.

Prices for palm kernel meal (PKM), brewer's dried grain (BDG) and wheat offal (WO) respectively were not the same. This corroborates the earlier reports of Iwegbu (2014) and Igene (2006) that PKM and BDG were relatively cheaper feed ingredients. The cost of feed/kg live weight gain was least (861.3) in the PKM treatment diet, BDG (1,132.2) and wheat offal (1145.6) while it was highest (1,273.8) in the control diet of maize. The low cost of feed/live weight gain observed in pigs in treatment 2 (PKM) translated to more revenue and profit in the animals given the diet. Thus, the palm kernel meal diet was the most efficient and cost effective. To buttress this, Table 2 revealed that the profit that accrued in the PKM diet was almost

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twice the one of maize. It was also discovered that the profit on BDG and WO diets were higher than maize treated diet. This goes to say that apart from PKM; BDG and WO were more economically viable and effective than the control diet.

The replacement of maize with cassava meal up to 50% level in weaner pigs diet resulted in higher revenue and profit (Igene and Esobhawan, (2003). Ugwuene (2002) had also reported that replacement of whole maize with maize offal brewer's dried grain up to 50% resulted to higher profit. Alimon (2004) stated that there is improvement in the feed efficiency through accelerated use of local feed stuff to represent a potential area of application to reduce high cost in livestock feeding and production. Report on this research showed PKM as a high energy source and cost effective ingredient for growing pig ration formulation. It corroborates with the findings of the above authors and justifies the need for continuous search for alternative feed ingredients to replace the costlier and scarce conventional feed ingredients.

4.0 Conclusion

The economic viability of the experimental energy based agro by-products showed that the cost of feed per kilogram and general cost of production was highest in maize based control diet while it least in palm kernel meal diet. Animals fed PKM diets had highest estimated revenue and profit for total live weight gain thus making PKM more viable economically.

4.1 Findings

i. Palm kernel meal is proven to be a better alternative to more expensive maize ingredients.
ii. Substituting maize wholly with palm kernel meal in grower pig production has no adverse health implication.
iii. Competition between human and animal (pigs) is grossly reduced when PKM is used to alternate maize in livestock production.

4.2 Recommendations

The following recommendations could be made based on the findings of this research;

i. Feed millers should be encouraged and educated on the use of palm kernel meal as an alternative to maize in feed compilation.
ii. Palm kernel meal should be investigated as a replacement for maize in weaner and finisher pigs and also for other non-ruminant ration.
iii. Hence findings of this research support economic viability of PKM, it is however recommended that pig farmers adopt it as an alternative to maize.

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Profitability Analysis and Resource Use Efficiency of Smallholder Palm Oil Production in Delta State.

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A R T I C L E I NFO

Key words:

Small-holder oil palm,

Profitability,

Resource Use

ABSTRACT

Oil palm is an important crop whose products (oil and kernel) are used for food and non-food purposes. Palm oil is a commodity which is in high demand in Nigeria based on its food and non-food uses. The study examines the profitability level and resource utilization efficiency of small holder palm oil production across the agricultural zones in Delta State. A multistage random sampling technique was used in selecting respondents for the study. Primary data were collected with the aid of well-structured questionnaire and interview schedule. Data were analyzed using descriptive statistics; mode, frequencies and corresponding percentages and gross margin model and profitability techniques. The result of the analysis revealed that, the small-holder palm oil agribusiness is dominated by people from 50 years and above (32.5%) mainly married (76.8%). About 37% and 29% of the farmers possess West Africa School Certificate and Primary School Leaving Certificates respectively as their educational qualification. About 50% of the farmers have 16-20 years' experience in oil palm business. The resource use efficiency showed that family labour, hired labour and processing method cost were over-utilized while number of fresh fruit bunches were underutilized. The profitability indices indicated that palm oil production was profitable in all the three agricultural zones but comparatively, it was most profitable in the Delta Central zone, followed by the Delta North zone with the least being the Delta South agricultural zone. The study concluded that with efficient use of resources, the small holder palm oil production is a profitable and viable agribusiness in Delta State.

1.0 Introduction

Palm oil is the world's highest yielding oil crop, with an output 5–10 times greater per hectare than other leading vegetable oils. From a production level of 1.6% and a consumption level of 6% in 1976, global palm oil production and consumption has grown to 28% in 2009 to become the world's largest produced and consumed oil with production rate increased to 73 million metric tons in 2012 (Shahbandeh, 2012). According to Aidenvironment (2014), Palm oil recorded its fastest increase in global production due to the significant contributions by Malaysia and Indonesia. Given its enormous economic advantages and rich agronomical features, the oil palm has tremendous potential role to play in the drive for more sustainable farming systems. Combined with historically low prices, relative shelf stability, and reported nutritional benefits (Friends of the Earth, 2015), palm oil leverages natural advantages that position it as a likely long-term staple of the global diet. Adetola (2019) asserted that rapidly expanding populations and changing consumption patterns, as well as increasing demand from the bioenergy and oleo-chemicals industries, have resulted in sustained high prices for crude palm oil. These market forces have driven enormous growth of the palm oil industry in recent decades. Analysts predict further palm oil demand acceleration in the near term— potentially a 36% increase by 2012 over 2010 baselines, and more than 65% growth by 2020 (Sherry, 2015).

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Nigeria was the world's largest producer of palm oil accounting for 43% of global palm oil production and also the largest consumer of palm oil in Africa with a population of 197 million people (AgroBusiness Times, 2017). Over-reliance on traditional production methods, excessive tapping of palm trees for palm wine and the civil war between 1967-1970, are factors that contributed to Nigeria's inability to meet up with the global rise in demand for palm oil. Currently, Nigeria is the fifth-largest producer of palm oil globally with less than two per cent of total global market production. According to Partnership Initiatives in the Niger Delta (2011) about 80 per cent of palm oil production in the country comes from dispersed smallholder farmers. Given the right capacity building, Nigeria can improve palm oil production. As global demand for palm oil is increasing, the crop cultivation serves as a means of livelihood for many rural families, and indeed it is in the farming culture of millions of people in the country.

The Nigerian Oil palm belt covers twenty-four states and Delta State is one of the major Oil palm producing State. Within the oil palm belt in Nigeria, 80% of production comes from dispersed smallholders who harvest semi-wild plants and use manual processing techniques. Akhaine (2017) stated that several million smallholders are spread over an estimated area ranging from 1.65 million hectares to 2.4 million hectares and to a maximum of 3 million hectares.

Oil Palm productivity of smallholder oil palm plots is an important factor in determining the profitability of oil palm for smallholder cultivators. Financial viability assessments and resource utilization efficiency enables smallholders identify suitable conditions under which they will be able to generate sufficient return on their investment to improve their livelihoods while minimizing environmental impacts. Therefore this study sought to; ascertain the contribution of socio-economic characteristics of respondents' to palm oil production level, determine the level of resource utilization in palm oil production and compare the profitability level of palm oil production across the agricultural zones in the State.

MATERIALS AND METHODS

Sampling Technique/Data Collection

Both primary and secondary data were used. For the primary data, structured questionnaires were administered to smallholder oil palm producers. The questions were tailored toward meeting the set specific objectives. A multistage random sampling procedure was used in this research. In all, a total of 60 oil palm farmers were selected from each of the three agricultural (Delta Central, Delta North and Delta South) zones in the State, giving a sum total of 180 respondents for the study. However, a total of 174 viable questionnaires were finally retrieved for analysis. For secondary data, annual statistical reports, journals etc. were useful in examining the coverage of the agricultural situations.

Data Analysis

Resource Use Efficiency in terms of Allocative Efficiency.

The ratio of the marginal value products (MVP) and the marginal factor cost (MFC) were used to determine resource utilization in palm oil production. The theory of efficiency is derived from the production process which involved the transformation of inputs into outputs.

Mathematically, it is expressed as,

$$\frac{MVP}{MFC} > 1 \ldots\ldots\ldots\ldots 1(Under\ Utilization) \ldots\ldots (1)$$

$$\frac{MVP}{MFC} < 1 \ldots\ldots\ldots\ldots 2(Under\ Utilization) \ldots\ldots (2)$$

$$\frac{MVP}{MFC} = 1 \ldots\ldots\ldots\ldots 3(Optimum\ Utilization) \ldots\ldots (3)$$

Marginal value product (MVP) was determined by finding the product of marginal physical product (MPP) of the input and price of output. Then,

$$MPP_i = \frac{P_i}{P_y} = \frac{MPP\ X\ P}{P_i} = \frac{MVP}{MFC} \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Where P*i* = price of input per unit

P*y* = price of output per unit

Resource utilization in palm oil production with respect to the inputs was computed. First, is to determine the marginal value product for each resource, which is the product of marginal physical product (MPP) and the price of output per unit (P)

$MVP = MPP.P_y$ ..... ……(5)

Where P_y, = Price of output per unit …… (6)

Depending on the functional form selected as the lead equation, the MPP values were obtained using the method applied by Agbamu and Fabusoro (2001) as follows:

For Linear form, MPP = dy/dx b*i* ……(7)

Semi-log, MPP b*i*/Y*i* ……..(8)

Double-log, MPP b*i*. Yi/X*i* ……...(9)

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Resource use efficiency (RUE) = Resource utilization Index = MVP/MFC or MVP/Pxi

Where: V b*i* = regression coefficient

Y*i* mean output of palm oil

X*i* mean value of the resource / variable input

dy/dx = derivative of Y*i* and X*i*

Px*i* = Price of resource per unit

The coefficient of production function determines whether a resource is efficiently utilized or not.

Budgetary Analysis

Gross and net margins were used to compare the profitability level of palm oil production across the agricultural zones in the study area. Costs are expenses incurred in the operations of a production unit. Variable cost items include: planting materials, labour, fertilizer, cost of pesticides etc. The fixed cost items include: sprayers, hoes, cutlasses, baskets etc. The depreciated values of the fixed cost items was estimated.

The budgeting technique employed is given as:

Profit (π) = Total Revenue (TR) – Total Cost (TC) …… (10)

Gross Margin (GM) = Gross or Total Revenue (GR) – Total Variable Cost (TVC)

That is GM; = $\Sigma Pi\ Qi - \Sigma CjiXji$ …… (11)

Where:

GM; = gross margin of the i^{th} palm oil enterprises.

P*i* = Market price of output *i* per kg.

Q*i* = Quantity of output produced by enterprise *i* (kg).

C*ji* = Market price of variable input *j* in production enterprise *i*.

X*ji* = Quantity of the variable input *j* used in producing enterprise *i*.

The GR ($\Sigma Pi\ Qi$) is the value of total sales and home consumption.

NFI*i* = GM*i* – TFC*i* ……..…. (12)

GM*i* = TR*i* – TVC*i* …… (13)

Where;

GM = Gross margin of i^{th} oil palm farm.

TR = Total revenue of the i^{th} oil palm farm.

TVC = Total variable cost of i^{th} oil palm farm.

TFC = Total fixed cost of i^{th} oil palm farm.

NFI = Net farm income of i^{th} oil palm farm.

Gross Margin Analysis:

GM = GFI (TR) – TVC …… (14)

Gross Margin Percentage: Gross margin (%) = GM/GFI x 100 ……... (15)

Farm earning = GM + value of products consumed at home …….. (16)

Return per Naira Invested (R/N): R/N = GM/TC …… (17)

Return per Gross Farm Income: GM/GFI = …… (18)

Production profitability Index (PPI): PI = Total Farm income / Total farm cost x 100 ……. (19)

where;

GM = gross margin (₦/ha)

GFI = gross farm income

TVC = total variable cost

TC = total cost

(Izekor & Olumese, 2010; Skarzynska, 2012).

RESULTS AND DISCUSSION

Determination of level of Resource Utilization by Gender

The resource use efficiency (RUE) was used to determine the level of resource utilization in the study area. RUE is related to the ability of the entreprise to utilize limited production resources in a cost-minimising or effective way. In order to achieve this

objective, the study employs the MVP/MFC analysis approach. This approach has been used by researchers such as Awunyo-Vitor, Wongnaa & Aidoo (2016), Sanusi *et al.* (2015) and Nimoh & Asuming-Brempong (2012) where the MVPs for each input used were computed and such computed MVPs were then compared with their respective acquisition cost, MFC. Results of this analysis is shown on Table 1.

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Table 1: Resource Use Efficiency Using Linear Function

Resources	MPP (b_i)	Py (N)	MVP (MPP.Py)	MFC (N)	Efficiency* (MVP/MFC)	Decision
No. of Oil palm bunches	0.812	125/litre	101.5	70/Bunch	1.45	Under Utilization
Family labour	0.010	125/litre	1.25	1200/md	0.001	Over Utilization
Hired Labour	-0.018	125/litre	-2.25	1200/md	-0.002	Over Utilization
Cost of Processing Method	-0.521	125/Litre	-65.125	2.5/Litre	-26.05	Over Utilization

Source: Field Survey Data, 2018

*When MVP/MFC > 1 indicates under utilization

MVP/MFC < 1 indicates over utilization

MVP/MFC = 1 indicates optimum use of resources

Note:

Py = Price of output palm oil / Unit

The result of the resource use efficiency in Table 1 showed that number of oil palm bunches, family labour, hired labour and processing method cost had efficiency indices of 1.45, 0.001, -0.002 and -26.05 respectively indicating underutilization of number of oil palm bunches and over utilization of family labour, hired labour and processing method cost. For these resources to reach optimum level the cost of processing method, hired labour and the number of family labour used should be reduced while oil palm bunches should be increased. When this is done profit will be maximized.

Profitability Level of Palm Oil Production across Agricultural Zones (Budgetary Analysis)

This sub-section focused on costs and returns structure of the palm oil producers, disaggregated across the agricultural zones (Delta Central, Delta South and Delta North) in the study area.

Costs and Returns

Various studies, (Jenkins, G.P *et al.* 2018; Aliyu A. A. (2015) have led credance to the usefulness of cost and returns model in the analysis of profitability. The data were analysed using various profitability indices. The items of cost were classified into fixed and variables cost items. The return of revenue in the study area was realized from the sales of oil palm processed from the farms by individual producer. The fixed costs items were depreciated over time while the variable cost items were determined by each producer based on the quantity used for palm oil production at a particular price. The profitability of palm oil production enterprise was examined using cost and returns analysis. The estimated costs and returns of small-holder palm oil producers when disaggregated across the agricultural zones in the study area are presented in Table 2 below.

The result from Table 2 showed the cost and return analysis as per hectare for the three agricultural zones; Delta Central, Delta South and Delta North. For Delta Central, the total cost was ₦112,458/ha, the total revenue or gross returns was ₦158,700/ha and the net farm returns was ₦46,242/ha while the return per naira invested (R.I) per hectare was ₦1.41. Similarly, result from Delta South agricultural zone indicated that the total cost was ₦101,414/ha, the total revenue was ₦120,060/ha and the net farm returns was ₦18,646/ha while the return per naira invested (R.I) per hectare was ₦1.18/ha. By the same token, the Delta North agricultural result revealed that total cost was ₦167,220/ha, the total revenue was ₦224,250/ha and the net farm returns was ₦57,030/ha while the return per naira invested (R.I) per hectare was ₦1.34/ha.

The summary from the analysis indicated that palm oil production was profitable in all the three agricultural zones but comparatively, it was most profitable in the Delta Central zone, followed by the Delta North zone with the least being the Delta South agricultural zone.

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Table 2: Cost and Returns for 1 ton of FFB from Small-holder Plantation (1ha)/year

	Cost and Returns for operating Small-holder Plantation (1ha) /year for Delta Central Agric. Zone			Cost and Returns for operating Small-holder Plantation (1ha) /year for Delta South Agric. Zone			Cost and Returns for operating Small-holder Plantation (1ha) / year for Delta North Agric. Zone		
Cost (Naira)	**Qty**	**Price**	**Total**	**Qty**	**Price**	**Total**	**Qty**	**Price**	**Total**
Weeding (rounds)	2	5000	10000	2	5000	10000	3	5000	15000
Fertilizer application (50kg bags)	4	6000	24000	4	6000	24000	8	6000	48000
Pruning (charge per tree)	140	100	14000	140	100	14000	140	100	14000
Fixed cost: Depreciation			3003			2459			2865
Harvesting (charge per FFB)	605	50	30250	455	50	22750	975	50	48750
Assembling (charge per FFB)	605	20	12100	455	20	9100	975	20	19500
Processing (bunch sterilization, threshing, pressing etc)/ton	1		19105		1	19105		1	19105
Total Cost			**112,458**			**101,414**			**167,220**
Revenue (Naira)	**Qty**	**Price**	**Total**	**Qty**	**Price**	**Total**	**Qty**	**Price**	**Total**
Yield in mt/ha	12			7			15		
Processed palm oil	690	230	158700	522	230	120060	975	230	224250
Total Revenue			**158,700**			**120,060**			**224,250**
Net Farm Returns			**46,242**			**18,646**			**57,030**
Return on Investment			**1.41**			**1.18**			**1.34**

Source: Field Survey Data, 2018.

Table 3: Profitability of Palm Oil Production

Model	Computation	Ratios		
		Delta Central	**Delta South**	**Delta North**
Benefit Cost Ratio / RoI	TR/TC	1.41	1.18	1.34
Rate of Return	Net Return/TC	0.41	0.18	0.34
Gross Ratio	TC/TR	0.70	0.85	0.75

Source: Field Survey Data, 2018.

CONCLUSION/ RECOMMENDATION

This study revealed that small-holder oil palm production is a profitable agribusiness, though the farmers have not been able to efficiently and effectively utilized productive resources to the optimal level. The above constraints which specifically were not captured because it didn't fall within the scope and objectives of this study, could however be a lead to provoke further research. Conversely the study has provided empirical evidence to draw conclusion and recommend that due to profitability of the oil palm agribusiness, the sector if adequately managed could be a source of job creation to leverage the unemployment challenges that has bedeviled the Country and drastically reduce the poverty index. Government should engage in adequate sensitization and awareness programme to the citizenry on the viability of oil palm agribusiness and encourage them through training and provision of takeoff grants to venture into it.

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Indigenous and Improved Yam Storage Technologies in Delta and Edo States, Nigeria: Comparative Compatibility Approaches

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A R T I C L E I NFO

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ABSTRACT

This study examined Farmers comparison of compatibility of indigenous and improved yam storage technologies in Delta and Edo states of Nigeria. A sample size of four hundred and forty-nine thousand (449) yam farmers were interviewed. Data for the study were collected through interview schedule using structured questionnaire. Data collected were subjected to analysis using statistical packages for social sciences (SPSS). Results of data analysis show that majority (79.1%) of the yam farmers were males while 20.9% were females and the mean age of the yam farmers was 47 years. Majority (30.7%) of the farmers' possessed junior secondary school certificate with a average farming experience of 13 years. The mean responses from the respondents reviewed that indigenous and improved yam storage technologies are technically, economically, socio-culturally and environmentally compatible in the study area. It is therefore recommended that Indigenous and improved yam storage technologies be used simultaneously by yam farmers since they are technically, economically, socio-culturally and environmentally compatible. There is need to develop and construct packages of improved yam storage technologies and be given to yam farmers at a subsidies rate. High publicity to improved yam storage technologies for adoption by farmers is a necessity.

Introduction

Nigeria is one of the world's leading yam producers. It accounts for 70–76 percent of global production. Yams are grown in rain forests, timber savanna, and southern savanna ecosystems along the coast. Anambra, Benue, Cross River, Adamawa, Delta, Ekiti, Imo, Edo, Kaduna, Ogun, Kwara, Ondo, Osun, Plateau, and Oyo are the states where yam is primarily grown in Nigeria. Yam is a root and tuber that is a staple meal in Nigerian and West African diets, providing about 200 calories of energy per capita on a daily basis. However, the current level of yam production in Nigeria is insufficient to accommodate the expanding population (Luka and Yahaya, 2012).

Indigenous knowledge is a distinct body of information established over time and linked with people in a certain geographic area in order for them to benefit from their natural resources. It is an indigenous society's storehouse of experience and knowledge about their technology, traditions, and beliefs that frequently serves as the foundation for making decisions that lead to stable livelihoods (Luka and Yahaya, 2012). Many cultures use indigenous knowledge to inform their decision-making in areas such as food security, human and animal health, education, natural resource management, and other critical economic and social activities (Gorjestani, 2002; Maretzki, 2013).

Tavana, (2002) mentioned that indigenous knowledge is divided into two categories: explicit indigenous knowledge and implicit indigenous knowledge. Explicit indigenous knowledge, according to Wyatt and Smith (2001), consists of facts, rules, relationships, and regulations that may be faithfully transcribed in paper or electronic form and communicated without discussion. They went on to define explicit indigenous knowledge as academic knowledge that is described in formal language, print or electronic media, and is utilized by people to document techniques.

Maretzki (2013) argued that tacit indigenous knowledge, like riding a bicycle, is difficult to communicate openly with words because it entails doing something without having to think about it.

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In essence, tacit indigenous knowledge refers to customary wisdom that is difficult to describe or express to outsiders (Tavana, 2002). He went on to say that it was heavily influenced by a person's emotions, experiences, insights, observations, and perceptions. This study's indigenous knowledge will concentrate on yam growers' explicit indigenous knowledge practices.

Indigenous technologies, according to Gemet (2019), are the result of indigenous knowledge. Indigenous technology, he continued, refers to the technologies used by natives or a certain socio-cultural group inside a country to produce goods and services. Indigenous technology aims to improve people's ability to preserve and renew balance and harmony in a complex environment. According to Ovwigho and Chuks-Okonta (2001), indigenous technology serves as a foundation for enhanced technology. They argued that a people's cultural history influences the emergence of both indigenous and enhanced technologies.

Scientific knowledge refers to facts and concepts that have been discovered via a long process of inquiry and investigation. Improved technologies are the result of scientific research. It is knowledge gained via careful study and organized according to certain broad principles. Researchers in research centers and universities generate scientific knowledge, which is then transmitted to farmers through extension workers (Chema *et al*., 2003; Mehta *et al.,* 2013).

Harvesting techniques, handling, processing, storage structures, transportation, management decisions, infrastructure, consumer preferences/attitudes, and availability of financial markets are all factors that contribute to food loss, according to Aulakh and Regmi (2013). The losses suffered at each step in the food supply chain vary based on the organization and technologies utilized. For example, in less developed countries with less mechanized supply chains, losses during drying, storage, processing, and transportation are higher (Adejo, 2017).

According to Elemo (2017), Nigeria's yearly post-harvest losses have climbed to above $9 billion. She claims that post-harvest losses from perishable crops such as fruits, vegetables, and yam account for up to 50% of annual food crop production in Nigeria. She went on to say that poor transportation, storage, and handling facilities were important contributors to the losses. She stated that perishable crops with high moisture content, such as grains, roots, and tubers, are more prone to losses due to climatic and biological variables.

Respiration, sprouting, rot-causing organisms, rats, and moisture loss were the main causes of yam storage losses. Dormancy is interrupted after a period of storage, according to Eze, Eze, Ameh, and Dansi (2013), and sprouts appear primarily from the head area. According to Tschannen *et al.* (2003), sprout growth raises the tuber's respiration rate, resulting in significant dehydration and dry matter loss.

The quantity of storage loss is frequently determined by the type of storage technology used. According to Odeyemi and Daramola. (2000) and Eze *et al*. (2013), roughly 50-60% of food crops in Nigeria are preserved in traditional indigenous structures, particularly at the family and farm level, for consumption and seed planting. They stressed that native structures are composed of locally available materials such as grasses, woods, and mud, with no enhanced design to ensure long-term pest protection for crops.

In spite of the increasing yam storage technologies, losses due to storage have remained a major challenge to yam farmers. There is need to compare various technological approaches. This study is therefore designed to investigate farmers' comparison of the compatibility of indigenous and improved yam storage technologies by yam farmers in different States of Nigeria.

Objective of the Study

The general objective of the study was to examine farmers' compatibility comparison of indigenous and improved yam storage technologies in Delta and Edo States. The specific objective was to compare the technical, economic, socio-cultural and environmental compatibility of indigenous and improved yam storage technologies in Delta and Edo States;

Materials and Methods

Brief Description of the Study Area

The study area consists of Delta and Edo states. The two states were created out of the former Bendel state on August 27th, 1991. The geography of the two states are described in the following sub sections.

Delta State

Delta state has an estimated land area of 17,698 square kilometers and lies between Latitude 5^0 00^l and 6^0 30^l North of the equator and Longitude 5^0 00^l and 6^0 45^l East of the Greenwich Meridian. Edo State borders it on the north, Balyesa and Anambra on the south, and Ondo State on the west. With a shoreline of 160 kilometers, the Atlantic Ocean defines its southern border (MANR, 2002). The State has a population of Four million, one hundred and twelve thousand, four hundred and forty five (4,112,445) people. There are two million sixty-nine thousand thirty-nine (2,069,309) males and two million forty-three thousand one hundred and thirty-six (2,043,136) girls

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in this group (NPC, 2006). Delta State is made up of twenty-five (25) Local Government Areas. The state is sub-divided into three senatorial districts, namely; Delta North (Ukwuani, Ndokwa-West, Ndokwa-East, Aniocha-South, Aniocha-North, Ika North-East, Ika South and Oshimili South, and Oshimili North), Delta Central (Ughelli South, Ughelli North, Ethiope East, Ethiope West, Sapele, Uvwie, Udu and Okpe); and Delta South (Bomadi, Burutu, Isoko-South, Isoko-North, Warri-North, Warri-South, Warri South-West and Patani).

Delta State Agricultural and Rural Development Authority (DARDA) divided the state into three (3) agricultural zones namely Delta North, Delta Central and Delta South Agricultural zones. The major occupations of people are farming, hunting, fishing and poultry.

Edo State

Edo state has an estimated land space of 17,802 square kilometers and lies between latitude 6^0 30^l North and Longitude $6^0 00^l$ East of the Greenwich meridian. The State is confined on the north and east by Kogi State, on the south by Delta State and on the west by Ondo State. Edo State has inhabitants of about Three million, two hundred and thirty three thousand, three hundred and sixty six (3,233,366) people. This is made up of One million, six hundred and thirty three thousand, nine hundred and forty six (1,633,946) males and One million, five hundred and ninety nine thousand, four hundred and twenty (1,599,420) females (NPC, 2006). Edo State is made up of eighteen (18) Local Government Areas. It is divided into three (3) Agricultural zones namely; Edo South (Oredo, Egor, Ikpoba-Okha, Orhionmwon, Ovia North-East, Ovia South-West, and Uhunmwode); Edo Central (Esan Central, Esan North-East, Esan West, Esan South-East and Igueben), and Edo North (Akoko-Edo, Estako Central, Estako East, Estako West, Owan East and Owan West).

Crude oil, limestone, marbles, quartzite, gold, chalk, and clay are among the numerous mineral resources found in the state. The inhabitants of Edo State's primary indigenous occupation is farming.

Sampling Techniques and Sample Size

Simple random sampling techniques done on a multi-stage basis was used to select extension blocks, cells and respondents. The first stage involved random selection of 60% of extension blocks from each of the three (3) agricultural zones in Delta and Edo States. This gave a total of fifteen (15) extension blocks in Delta and eleven (11) extension blocks in Edo State. The second stage involved random selection of 40% of extension cells from the selected extension block. This gave a total forty-five (45) extension cells in Delta and in Edo state this will give a total of thirty-six (36) extension cells. The third stage involved random selection of 20% of yam farmers from each cell in the three agricultural zones in Delta and Edo states. In Delta state this gave a total of two hundred and nineteen (219) yam farmers and in Edo state it give a total of two hundred and forty six (246) yam farmers. The sample size therefore was hundred and sixty five 465 yam farmers. Out of which 449 respondents information were useful. The sample size distribution is shown in Table 1.

Table 1: Numbers of questionnaires issued and retrieved from yam farmers in Delta and Edo States

State/Zone	No of questionnaire Issued	No of questionnaire retrieved	No of questionnaire not retrieved	percentage retrieved
Delta				
Delta North	77	73	4	94.81
Delta Central	103	97	6	94.17
Delta South	39	38	1	97.43
Sub-total	219	208	11	
Edo				
Edo North	93	93	0	100
Edo Central	63	61	2	96.83
Edo South	90	87	3	96.67
Sub-total	246	241	5	
Grand total	465	**449**	16	
Percentage of Questionnaires Retrieved				$\left(\frac{449}{465} X \frac{100}{1}\right) = 96.56\%$

Data for the study were collected through interview schedule using structured questionnaire. Data collected were subjected to analysis using statistical packages for social sciences (SPSS)

Result and Discussion

This section presented the data and discussion of findings of the study in the following ways; demographic characteristics of the yam farmers and farmers perception of compatibility of indigenous and improved yam storage technologies.

Demographic Characteristics of the yam Farmers.

The demographic data were gender, age, marital status, educational level, household size, farming experience and religion (Table 2)

Gender

Majority of the respondents in the study areas were male dominated (79.1%) while 20.9% were females. This findings agreed with David (2015) which stated that yam production in Nigeria is male dominated. Olayemi et al. (2012), in their study on Planting date and gender of yam farmers and the adoption of yam minisett technique in Nigeria, observed that yam production was dominated by men.

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Age
The mean age of the respondents is 47 years. Age as a factor is very important in farming. The age of a farmer can generate or erode confidence in adoption of improved storage techniques. Caswel *et al.* (2001) explained that elderly farmers often have different goals other than income maximization in which case, they would be expected to adopt an income-enhancing technology

Marital Status
A high proportion of the respondents were married (77.5%), single (10.9%), divorced (2.9%) widow (1.6%), Widower (2.0%), separated (1.3%) and respondents who do not indicate their marital status (3.8%). The high proportion of the married respondents implies that most of them have family responsibility that need financial commitment (Ayado, 2017).

Educational Level
Majority of the respondent have Junior Secondary School (JSS) education (30.7%), Senior Secondary School (24.7%), Ordinary National Diploma / National Certificate in Education (16.7%), Non-formal Education (10.2%), respondents who do not indicate their educational level (8.7%), primary school leaving certificate (6.9%) Higher National Diploma/Bachelor of Science Degrees (1.8%) and Post-graduate degrees (0.2%). Education is thought to create a favourable mental attitude for the acceptance of new practices (Caswell et al 2001). Doss and Morris (2001) explained that increased education was expected to improve the productivity of farmers.

Household size
The mean household size is 6. A large household size will be able to provide the labour that might be required for the adoption of improved yam storage technology. This is similar to the findings of Ovharhe, et al. (2021) that the average household sizes of farmers in Delta ranges between 4 and 6.

Farming experience
The mean farming experience of the respondents was 13 years. This implies that yam farmers in the study areas were experienced. Higher relative experience will be positively associated with adoption of improved yam storage technologies.

Religion
Majority of the respondents were Christian (73%), muslim (17.6%), traditional (7.6%), and religion not indicated (1.8%)

Table 2: Demographic characteristics of the yam farmers

S/N	Characteristics	Frequency N=449	Percentage	Mean	Mode	Remark
1.	Gender:					
	Males	79.1			Male	Male
	Female	20.9				dominated
2.	Age			47	50	Middle age
3.	Marital Status					
	Married	348	77.5			Married
	Single	49	10.9			
	Divorced	13	2.9			
	Widow	7	1.6			
	Widower	9	2.0			
	Separated	6	1.3			
	Marital status not indicated	17	3.8			
4.	Educational level ;					
	No Formal Education	46	10.2			
	Primary School Leaving	31	6.9			
	Certificate	138	30.7		JSS	
	Junior Secondary School	111	24.7			
	Certificate	75	16.7			
	Senior Secondary School	8	1.8			
	Certificate	1	0.2			
	OND/NCE	39	8.7			
	HND/B.SC					
	Post- graduate					
	Educational level not indicated					
5.	Households size:			6.4	6	
6.	Farming Experience			13years	6	
7.	Religion:					
	Christian	327	73.0		Christian	
	Muslim	79	17.6			
	Traditional	34	7.6			
	Free thinker	4	0.9			
	Religion not indicated	4	0.9			

Source: **Field data**

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In Table 3 respondents agreed that indigenous yam storage technologies are easy to operate by farmers with mean score (3.708), indigenous yam storage technologies are made of locally available material with mean score (3.637) and indigenous yam storage technologies are easy to construct with mean score (3.316). These indicated that indigenous yam storage technologies are technically compatible.

Table 3: Mean response to farmers perception of technical compatibility of indigenous yam storage technologies (N=449)

S/N	Statements	Mean	Std. Error	Remark
i.	Indigenous yam storage technologies are easy to operate by farmers.	3.708	.028	Economically Compatible
ii.	Indigenous yam storage technologies are easy to construct.	3.316	.033	Economically Compatible
ii	Indigenous yam storage technologies are made of locally available materials.	3.637	.027	Economically Compatible

Source: Field data *NB:* Mean cut off = 2.50

In Table 4 respondents agreed that indigenous yam storage technology are easy to procure with mean score (3.361), indigenous yam storage technologies are cheap with mean score (3.345), indigenous yam storage technologies minimize risk of investment with mean score (3.123), indigenous yam storage technologies minimize losses with mean score (2.902) and indigenous yam storage technologies are durable with mean score (2.704). These indicated that indigenous yam storage technologies are economic compatible.

Table 4: Mean response to farmers perception of Economic Compatibility of indigenous yam storage Technologies (N=449)

Statements		Mean	Std. Error	Remark
i.	Indigenous yam storage technologies minimize risk of investment.	3.123	.038	Economically Compatible
ii.	Indigenous yam storage technologies are cheap	3.345	.030	Economically Compatible
iii.	Indigenous yam storage technologies are easy to procure.	3.361	.037	Economically Compatible
iv.	Indigenous yam storage technologies minimize losses	2.902	.038	Economically Compatible
v.	Indigenous yam storage technologies are durable	2.704	.051	Economically Compatible

Source: Field data, 2020
NB: Mean cut off = 2.50

In Table 5 respondents agreed that indigenous yam storage technologies are not affected by religious belief with mean score (3.521), indigenous yam storage technologies do not require much formal education and experiences with mean score (3.403), indigenous yam storage technologies are culturally acceptable with mean score (3.227), indigenous yam storage technologies are not well spread among farmers social group with mean score (2.913) and indigenous yam storage technologies promote community participation with mean score (2.659). These indicated that indigenous yam storage technologies are socio-culturally compatible.

Table 5: Mean response to farmers perception of socio-cultural compatibility of indigenous yam storage technologies (N=449).

S/N	Statements	Mean	Std. Error	Remark
i.	Indigenous yam storage technologies are culturally acceptable.	3.227	.041	socio-culturally Compatible
ii.	Indigenous yam storage technologies do not require much formal education and experiences.	3.403	.029	socio-culturally Compatible
iii	Indigenous yam storage technologies promote community participation.	2.659	.043	socio-culturally Compatible
iv	Indigenous yam storage technologies are not well spread among farmers social group	2.913	.042	socio-culturally Compatible
v.	Indigenous yam storage technologies are not affected by religious belief	3.521	.089	socio-culturally Compatible

Source: Field data *NB:* Mean cut off = 2.50

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In Table 6, respondents agreed that indigenous yam storage technologies do not pollute the environment with mean score (3.183) and yam stored under indigenous storage technologies are not easily affected by weather elements with mean score (2.786). These indicated that indigenous yam storage technologies are environmentally compatible.

Table 6: Mean response to farmers perception of environmental compatibility of indigenous yam storage technologies (N=449)

S/N	Statements	Mean	Std. Error	Remark
i.	Indigenous yam storage technologies do not pollute the environment.	3.183	.034	Environmentally compatible
ii.	Yam stored under indigenous storage technologies are not easily affected by weather elements.	2.786	.045	Environmentally compatible

Source: Field data, 2020
NB: Mean cut off = 2.50

In Table 7, respondents agreed that improved yam storage technologies made of locally available materials with mean score (2.806), improved yam storage technologies are easy to operate by farmers with mean score (2.517), and improved yam storage technologies are with mean score (2.443). These indicated that improved yam storage technologies are technically compatible.

Table 7: Mean response to farmers perception of technical compatibility of improved yam storage technologies (N=449)

S/N	Statements	Mean	Std. Error	Remark
i.	Improved yam storage technologies are easy to operate by farmers.	2.517	.038	Technically compatibility
ii.	Improved yam storage technologies are easy to construct.	2.443	.047	Not-technically compatibility
iii	Improved yam storage technologies made of locally available materials.	2.806	.041	Technically compatibility

Source: Field data *NB:* Mean cut off = 2.50

In Table 8, respondents agreed that improved yam storage technologies are durable with mean score (3.262), improved yam storage technologies minimize losses with mean score (3.178), improved yam storage technologies are easy to procure with mean score (2.895), improved yam storage technologies minimize risk of investment with mean score (2.806) and improved yam storage technologies are cheap with mean score (2.501). These indicated that improved yam storage technologies are economically compatible.

Table 8: mean response to farmers perception of economic compatibility of improved yam storage technologies (N=449)

S/N	Statements	Mean	Std. Error	Remark
i.	Improved yam storage technologies minimize risk of investment.	2.806	.044	Economically compatible
ii.	improved yam storage technologies are cheap.	2.501	.046	Economically compatible
iii.	Improved yam storage technologies are easy to procure.	2.895	.041	Economically compatible
iv.	Improved yam storage technologies minimize losses	3.178	.035	Economically compatible
v.	Improved yam storage technologies are durable	3.262	.036	Economically compatible

Source: Field data *NB:* Mean cut off = 2.50

In Table 9, respondents agreed that improved yam storage technologies are not affected by religious belief with mean score (3.258), improved yam storage technologies are well spread among farmers with mean score (3.205), improved yam storage technologies promote community participation with mean score (2.853), improved yam storage technologies do not require much formal education and experiences with mean score (2.715) and improved yam storage technologies are culturally acceptable with mean score (2.586). These indicated that improved yam storage technologies are socio-culturally compatible.

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Table 9: Mean response to farmers perception of socio-cultural compatibility of improved yam storage technologies (N=449)

S/N	Statements	Mean	Std. Error	Remark
i.	Improved yam storage technologies are culturally acceptable.	2.586	.042	socio-culturally compatible
ii.	improved yam storage technologies do not require much formal education and experiences.	2.715	.041	socio-culturally compatible
iii.	Improved yam storage technologies promote community participation.	2.853	.045	Socio-culturally compatible
iv.	Improved yam storage technologies are well spread among farmers.	3.205	.035	Socio-culturally compatible
v.	Improved yam storage technologies are not affected by religious belief.	3.258	.033	Socio-culturally compatible

Source: Field data *NB:* Mean cut off = 2.50

In Table 10, respondents agreed that improved yam storage technologies do not pollute the environment with mean score (3.056) and yam stored under improved storage technologies are not easily affected by weather elements with mean score (2.946). These indicated that improved yam storage technologies are environmentally compatible.

Table 10: Mean response to farmers on environmental compatibility of improved yam storage technologies (N=449)

S/N	Statements	Mean	Std. Error	Remark
i.	Improved yam storage technologies do not pollute the environment.	3.056	.033	Environmentally compatibility
ii	Yam stored under improved storage technologies are not easily affected by weather elements.	2.946	.035	Environmentally compatibility

Source: Field data *NB:* Mean cut off = 2.50

Conclusion and Recommendations

The study reviewed the various indigenous and improved yam storage technologies adopted by yam farmers in the study areas. The indigenous and improved yam storage technologies were technically, economically, socio-culturally and environmentally compatible in the study areas. Therefore Indigenous and improved yam storage technologies should be used simultaneously by yam farmers since they are technically, economically, socio-culturally and environmentally compatible.

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Choice of Climate Change Adaptation Strategies used by Food Crop Farmers in Delta State, Nigeria: The Multinomial Logistic Regression Approach

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A R T I C L E I NFO

Key words:

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ABSTRACT

This study determined food crop farmer's choice of climate change adaptation strategies used in Delta State Nigeria. The multi-stage random sampling technique was used in selecting 325 farmers adopting the proportionate sampling method. The study data was collected by questionnaires and personal interview schedules. Statistical tools such as table; frequency; percentage; mean and the multinomial logistic regression model were used to examine the data. The results indicate that the mean age of the farmers was 49 years with mean years of schooling at 14. The mean farming experience was 24 years and a mean household size of 8 persons. Empirical result also revealed that age; household size; level of education; sex; farm size; distance; extension contact; access to credit; household income; years of climate change awareness; tenure security and access to weather information are major determinants of the choice of climate change adaptation strategies used by farmers in the study area. Based on the findings it was therefore recommended that there is need for government and non-governmental organizations to invest in climate resilient projects and improving on climate monitoring and reporting stations towards sustainable agricultural and rural development.

Introduction

Climate change according to Intergovernmental Panel on Climate Change (IPCC, 2007) refers to any change in climate over time, whether due to natural variability or as a result of human activity. It also refers to changes in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and or the variability of its properties and that persists for an extended period, typically decades or longer. Literature have shown that for the past decades, anthropogenic factors like urbanization, deforestation, population explosion, industrialization and the release of green house gases (GHGs) are the major contributing factors to global warming and climate change (Buba, 2004; Nigerian Environmental Study Action Team [NEST], 2004; Odjugo, 2007). The increased level of GHGs mainly, Carbon dioxide (CO_2), nitrous oxide (N_2O) and methane (CH_4) has created a greenhouse effect which subsequently altered precipitation patterns and global temperatures around the world. Impacts have been witnessed in several areas due to change in precipitation and temperature. The areas affected include agriculture, aquaculture, livestock, forestry, water resources, biodiversity, desertification, and human health (Khanal, 2009; Rosegrant *et al*., 2008).

Economic sectors that largely depend on weather conditions – either directly or indirectly – most notably agriculture and fisheries are increasingly subjected to the impacts of climate change (IPCC, 2012). Climate change presents an additional burden on the world's agricultural and natural resources, which are already coping with the growing food demand driven by population growth in developing countries (Wassmann *et al.,* 2013). Climate change has a direct, often adverse influence on the quantity and quality of agricultural production in Nigeria. There is observed decline in crop yield and food crop production due to reduction in rainfall and relative humidity, and increase in temperature in Nigeria. Higher temperatures affect yields of crops, and encourage weed and pest proliferation. Studies by the International Food Policy Research Institute (IFPRI) have shown that increased floods and droughts increases the likelihood of short-term crop failures and long-term production declines in both

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crops and animals (IFPRI, 2009). If left unchecked, climate change is expected to lower global per capita Gross Domestic Product (GDP) by 20% in the year 2200, threatening global food security (Stern, 2006). In all, there are increasing concerns about the rising threats to current income and consumption patterns of households and individuals that earn their livelihoods from these sectors (Foresight, 2011).

The deterioration in agricultural production due to climate change variability has caused many households to look for livelihood choices other than purely crop production and animal production due to uncertainty in earning patterns of these farming operations. Livelihood choices are those employment options that the farm household can engage in order to provide their needs. Household engage in farm and nonfarm (non agricultural) livelihood activities such as crop production, animal rearing, petty trading in order to generate additional income for survival and cope with this difficult and harsh environment (Kalinda and Langyintuo, 2014). Combating climate change can come by way of mitigation and adaptation measures. According to Ngigi (2009) adaptation involves the action that people take in response to, or in anticipation of, projected or actual changes in climate to reduce adverse impacts or take advantage of the opportunities posed by climate change. According to IPCC in Oladipo (2010) adaptation to climate change is defined as an adjustment in natural or human systems to actual or expected climatic stimuli or their effects, which moderates harm and exploit beneficial opportunities. While mitigation is a response strategy to global climate change, and can be explained as measures that reduce the amount of emissions (abatement) or enhance the absorption capacity of greenhouse gases (sequestration). These adaptation measures proffered involve cost on the part of the farmers. These costs are in addition to the existing cost of production borne by the predominantly small-scale farmers whose livelihoods depend on agriculture.

It is however, necessary to understand how the set of strategies implemented in the field by the farm households (e.g., Irrigation, less fertilizer, soil conservation measures, etc) in response to long term changes in environmental conditions affects farm income from food crop farmers. This is particularly important because most of the discussion on climate change in agriculture has been focusing on the impact of climate change rather than on the role adaptation plays. These changes in the environment and the adaption strategies employed, affect the composition of rural livelihoods through their impact on agricultural production, earning pattern of farms, farmer's income and the implications of both on farmer's earning pattern. Consequently, the study aims at establishing the choices of climate change adaptation strategies among food crop farmers in Delta State, Nigeria.

Objective of the study

The broad objective of this study is to examine the choice of climate change adaptation strategies used by food crop farmers in Delta State Nigeria. The specific objectives are to:

- describe the socio-economic characteristics of the food crop farmers in the study area;
- identify climate change adaptation strategies adopted by food crop farmers in the study area;
- determine the factors that influence the choice of climate change adaptation strategies used by food crop farmers in the study area;

Hypothesis of the study

Based on the research objectives above, this study was guided by the null hypotheses below: There is no significant relationship between selected socio-economic and institutional variables and the choice of climate change adaptation strategies adopted by food crop farmers.

Area of Study

The study was conducted in Delta State of Nigeria. Delta State is located in the South South of Nigeria and one of the 36 States constituting the Nigeria Federation. The State was created in August 27, 1991 out of the formal Bendel State. The State comprises Twenty-five (25) Local Government Areas (LGAs). Delta State is located between longitude $5^0\,00^1$ and $6^0\,45^1$ East and latitude $5^0\,00^1$ and $6^0\,30^1$ North. It is bounded on the North by Edo State, on the Northwest by Ondo State, Anambra State on the East and Bayelsa State on the South East. On the Southern flank is the Bight of Benin, which covers approximately 160 kilometers of the State's coastline The 2006 population census puts the population of Delta State at 4,098,391 made up of 2,074,306 males and 2,024,085 females, with a land area of 17,011sq kilometres (NPC, 2006).

The State has a tropical climate marked by two distinct seasons: the dry and rainy seasons. The dry season occurs between November and April, while the raining season begins in April and last till October. There exists a brief dry spell in August commonly referred to as 'August break'. The average annual rainfall is about 2667mm in the coastal areas and 1905mm in the Northern areas. Rainfall is heaviest in July. Delta State has a high temperature

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ranging between 29^0 C and 44 ^{0} C with an average of 30^0 C (Delta State main fact, 2018).

Sampling Procedure; Data Collection and Analysis

To make for a good coverage of respondents in this study, the multi-stage random sampling technique was used to sample a total of three hundred and twenty five (325) farmers. Primary and Secondary data were used in this study. Structured questionnaires were used to elicit information from the respondents. The data collection instrument focused on socio-economic characteristics; institutional characteristics, climate change adaptation strategies used by the food crop farmers, and problems faced by the farmers. Secondary data were sourced from both published and unpublished relevant materials; climate variables were obtained from the Nigeria Meteorological Agency (NIMET) database. The specific objectives were achieved using both descriptive and inferential statistics, such as tables, frequencies, percentages, means, and the multinomial logit regression analysis.

Results and Discussion

Socio-economic and Agricultural Characteristic of Respondents

The socioeconomic and agricultural characteristics of the respondents are reported in Table 1. The result in Table shows that majority of the respondents (34.3%) are between the ages of 41 – 50 years while only 6.7% of the respondents are above 60 years. This implies that most farmers are still in their productive age. These results imply that food crop farmers in the area were above the dependent age i.e. not within the economically active age range, which means that food crop production is tending towards the declining productivity class of greater than 50 years. Majority (62.3%) of the farmers were males while 37.7% were females. This implies that males are more actively involved in farming in the study area. The dominance of the male counterparts may be attributed to the laborious nature of farming in the area whereby most of the farming operations are carried out manually using crude farm implements. In such situation, males may be more able to withstand the stressful and energy dissipating nature of farming. This has implications for gender equality and calls for mainstreaming of women especially in agriculture where they constitute a bulk of the workforce in other clines.

The result also indicates that 56.3% of the respondents were married, 19.0% were single, 10.0% widowed and 14.7% divorced. This implies that majority of the respondents are married and involved in farming in the study area. Household size ranges from 1 -5 (5.3%), 6 – 10 (50.7%), 11–15 (28.3%) and above 15 (15.7%) and 29-35 Higher family size is an indication that there are enough hands to carry out the farming activities. Hence, household size as a proxy to labour availability reduces labour constraint. It should however be noted that large household size may increase the probability of poverty if majority of the members are not involved in income generating activities but are merely dependants.

Table 1: Socio – economic characteristics of respondents

Age	Frequency	Percentage
21- 30	22	7.3
31-40	87	29.0
41-50	103	34.3
51-60	68	22.7
Above 60	20	6.7
Mean	49	
Sex		
Male	187	62.3
Female	113	37.7
Marital Status		
Single	57	19.0
Married	158	52.7
Divorced	44	14.7
Widowed	30	10.0
Separated	11	3.7
Household size		
1-5	16	5.3
5-10	152	50.7
11-15	85	28.3
Above 15	47	15.7
Mean	8	
Educational Level (Years of Schooling)		
No Formal Education	23	7.7
Primary (6 years)	56	18.7
Secondary (12 years)	121	40.3
OND/NCE (14/15 years)	63	21.0
HND/BSc (16 years)	37	12.3
Occupation (Primary		
Farming	231	77.0
Civil Servant	22	7.3
Trading/Business	39	13.0
Schooling	8	2.7
Experience (in years)		
1-10	29	9.7
11-20	86	28.7
21-30	145	48.3
Above 30	40	13.3
Mean	24	
Farming System		
Sole Cropping	27	9.0
Mixed Cropping	273	91.0
Farm Size (in hectares)		
Less than 1	54	18.0
1-5	191	63.7
6-10	42	14.0
Above 10	13	4.3
Total Mean	4.2	
Total	**300**	**100.0**

Source: computation from field survey data; 2018.

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Table 1 also reports the educational status of the sampled farmers. The result shows that 7.7% of the farmers had no formal education, 18.7% had primary education, 40.3% had secondary education, 21.0% had OND and NCE education while 12.3% had university education. This shows that the farmers have some level of education and would therefore be able to comprehend the complexities of farming and climate change better. This implies that majority of them only attempted secondary schools or its equivalents.

Based on the main occupation of the farmers, majority of the farmers were into full time farming 77%, civil servants were 7.3%, schooling 2.7% and trading and business is 13%. Majority of the farmers have been farming for the past 21 to 30 years with a mean farming experience of about 19 years. Based on the Types of farming system majority of the respondents 91% practiced mixed cropping and 9% of them practiced mono cropping on some food crop farm plots. Farm size in hectares indicate that majority of the respondent farmers 63.7% possess 1-5 hectares of usable land while 18% of the farmers have less than 1 hectare of land and about 14% of the respondent farmers possess between 6 -10 hectares of land and only 4.3% of the farmers have above 10 hectares of land. The mean average land available to the respondent farmers was 4.2 hectares. the result indicated that majority of the respondent farmers have less farm land to practice some of the climate change adaptation strategies such as shifting cultivation and bush fallowing.

Climate change Adaptation strategies used by food crop farmers.

Table 2. Adaptation strategies used by farmers

Adaptation strategies	Frequency	Percentage
Crop rotation	283	94.3
Intercropping	273	91.3
Irrigation	201	66.9
Use of resistant varieties	186	61.9
Plant cover crops	143	47.7
Mixed cropping	269	89.7
Mulching	197	65.7
Minimum tillage	183	60.9
Planting trees	45	15
Water conservation	127	42.3
Early planting	210	70.1
Crop diversification	193	64.3
Late planting	225	74.9
Application of farm yard manure	173	57.7
Fertilizer application	294	97.9
Soil conservation	182	60.7
Livestock diversification	127	42.3
Off- farm employment	190	63.3
No adaptation	6	2
Total	**300**	**100**

Multiple choice responses recorded.
Source: Computation from field survey data; 2018.

In response to the risks on agricultural productivity from the increasing temperature and unpredicted rainfall, farmers in the study area adopted various adaptation strategies. As revealed in table 4, the major actions that have been taken by farmers in response to the negative effect of climate change were: adoption of crop rotation (94.3%), intercropping (91.3%), and increasing use of irrigation (66.9%), use of resistant varieties (61.9%), planting of cover crops (47.7%), use of mixed cropping (89.7%), mulching (65.7%), minimum tillage (60.9%),planting of trees (15%),water conservation(42.3%), early planting (70.1%), crop diversification (64.3%), late planting (74.9%), application of farm yard manure(57.7%), fertilizer application (97.9%), soil conservation (60.7%), livestock diversification(42.3%) and off farm employment (63.3%). As observed in table 5, majority of the farmers who implemented adaptation measure have a propensity of implementing multiple adaptation strategies in combination and only 2% of the respondents did not used any adaptation methods.

Factors that influence the choice of climate change adaptation strategies used by crop farmers in Delta State

The estimation of the multinomial logit (MNL) model for this study was undertaken by normalizing one category which is referred to as the 'reference state' or the ''base category'' in this analysis, the base category is no adaptation. The result of the multinomial logit model indicates that different socio-economic, farm specific and institutional factors (age, household size, years of education of household head, sex of household head, farm size, average distance, access to credit, years of climate change awareness, household income, marital status and tenure security) affects the farmers choice of the main farm level climate change adaptation strategies of food crop production in Delta State. Results of the parameter estimates from the multinomial logit model are presented in table 3 below.

The likelihood ratio statistics as indicated by X^2 statistics were highly significant ($P< 0.000$), suggesting the model has a strong explanatory power. Also, the pseudo (Negalkerke) R^2 was 89.9 % thus confirming households' choice decision making process was highly attributed to fitted covariates. In terms of consistency with *a priori* expectations on the relationship between the dependent and the independent variables, the model appeared to have performed well.

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Table 3: Multivariate analysis of the influence of socio-economic; farm specific and institutional factors on the choice of climate change adaptation strategies used by farmers.

Variables	Soil Multiple Conservation operations	Crop Off-farm Planting operations	Portfolio Diversification operations	Employment operations	Diversification operations
Age	.169(7.458) .082^{x}	0.745(7.193) .007^{xxx}	-.439(5.992) .042^{xx}	-.729(6.722) .014^{xx}	.1.000 (6.681) .081^{x}
House hold size	.097 (.823) .006^{xxx}	.101(.772) .005^{xxx}	.120(.661) .056^{x}	.144(.742) .046^{xx}	.083 (.009) .009^{xxx}
Educational status	.004 (1.679) .098^{x}	.014(1.439) .092^{x}	235(1.287) .005^{xxx}	.196(1.569) .001^{xxx}	168 (1.529) .012^{xxx}
Sex	.124 (1.953) .049^{xx}	212(1.761) .004^{xxx}	.269(1.612) .067^{xx}	.350(1.832) .049^{xx}	-144 (1.760) .03^{xx}
Farm size	.136 (1.625) .003^{xxx}	-.219(1.404) .076^{x}	.009(1.252) .004^{xxx}	.026(1.442) .085^{x}	.035 (1.433) .004^{xxx}
Average distance	-.030 (1.519) .004^{xx}	-.254(1.438) 0.86	-.156(1.301) .005^{xxx}	-.278(1.505) .053^{xx}	-.180 (1.451) .001^{xxx}
Access to extension	.184 (.897) .037^{xx}	.192(.823) .016^{xx}	213(.737) .073^{x}	.169(.902) .051^{xx}	.198 (.804) .005^{xxx}
Access to credit	2.441(11.813) .036^{xx}	3.744(11.373) .042^{xx}	3.932(8.832) .056^{x}	1.511(11.325) .094^{x}	2.325(10.725) .028^{xx}
Marital status	.000 (.000) 0.91	.000 (.000) 0.876	.000 (.000) 0.883	.000 (.000) 0.919	.000 (.000) 0.919
House hold income	.123 (.931) .095^{x}	.214 (827) .006^{xxx}	303(.707) .068^{x}	.113(.888) .009^{xxx}	.265(790) .038^{xx}
Years of awareness	2.636 (14.857) .059^{xx}	2.956 (13.933) .032^{xx}	1.651 (12.576) .006^{xxx}	2.696 (12.714) .033^{xx}	1.620 (12.171) .094^{x}
Tenure security	.157 (13.107) .090^{x}	.955 (12.497) .039^{xx}	.580 (11.393) .059^{x}	.774 (11.487) .046^{xx}	1.594 (10.887) .084^{x}
Access to weather information	.026 (.737) .071^{x}	.132 (.726) .005^{xxx}	.014 (.588) .001^{xxx}	.063 (.696) .028^{xx}	.048 (.646) .040^{xx}
Constant	5.908 (82.978) .043^{xx}	-6.558 (82.709) .037^{xx}	-2.356 (71.298) .004^{xxx}	-4.863 (82.465) .003^{xxx}	.913 (82.103) .001^{xxx}

Chisquare=680.273; -2 loglikelihood =1204.960; NagelkertkeR-square=.898; Coxand Snell=.896; Mcfadden= .361; No. of Observations= 300.
$^{xxx;\ xx;\ x}$ **means significant at 1, 5 and 10% probability level, respectively; while first figures are the betas; the bracket are the standard errors and the last figures shows the level of significance.**
Source: computation from field survey data; 2018.

Age of the household head: Age is significantly and positively related to the probability of choosing and using soil conservation, multiple planting dates and portfolio diversification and negatively related to the probability of choosing and using crop diversification and off farm operations as adaptation strategies to climate change in Delta State compare to no adaptation methods used. This implies that as the age of the farmers increase, they are likely to adopt soil conservation, multiple planting date and portfolio diversification and as younger farmers are not likely going to use crop diversification and off farm operations. A unit change in the age of the farmer has a direct effect on the farmers ability to adopt climate change adaptation strategies the marginal effects or magnitude of change are captured in the results as shown in appendix. This results agrees with the findings of Temesgen; Yehualashet and Rajan (2015) which found that GM corn adaption increased with age for younger farmers as they gain experience and increase their stock of human capital but declines with age for those farmers closer to retirement and also the work of Hassan and Nhemachena (2008) which found that age is directly related to the probability of choosing and using mono crops-livestock under irrigation. Similar result was discovered by Maddison (2008) that the age of farmers has a positive influence on adoption of rock walls as soil management practice in Fort- Jacques in Haiti and on adoption rbST in Connecticut dairy farms.

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Household size: The results shows that there is a positive and significant relationship between household size and the probability of choosing soil conservation, multiple planting date, crop diversification; off-farm employment and portfolio diversification as adaptation strategies among food crop farmers in Delta state compare to the base category of no adaptation measure used. This implies that the larger food crop families are the higher the likelihood that they may be able to choose these main climate change adaptation strategies than smaller families. Based on the result of the marginal effect, a unit increases in the number of economically active household increases the likelihood of adopting the above adaptation categories except multiple planting dates. The result agrees with findings of Gbetibouo (2009) which indicated that a large household are more willing to choose labour intensive adaptation measures. According to his findings, household size positively and significantly leads to an increase in the likelihood of adapting to climate change. The fact that increasing household size is normally associated with a higher endowment, which would enable a household to accomplish various agricultural task during peak seasons (Deressa *et. al.,* 2010). This results was also confirm by Okon and Enete (2009) , Hassan and Nhemachena (2008) and Nhemachena (2009).

Educational status: Education of the household head has a significant and positive correlation with all the adaptation measures. Education increases the likelihood of the use of soil conservation measures, use of multiple planting date, portfolio diversification, crop diversification and off-farm employment at different significant levels. This implies that an increase in the years of schooling education of the household head will have a marginal increase in the likelihood of the household head adopting all the climate change adaptation strategies enumerated compared with no adaptation. Education is expected to impact positively on farmers decision makings since educated household are expected to be more informed and knowledgeable on the best livelihood choices to make in combating the effect of climate variability. This finding is in line with that of, Birkann and Fernando (2008), who noted that education and skills up grading are powerful adaptive strategies for individual families and communities. In addition, Temesgen, Yehualashet and Rajan (2015) reported a strong association between education status of the household head and the probability of adopting multiple adaptation measures in combination like irrigation with agricultural inputs, agronomic practices with agricultural input and irrigation with collection of agronomic practices at less than 5% probability level.

Sex of household head: Male household head have a high probability of choosing, using and intensifying soil conservation multiple planting dates; off-farm employment and crop diversification than their female counterparts among the sampled food crop farmers in Delta State and possess negative correlation with portfolio diversification when compared with no adaptation measures adopted. An additional unit of a male headed household would lead to an increase in probability of choosing and using the aforementioned adaptation strategies except for portfolio diversification. While female household heads have a higher probability of choosing, using and intensifying portfolio diversification than their male counterparts this implies that that an additional unit of a female headed household would lead to an increase in the likelihood of choosing and using portfolio diversification as adaptation strategy in the study area as compared with the based category. Correspondingly, the following previous studies found that male household heads have a positive relationship in adoption of manure and intensity of its use and fertilizer adoption and intensify of use of farm technology adaptation in Kenya (Senait, 2002), on multiple crops under irrigation and multiple crop- livestock under irrigation as farmers strategies for adapting to climate change (Deressa *et. al.*, 2008).

Farm size: The model results showed that farm size has a positive and statistically significant association with soil conservation, portfolio diversification, crop diversification and off- farm employment adaptation categories but negatively related to multiple planting operations as compared to no adaptation measure used. This implies that famers with more farm land tend to use all the other adaptation measures except multiple planting operations when compared to the based category. Whereas farmers with larger size of farm land has better probability of increasing land under cultivation practicing shifting cultivation and planting of fodder trees as an adaptation measure in reducing the negative effect of climate change. Gbetibouo (2009) showed that farm size positively and significantly leads to an increase in the likelihood of adapting to climate change. In agreement to this finding, the coefficient on farm size is significant and positively correlated with the probability of choosing irrigation as an adaptation measure.

Average distance: Average distance of the farms to the residents of the farm households is negatively related and statistically significant. This implies that a one unit increase in average distance would lead to a decrease in the probability of the food crop farmers of choosing and using soil conservation practices, multiple planting dates, crop diversification, off –

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farm employment and portfolio diversification as climate change adaptation strategies compared to the based category. It means that long distance i.e remoteness of the food crop farmer's residents to their farms discourages the use of climate change adaptation strategies among food crop farmers in the study area thereby promoting no adaptation. This result was in agreement with the study of Maddison (2008) which found out that distance from plot to farmers residence had negative relationship with adoption of climate change adaptation strategies. They further stress that distance encourages the use of more cultural practices such as bush fallowing, shifting cultivation, use of inorganic fertilizer and terracing as land management practices in Uganda. This result is also confirm by findings by Deressa *et al.,* (2008), Yehualashet and Rajan (2014) and Nhemachena (2009).

Extension contact: Extension contact/services significantly and positively correlated with soil conservation, multiple planting dates, off-farm employment; portfolio diversification and crop diversification as compared with the based category. This means that a one unit increase in extension contact services would increases the probability of choosing the above adaptation strategies in the study area. This result supports the innovation theory and also suggests that the food crop farmers in Delta State have made use of these climate adaptation strategies categories probably because of their personal conviction as a result of advice received from extension personnel. Previous studies have found positive influence of extension contact/ services on adoption of agricultural and farm technologies; among them are Maddison (2008) that found positive relationship between agricultural extension and adoption of inorganic fertilizer as land management technology in Uganda, Hassan and Nhemachena (2008) found out that extension contact had positive influence on adoption of multiple crop under irrigation; mono crop- livestock under dry land as adaptation strategies employed by African farmers. Senait (2002) also found positive relationship between fertilizer intensity and extension contact in farm technology adoption in rain fed semi arid lands of Kenya.

Access to credit: As hypothesized access to credit has a positive and significant effect on the probability of a household head to choose soil conservational practices; multiple planting dates; crop diversification; portfolio diversification and off-farm employment as adaptation strategies among food crop farmers in Delta State compared to the based category. This implies that the more access food crop farmers have to useable credit the more likelihood of the farmers adopting adaptation strategies to combat climate change variability. Based on the result of the marginal effect a unit increase in the amount of farm credit available to the food crop farmers increases the probability of adopting the above climate change adaptation strategies compared with no adaptation. The advantage of credit provision in solving the financial constraints of farmers to invest on agricultural technologies was clearly expressed from this result; farmers having better access to credit will have the probability of using different adaptation strategies. Other studies (Deressa *et al.,* 2008; Gbetibouo, 2009; Nhemachena, 2009) reported similar results with regard to the effect of credit access in adaptation decision. Gbetibouo 2009 reported that access to credit increase the likelihood that farmers will take up portfolio diversification and buy feed supplements for their livestock. Having access to credit indeed increases the likelihood of choosing portfolio diversification by 3%.

Household income: the sign from the result for this variable is consistent with *a priori* expectation which is statistically significant at different probability levels on adoption of soil conservation practices; multiple planting dates, crop diversification; portfolio diversification and off-farm employment. As depicted in the model result, household income was found to have positive and strong association with all categories adaptation measures as compared with the based category. The likelihood of adopting soil conservation, multiple planting dates, portfolio diversification, crop diversification and off- farm employment will increase with a unit increase in household's income. This implies that a unit increase in the amount of house hold income will directly result in the likelihood of increasing climate change adaptation strategies by the farmers in the study area and a decrease in household income will increase no adaptation; the implication is that the availability of more funds will mean additional incentive for combating the menace of climate variability. Deressa *et al.,* (2008) also reported a positive relationship between farm income and adoption of soil conservation practices, use of different crop varieties and adjustment in planting dates. Temesgen, Yehualeshet and Rajan (2014) reported that income from non-farm activities increases the financial base of the household which in turn contribute positively for adaptation at farm level.

Years of climate change awareness: Years of climate change awareness has a positive relationship and was statistically significant with the probability of choosing among the different climate change adaptation strategies compared with the based category. This implies that a unit increase in the

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years of climate change awareness has directly increased the likelihood of the food crop farmers in the study area to choose any of the various adaptation strategies thereby reducing no adaptation. The result is in conformity with Senait (2002) who reported that years of climate change awareness has a positive relationship with the probability of choosing and using multiple crop varieties and multiple planting dates among African farmers.

Tenure security; Tenure security has positive relationship and statistically significant with the probability of choosing and using soil conservation, multiple planting dates, off-farm employment; portfolio diversification and crop diversification in the study area compared to the based category. This means that food crop households that own their own plots or lands have higher probability of choosing and using the above adaptation measures as climate change adaptation strategies. Tenants can be assumed less likely than land owners to use new or emerging climate change adaptation strategies as the benefits may not necessarily flow to them, while land ownership influences the farmer's decision. An additional unit of land secured food crops farmer would increase the likelihood of choosing and using the various climate change adaptation strategies. This finding agrees with the study of Maddison (2008) that found that secure land tenure has a positive influence on the probability of adopting terrace as a farm technology in the rain-fed semi-arid lands of Kenya.

Access to weather information; in conformity with *a priori* expectations; access to weather information appears to have positive and significant relationship with the likelihood of using the above climate change adaptation measures there by reducing the based category (no adaptation). A marginal increase in the amount of weather information received by the farmers in the study area will directly increase the response to climate change. Farmers with better access to information of the changing climate have more probability of using several adaptation measures. This study conforms to work by Nhemachena and Hassan 2007 who reported that access to weather information positively and significantly affects the decision to take up climate change adaptation measures.

Conclusion and Recommendations

Global climate change is a threat that is already having initial tangible impacts upon humankind and nature today. Reports have shown that the impacts of climate change on livelihoods and agriculture in countries of the world including Nigeria are inversely proportional to the nation's responsibility for the problems. The observable impacts include: low agricultural productivity, food insecurity, water stress, low income due to changes in earning patterns of various farm assets, poverty, unemployment, resource conflicts, environmentally induced mitigation, hunger and starvation, health problems, violence and the ultimate price- death. All these conditions impact negatively on national development. Based on the findings of this result; it was recommended therefore that:

- Farmers should be granted incentives such as farm inputs; credit facilities and innovative technologies that will place them in an advantage position.
- There is need for government and non-governmental organizations to invest in climate resilient projects and improving on climate monitoring and reporting stations.
- The level of education of farmers should be improved in order to increase their ability to adjust to the effects of climate variability.
- The determinants which influence farmer's likelihood of adopting climate change adaptation strategies should be harnessed and properly utilized.

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Sustainability of Greenhouse Gas Emission Reduction Practices (GHGERPs) Usage: Evidence from Commercial Chicken Farms in Nigeria

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ABSTRACT

Production of chicken in Nigeria moved to a larger scale with the ban of poultry product importation in the 2002. This has triggered the emission of greenhouse gases; resulting to environmental degradation due to climate change. An increased in chicken production and the droppings from commercial farms have a direct relationship with the greenhouse gas emission and this constitutes a major source of both environmental, social and health issues. This necessitates the reduction practices of greenhouse gas emission among commercial chicken farms. Therefore, this study assessed the sustainability of such practices in commercial chicken production with a view to unvailing the sustainability status of farms with respect to the practices. Structured and validated questionnaire with a reliability value of 0.72 was used to collect the cross-sectional data used for the study, through a two-stage sampling procedure to sample 349 commercial chicken farms in north central and south west geopolitical zones in Nigeria. Sustainability index and binary logistic regression were used to analyze the data. Test of significance were carried out at 5% level. The findings showed that the mean sustainability index of 0.47 was not sustainable as most of the farms practices of reducing greenhouse emission were categorized as unsustainable. However, it was observed that access to credit; capital investment and size of farms were the significant determinants of the level of sustainability at 95% level of probability. It was recommended that government should encourage more investment in chicken production and facilitate access to credit in order to improve the status of sustainable greenhouse gas emission reduction practices.

Introduction

The Nigerian livestock industry is the most commercialized subsector of the agricultural sector of the economy (Ogunsina and Taiwo, 2019), thus, it provides employment opportunities to various categories of people (Agricultural Transformation Agenda, ATA, 2012, Emokaro and Erhabor, 2014). According to the United States Department of Agriculture (2003) and Heise, Crisan and Theuvsan (2015), the poultry industry is the most active sector and the mainstay of the livestock sector in Nigeria. Similarly, Bamiro, Ajiboye and Adeyonu (2017) opined that in addition to poultry contributing to Nigeria's Gross Domestic Product (GDP) and providing employment, it is also a major source of cheap protein through the consumption of eggs by old and young. The most popular of the domesticated birds in the poultry family is chicken. Others are turkey, quail, pigeon, peafowl, ostriches, pheasants and other game birds. Chicken farming is basically the rearing of birds either for table meat or egg production. In both cases, the nutritional derivation is unitary, and it is protein. It has been argued by Kim and Self (2013) that the societal desirability and the market acceptability of a product is a function of its usefulness and cultural barrier if any. Interestingly, in case of chicken, the secular mix of the Nigerian society does not bear any indication against the consumption of eggs or meat.

Owing to the general acceptability of chicken products and the enterprise, many people derirve their livelihood from it. Hence, many commercial chicken farms are found across Nigeria. In terms of employment figure, Akpan (2020) stated that over 20 million people are directly or indirectly employed into the poultry sub-sector of the agricultural sector and by this; the sector contributes about 21% to the Nigerian GDP. According to Africa Sustainable Livestock 2050 (2018), chicken production in Nigeria amounts

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up to 454 billion tonnes of meat and 3.8 million tonnes of eggs per year with a standing population of 180 million birds. About 80 million chickens are raised in extensive systems, 60 million in semi-intensive systems and the remaining 40 million in intensive systems. With the huge chicken population and considering the number of commercial chicken farms in Nigeria, practices that reduce Greenhouse gas emission are being utilized in order to reduce the impact of climate change through the emission of this gas that is poisonous to the chicken birds and to humans.

The efforts by the commercial chicken farms engaged in Greenhouse Gas Emission Reduction Practices (GHGERPs) to yield remarkable outcomes in the reduction of greenhouse emission will lead to the reduction in the adverse effect of climate change. This will eventually translate to a cleaner air, environmentally friendly status of the poultry farms which will lead to an improved health, sustainable profit and reduction in the mortality of flocks. The reduction in greenhouse gas emission is one of the Sustainable Development Goals (SDG) 13. Similarly, the Food and Agriculture Organisation (FAO, 2010) crafted the Climate Smart Agriculture (CSA) idea on three pillars; increased sustainable farm productivity, enhanced resilience of agriculture and food security system and the reduction of greenhouse gas emission. The Nigerian government 2016 Agricultural Promotion Policy (APP) road map also known as the Green Alternative was however hinged on the third pillar of the Climate Smart Agriculture (Ifeoma, 2019).

Dunkley and Dunkley (2013) and Im *et al.*, (2020) stated that; there are some practices used worldwide in chicken production to reduce greenhouse gas emission. Some of such GHGERPs include; use of good quality feed, use of enclosed pens, greenhouse gas emission friendly energy use which is term energy use reduction, use of circulatory fans, use of radiant heating system, use of spark ignition brooders, use of fluorescent or LED lights and the use of drum composter. Here in Nigeria, in addition to the aforementioned practices are the use of digestive enzymes in chicken feed, use of larvicides, use of energized water, use of wood shavings and the application of alternative sources of digestible protein. (Dunkley & Dunkley, 2013) and this assertion was supported by the preliminary investigation.

With the size of the chicken industry in Nigeria growing and the attendant challenge of the greenhouse gas emission, one major issue that is emerging is how to sustain the GHGERPs in order to achieve healthier and cleaner lives. Sustainability in this context is meeting the need of the present without compromising the ability of the future generations to meet its own needs. In line with this study, sustainability means commercial chicken farms will operate in a way they will emit greenhouse gases in order not to affect futher generational to peoples' health, environmental degradation like climate change and global warming among others. Sustainable practices are the management of natural resources to prevent their depletion or the destruction of the environment which not only affects the productivity of the birds but also it affects humans. Therefore, the sustainability of the greenhouse gases reduction practices worth investigating so as to ascertain the economic and environmental implications.

Statement of the Problem

The Nigerian government in 2002 placed a total ban on the importation of some poultry products like day old chicks, eggs and frozen chicken. The ban was aimed at boosting internal production and self-sufficiency through domestic production. The ban also led to the review of the general livestock policy. However, Liverpool-Tasie *et al* (2017) reported that there is the existence of chicken importation despite the ban in 2002 by the Nigerian government, which has also opened a huge potential for its domestic production. This spur in domestic chicken production has come with its own environmental issues which are climate change related. However, a direct relationship with increased production is the increase in the emission of greenhouse gases.

The droppings from commercial chicken production constitute a major source of greenhouse gas emission. The large amount of pullet and broiler birds being produced in Nigeria has resulted to the monumental emission of greenhouse gas and it has been reported that the highest carbon dioxide (CO_2) amounting to about 1,665.342kg comes from manure, while the highest methane

(CH_4) amounting to about 126,207.84g comes from the feeds and the highest nitrous oxide (N_2O) amounting to about 20,316.87g comes from the beddings in modern broiler commercial chicken farms (Suffian *et al,* 2018). The emission of these gases has been confirmed to be dangerous. However, it is believed that, greenhouse gases are induced substances in the atmosphere (Franzluebbers *et al.*, 2015; Global Research Alliance on Agricultural Greenhouse Gas, 2015). The atmosphere contains a lot of heat confined in it as a result of enourmous levels of carbon (iv) oxide (CO_2) and other heat-trapping gases that prevent it from releasing heat into space thereby, creating a phenomenon known as the "greenhouse effect" (Aiyeloje, 2021). The short-

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wave energy from the sun is trapped and re-emitted as heat, producing long wave radiation which will increase atmospheric temperature (MacCarthy *et al.*, 2018).

The other primary gases responsible for causing the greenhouse effect are ammonia (NH_3), sulphur hexafluoride (SF_6), perfluorocarbon (PFCs) and hydrofluorocarbons (HFCs). In 2010, the emission of CO_2, NO_2 and CH_4 translated to 66.5 percent, 17.2 percent and 15.4 percent of the global greenhouse gas emission, respectively (MacCarty *et al,* 2018). Dunkley and Dunkley (2013) stated that for every pullet birds and every ton of broiler bird produced, certain amount of greenhouse gas (1kg of nitrous oxide, 11kg of ammonia, 1 kg of methane, some amount of carbon (iv) oxide as well as hydroflorocarbon are being emitted into the atmosphere.

According to With (2013) and Caro *et al.,* (2014), cattle, chicken, buffalo, pigs and small ruminants also emit greenhouse gases but in all of them the N_2 emission effect from poultry is higher than other ruminants. Apart from climate change variables, air and water pollution, biodiversity loss and land degradation, the other known major greenhouse gas emission contributors are; the commercial chicken farms (Dunkley and Dunkley, 2013; Kumar & Chakabarti, 2019; Yona *et al.*, 2020). There is a change in climate with increasing global temperature which now has negative effects on how the fauna and flora survive as a result of the outcome of greenhouse gas emission (Hiraishi *et al.*, 2014). Therefore, poultry farms must adopt practices that would reduce the future impact of the currents practices that are being used to reduce the volume of greenhouse gases released in poultry farms in Nigeria.

This necessitates the reduction practices of greenhouse gas emission among commercial chicken farms. Some of the farms are deliberately of inadvertently engaging in some practices that tend to reduce the effect of these emissions on the environment (Dunkley, 2012). Though, studies on the investigation of the sustainability of these practices are scanty in literature. Hence, this study was conducted to investigate the sustainability of greenhouse gas emission reduction practices showing evidence from commercial chicken farms in Nigeria. Specifically, the study examined farm characteristics, analyzed profitability and isolated factors that determine sustainability of the GHGERPs in the sampled commercial chicken farms in Nigeria with a view to unraveling the sustainability of the use of the practices.

Methodology

Brief Description of the study area

The study was carried out in Nigeria. It is geographically divided into two: Northern and southern regions. For this study, it specifically used North Central and South West zones with two states each from the selected regions; these are: Kwara and Plateau in north central and Oyo and Ogun in the southwestern zone based on the fact that these identified states are the major hubs of chicken production. The choice of Kwara and Plateau out of the six States of the North Central and Ogun and Oyo out of the six States of from the South West was because from the Poultry Association of Nigeria (PAN) register, the States have more numbers of commercial farms where chicken birds (broilers and layers) are raised.

Sampling Procedure and size

Structured and validated questionnaire was used to collect the cross-sectional data used for the study through two-stage sampling techniques described as follows: The first stage involved a purposive selection of the North Central and South West zones which are the major commercial chicken production hubs in Nigeria from the PAN registers. At this stage, Krejie Morgan (1970) sample size table was used to select statistically represented sample at 5% level of probability. At the second stage, a proportionate-to-size random selection of 380 commercial chicken farms from the two zones using the register of PAN as the sampling frame was obtained. At the end of the data collection, about 31 copies of the questionnaire meant for 31 farms were dropped during the cleaning of the data because they were not properly filled by the farm managers from glaring facts and perceived exaggeration of information provided. This gave the response rate of 91.8%. The farms served as the unit of analysis but the farm managers provided information on the farm visited with the use of questionnaire.

Method of data collection

This study used primary data obtained from cross-sectional survey of commercial chicken farms with the aid of a well-structured questionnaire. The questionnaire with a reliability coefficient of r = 0.72 using Spearman Rank Order Correlation was found reliable. Data were collected on socio -economic characteristics of farms, farm size, amount and cost of feed, veterinary drugs, vaccines, labour, other variable cost, prices of crates of eggs and kilogram of meat, return to chicken production per 1,000 birds per cycle based on extent use of GHGERPs as well as the classification and determinants of sustainability of the use of GHGERPs. These were complemented with the

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commercial chicken farms groups' checklist and were administered through the participatory approach using Focus Group Discussion (FGD) sessions and Key Informat Interview (KII) to validate some of the findings from the data collected with the use of questionnaire.

Method of Data Analysis

Sustainability index and binary logistic regression were used to analyze the data. Test of significance were carried out at 5% level.

i. Classification of Sustainability of Use

The classifications of sustainability of use of GHGERPs were achieved with the aid of a sustainability index. This was calculated by assessing the four sustainability statements of the study which were derived from three statements of the economic sustainability; what is your view on the effect of the practice on reduction in the cost of production? To what extent does the usage of practice increase the weight of birds? To what extent does the usage of practice affect mortality of birds? and one statement of the environmental sustainability; what extent does the usage of practices affect smell in the farm? were used. Thereafter, weights were assigned to the statements on a scale of 1---5 with 1=very low, 2=low, 3=moderate, 4= high and 5= very high. The total responses of all the commercial chicken farms managers were collated to give a total weight. The first three statements of the economic sustainability were multiplied by 5, which is the highest weight attained by the farm managers to get 15. The commercial chicken farms manager individual scores were gotten by adding them together which was thereafter divided by 15 to arrive at the individual index for the farm managers. The indexes for the individual managers were summed together to get 0.77. For the environmental, the only sustainability statement was multiplied by 5 which is the highest weight attained by respondents to get 5. Just as with the economic sustainability, the individual scores of the farms were added together and thereafter divided by 5 to get the individual index for the commercial farm managers. The manager's individual index was summed together to get 0.22. The sum of 0.77 and 0.22 gave a figure of 0.94 for both the economic and environmental sustainability. This was further divided by 2 to get the average of 0.47 as the sustainability index for the study. This was used for the classification.

ii. Binary Logistic Regression

Regression methods have become an integral component of any data analysis concerned with describing the relationship between a response variable (outcome or dependent) and one or more explanatory variables (predictor or independent). It is often the case that the outcome variable is discrete taking on two possible values. Binary discrete phenomena usually take the form of a dichotomous indicator or dummy variable with values of 1 and 0. The dependent variable takes the value of 0 and 1 but the predicted values for regression take the form of mean proportions or probabilities conditional on the values of the independent variables.

The binary logistic regression is a type of regression analysis that is used to estimate the relationship between a dichotomous dependent variable and ratio-level independent variables. Many different variables of interest are dichotomous, e.g. whether it is sustained or unsustained. These types of variables are often referred to as discrete or qualitative. Dichotomous or dummy variables are usually coded 1, indicating "sustainable" or 0 "unsustainable". There are a number of alternative approaches to modeling dichotomous outcomes including logistic regression. It is a type of regression analysis that is used to estimate the relationship between a dichotomous dependent variable and dichotomous interval and ratio-level independent variables. It is a type of regression analysis where the dependent variable is a dummy variable coded 0 and 1.

The logistic regression model is given as:

$$\text{Logit}(p)=\ln[p/(1-p)]$$
$$=\beta 0+\beta_1X_1+\beta_2X_2+.....+\beta_5X_5+\beta_6X_6+u \quad \ldots\ldots..(1)$$

Where:

P= probability that the chicken farms sustain the GHGERPs use.

p(Y=1) (1-p) = probability that the farms do not sustain GHGERPs use p(Y=0)

P/(1-p) = the "odds ratio"

ln[p/(1-p)] = the log odds ratio, or "logit"

X_1 = Capital invested (~~₦~~)

X_2 = Farm age (years).

X_3 = Access to credit (dummy, 1 if yes, 0 if no)

X_4 = Total feed quantity used (kilograms)

X_5 = Farm size (number of birds)

X_6 = Labour (number of manday used)

$\beta 0$ = constant

β_1.....β_6 are vectors of the respective parameters which are estimated using maximum likelihood method

u = Error term.

Measurement of Variables used in the Model.

(i) Sustainability of GHGERPs use (β)- This was measured in economic and environmental

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sustainability. An index was calculated for measuring it into sustainable and unsustainable.

(ii) Capital invested (X1)- This was the amount of capital used for the purchase of the GHGERPs by the commercial farms both from the formal and informal sources during the 2019 production year. It is an important input in chicken production. It was measured in Naira (₦).

(iii) Farm age (X2)- This was measured in years by how long the farms have been in chicken production. It also serves as proxy for farm experience of GHGERPs practices. The older the farm, the more the chances of embracing the practices.

(vi) Access to credit (X3)- This is a dummy variable. It was measured by those with access to credit are classified as 1, while those that did not have access to credit are classified as 0.

(v) Feed quantity (X4)- This was the amount of feed used for rearing the pullet birds for eggs production and broiler birds for meat production. It was measured in kilogram. Most of the chicken feed is sold in bags of 25kg. Those for the pullet birds were chick mash used from day old to six weeks, growers mash used from six weeks to 18 weeks and the layers mash from the 18th week to the end of the laying period which in most cases extend to between 85weeks to 100 weeks. The broiler birds were fed with broiler super starter mash from day old to two weeks, broiler starter from the two weeks to three weeks and broiler finisher mash from the three weeks to six weeks.

(vi) Farm size (X5)- This was measured by the number of birds. It was the number of chicken birds reared during the 2019 production year. Those farms with 1-5,000 birds were classified as small size and those greater than 5,000 birds were classified as large size.

(vii)Amount spent on labour (X6)- Labour was measured by the number of days worked by the labour on the farms. It included permanent, hired, contract and family labour. For all paid labour, the cost was calculated for each of the individual activities like brooding, cleaning, stocking, feeding, giving of water, culling, medicating, vaccinating, dressing and packaging done in chicken rearing. This was achieved by multiplying the wage rate of the activities by the paid labour recorded for that activity throughout the production season. The value of family labour was imputed using the going wage rate. The aggregated sum of amount of the labour cost for all the activities was used for individual farms.

Results and Discussion

Farm characteristics

Evidence in Table 1 shows that classification of the commercial chicken farms according to size. The two classified farm sizes are small and large. The operations of the commercial chicken farms are classified into sizes as documented by Akpan (2020). The farms were stratified into two categories of less than 10,000 birds as small commercialized with 20.4% and ≥ 10,000 birds as large commercialized with 79.6% respectively. This shows that most of the farms were large commercialized ones due to their large-scale involvement to the chicken subsector. The larger the farm size, the higher the likelihood of controlling dominance on the chicken value chain in the subsector. Also, the commercial chicken farms according to breed of chicken reared as day old chicks as ISA brown, hyline brown, bovan nera, delkab, arbor acre+, marshal, ross, hubbard and cobb ventress. As presented in Table 1, over 50 percent of the farms reared broiler birds for meat stock Arbor Acre+ and ISA brown breeds for pullet birds stocked in the last one year. While the least breed reared were Dekalb, Hyline brown and Bovan nera. The use of the two identified major breeds may not be unconnected to the fact that they have better characteristics such as; high productivity, disease resistance and high maturity status. Nwogwugwu *et al*. (2018) reported that the prominent birds in many of the fast- growing Nigerian farms are those with high potentials in terms of productivity. This finding confirmed the previous study made by Afolabi (2013) that most broiler farms in Nigeria rear the Arbor acre+ breed.

Furthermore, results in Table 1 show that most of the farm managers were male (71.6%). This shows that male dominated the management position in the sampled farms since the managers direct the affairs of an organization, though with the directives from the Central Executive Officer (CEO) if any. This may not be unconnected with the cultural norms in many parts of Nigera where males are noted to muscle out women in the control of resources and position of authority. Kameri-Mbote (2007) posited that there are gender differences in access and control over resources in many African countries and male usually have more and better access to resources than the female. In poultry farms, access to land especially in commercial capacity may not easily be accessed by the female as their access to land is limited. This is because land has both economic and cultural values to an average African community; hence, allowing women who may transfer the ownership and title of the land to the husband (who may not necessarily be related to the women community) is seen as a reason for limiting women access to farmland. In line with the above assertion, Allendorf (2007) opined that citing a chicken farm requires ownership of land and Doss, *at al* (2015) argued that there were claims that less than 2 percent of the world's land is owned by women or that women make up less than 5 percent of agricultural landholders in North Africa and about 15 percent in

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Sub-Sahara Africa. These studies further argued that, the low rate of land ownership significantly obstruct access to financial loans including credit and savings which are resources that could be invested into a business-like commercial chicken farm. Imogie and Eraikhueme (2008), Obielumani (2010) and Nakpodia and Urlen (2012) submitted that many training opportunities and career ladders have been either closed to women or considerably less opened to them than men. This is an indication that women are disadvantaged when it comes to education and control of resources. This might be responsible for the results obtained where women were in less proportion in ownership of farms as well as in the management.

Most of the farm managers acquired tertiary education as shown from the result of the study. There was a little less than five percent of the farm mangers that attended none or primary school education. The implication of this finding is that farm managers with higher education might have the educational requirements to perform better in GHGERPs than those with less education. Famakinwa, Adisa and Alabi (2019) reported that for a better performance of task, education was a critical factor that influenced role performance of community leaders in rural development in South West, Nigeria. Furthermore, Enete and Amusa (2010), found education as a determinant contribution to a productive farming. Thus, there is every possibility that a better educated farm manager is more likely to apply GHGERPs because it would enhance the knowledge of apractice that would increase productivity as opined by Oduro-Ofori, Aboagye and Acquaye (2014). Majority of the farm managers have agricultural background as discipline of study. They may likely manage GHGERPs in chicken farms better as they might have been taught while in their training years.

As for the age of the chicken farms sampled, the findings reveal 40 as the maximum numbers of years and 5 minimum numbers of years with a mean of 8 years. This shows that chicken farms in the study area had a long history of existence. The findings corroborate the assertion of Eruvbetine (2008), which stated that some parts of South West and North Central, Nigeria had a long history of the existence of chicken farms. This goes to show that some of the farms earlier commenced as subsistence chicken farming until they grew into commercial chicken farms as evident by Eruvbitine (2008). On the years of experience of the farm managers on commercial chicken production, results show that it had a maximum and a minimum of 30 and 3 years, respectively with a mean year of approximately 5 years.

Table 1: Farm characteristics

Number of birds	**F**	**%**	**Mean**
<10,000	17	20.4	
> 10,000	278	79.6	15,591.55
Breeds			
ISA brown	188	53.8	
Hyline brown	2	0.57	
Bovan near	17	4.87	
Delkab	1	0.29	
Arbor acre+	190	54.4	
Marshal	47	13.5	
Ross	36	10.3	
Hubbard	25	7.2	
Cobb ventress	35	10.3	
Age of farm (Year)			*7.45*
Educational Status of managers			
None	3	0.8	
Primary	14	4.1	
Secondary	67	19.2	
Tertiary	265	75.9	
Field of study of managers			
Agric related	213	61.1	
Non-Agric	136	38.9	
Sex of manager			
Male	248	71.6	
Female	101	28.4	

Source: Field Survey, 2019.

Profitability of poultry farms

Results in Table 2a, the returns per production cycle with low GHGERPs use, the chicken farms averagely incurred a total of ₦1,500,818 out of which ₦24,100 went for fixed cost after depreciation of building, feeders/drinkers and fluorescent /LED light and ₦1, 476,717 was spent on variable cost of good quality feed, veterinary drugs, vaccines and labour for the production cycle. The revenue realized from the sales of eggs was ₦257, 371, meat was ₦1, 383,147 and spent layers were ₦203,540 giving total revenue of ₦1, 844,058. The return on capital investment was 1.23 percent. This showed that for every ₦100 the chicken farms invest on GHGERPs, they will realize ₦23 as return on investment.

While the return per production with high GHGERPs use (Table 2b), the chicken farms on the average spent ₦12,249,420 as total expenditure with ₦487,851 incurred as fixed costs, after the depreciation of use of enclosed pens, energy use reduction, use of circulation fans, use of radiant heating systems, use of spark ignition brooders, use of fluorescent or LED light, use of drum composter and the use of drinkers/feeders and ₦11,761,569 spent on variable costs of good quality

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feed, veterinary drugs, vaccines and labour for the production cycle. The revenue got from the sales of eggs was ₦2,124,783, meat was ₦13,057,684 and spent layers was ₦1,100,234 to give a total revenue of ₦16,282,701. The return on investment capital invested was 1.33 percent. This implies that for every ₦100 the chicken farms invest on GHGERPs use, they will realise ₦33 as returns on investment.

From the study, there is a progressive increase of returns per production cycle of 23 percent and 33 percent for low and high GHGERPs use respectively for commercial chicken farms in Nigeria This confirmed the assertion by Lewis (1998), Aiyeloja and Popoola (2008), Laride and Aiyeloja (2009), Emokaro, Ekunwe and Achille (2010) and Aiyeloja and Ogunjinmi (2013) that farming is a profitable venture. This implies that chicken farm managers can continue with its rearing in order to increase their sources of income. This result agrees with the findings of Popoola, Aiyeloja and Ogunjinmi (2009), Erhabor and Emokaro (2010), Larinde and Aiyeloja (2013) and Oladele, Aiyeloja and Aguma (2013) who stated that chicken farming is profitable in Nigeria and that farm managers should be encouraged to go into its production. The results of the Focus Group Discussion (FGD) and the Key Informant Interview (KII) showed that chicken farming is a profitable enterprise but with huge investment based on the report of the participatory appraisal. This agrees with the earlier assertion by Olomu (1996), Erubetine (2008) and Kwari *et al* (2014) that quality feed which contains about 70 percent of cost of agro inputs are becoming expensive with the escalating prices, of its raw materials.

Table 2a: Return on Investment per production cycle for low GHGERPs use.

Item	Useful life	Purchase Price(N)	Annual cost(N)	Depr cost/cycle(N)	Total(N)
Fixed cost					
Building	10	1,184,800	118,480	19,747	
Feeder/drinkers	3	61,313	20,437	3,406	
LED light	0.5	2,843	5,686	948	
Total Fixed Cost					24,101
Variable cost					
Feed				1,195,841	
Drugs				54,344	
Vaccines				8,152	
Labour				218,380	
Total Variable Cost					1,476,717
Total Cost					1,500,818
Revenue					
Eggs				257,371	
Meat				1,383,147	
Spent layers				203,540	
Total Revenue					1,844,058
ROI(TR/TC)					1.23

Source: Field Survey, 2019

Table 2b: Return on Investment per production cycle for high GHGERPs use.

Item	Useful life	Purchase Price	Annual cost	Depr cost/cycle	Total
Fixed cost					
Enclosed pen	10	10,695,529.25	1,069,552	178,258.80	
Energy use reduction	10	733,430.50	77,243	12,873.80	
Circulation fan	10	6,646,397.10	664,639	110,773.30	
Radiant heating system	10	6,550,413.30	655,041	109,173.60	
Spark ignition brooder	10	1,472,868.20	147,286	24,547.50	
LED	0.5	11,530.00	23,060	3,843.40	
Drum composter	10	2,441,650.40	244,165	40,694.30	
Drinkers/feeders	3	140,160	46,720	7,686	
Total Fixed Cost					487,851

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Item	Useful life	Purchase Price	Annual cost	Depr cost/cycle	Total
Variable cost					
Feed				10,333,123	
Drugs				259,304	
Vaccines				64,326	
Labour				1,104,816	
Total Variable Cost					11,761,569
Total Cost					12,249,420
Revenue					
Eggs				2,124,783	
Meat				13,057,684	
Spent layers				1,100,234	
Total Revenue					16,282,701
ROI(TR/TC)					**1.33**

Source: Field Survey, 2019.

Sustainability of the use of GHGERPs

Classification of the sustainability of the GHGERPs was obtained as described under the research methodology and presented in Table 3. With the mean sustainability index of the use at 0.47, a classification was carried out with a range of <0.5 and >0.5 of mean by filtering the data. It was observed that about 61.6% of the farms GHGERPs used were classified as unsustainable while only 38.4% was classified as sustainable. This shows that most of the farms practices are unsustainable and the implication of this is that the greenhouse gas emission would have negative effects on the future generation if the practices are not sustained. See FGD translation on the excerpts from PRA for the study**.**

Table 3. Classification of Sustainability of the use of GHGERPs

Range	Frequency	%	Classification	Categorical
< 0.5	215	61.6	Unsustained	0
> 0.5	134	38.4	Sustained	1
Total	**349**	**100**		

***Sustainability Index=0.47**

Determinants of sustainability of GHGERPs in farms

The determinants of the sustainable use of GHGERPs by the commercial chicken farms are presented in Table 4. From the binary logistic regression estimates, the result shows the model (regression line) fits the data reasonably with the large Log likelihood of -169.49. The model had an adjusted Pseudo R^2 of 0.27 approximately implying that the observed explanatory variables in the model explained about 27 percent of the variation in the model. Furthermore, the regression of the sustainable use of GHGERPs analysed shows that capital invested (Odd ratio = 3.58), size of the farm (Odd ratio = 1.51) and access to credit (Odd ratio = 2.42), were significant at 5% level. This shows that these above significant factors influence sustainability of use of GHGERPs in the sampled farms. The result showed that the sustainability of use of GHGERPs was influenced by the capital invested by the farm. The odd ratio of the capital invested of the farm was 3.58 implies that the likelihood of practicing sustainable GHGRPs would increase by 3 times with high capital investment while access to credit had a likelihood of increasing farms sustainable greenhouse emission reduction practices by 2 times and having a big farm size would likely increase the chance of practicing sustainable greenhouse emission reduction. Based on model performance criteria, the explanatory power of the model is high, with the coefficient of multiple variation, pseudo $R^2 = 0.27$ and thus explains 27 percent of the total variations in the determinants of the sustainability of GHGERPs. The LR chi^2 statistic of joint significance of the explanatory variables was 125.86, with a probability > chi^2 =0.000 indicating that the model parameters were jointly significant at 5 percent level and adequate in fitting the data. The implication of the finding is that the unsustained use of the identified GHGERPs may be attributed to the farms knowledge and cost involved

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in the management of GHGERPs as supported by the results of participatoryappraisal as follows.

...we heard about it (GHG) at the farmers" workshop held in our states. We heard it through newspapers and radio programmes usually live on radio in our zone. Information on how to sustain the reduction practices. The manager ended his comments, by saying, "the program presenters usually warn that farms must find a way to sustain the practices for the good of our lives and the environment.".... ***Excerpts from PRA for the study.***

Table 4. Determinants of Sustainability of the use of GHGERPs

Sustainability level	Odd ratio	Std Error	z-value
Capital Invested	3.58	4.01	3.92*
Feed quantity	2.80	5.88	0.90
Farm age	0.97	0.02	-1.20
Farm size	1.51	2.65	3.15*
Access to credit	2.42	0.47	4.59*
Labour	0.99	0.00	-1.50
Constant	0.11	0.03	-6.60
Number of observations =349			
LR chi^2 (6) =125.86			
Prob > chi^2 =0.000			
Pseudo R^2 = 0.27			
Log likelihood = -169.49			

Conclusion and Recommendations

Based on the findings of this study, it was concluded that most of the commercial chicken farms in the study area practices of reducing greenhouse gas emission are not sustainable. However, with higher investments, access to credit and increase in farm size, their level of sustainability would appreciably increase at a probability level of 95%. Therefore, stakeholders in the poultry subsector of the agricultural sector should ensure that they encourage more investment in the chicken farms and link farms with friendly source of credits (with 1 digit interest rate) with the aim of improving the level of sustainable greenhouse gas emission reduction practices. This will promote cleaner environment and healthy living.

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The Role of Human Capital Development on Sustainable Agricultural Productivity in Nigeria

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A R T I C L E I NFO

ABSTRACT

This paper evaluates the role of human capital development on sustainable agricultural productivity in Nigeria. Precisely, it aims to: (i) highlight the importance of human capital development in the agricultural activities in Nigeria; and (ii) identify the effects of human capital development on agricultural productivity in Nigeria. The paper adopted a desk research approach, using empirical studies to achieve the objective of the study. From the reviewed literature, it was established that human capital development significantly affects agricultural productivity in Nigeria. Therefore, to achieve a sustainable agricultural productivity in Nigeria, the paper recommends amongst others that government should carry out a critical assessment of the Nigerian educational sector aimed at revitalizing the sector since it plays a key role in human capital development of any country

INTRODUCTION:

Agriculture plays an important role in the economy of most sub-Saharan African countries, with one third of total Gross Domestic Product (GDP) being contributed by the sector (Nyamkye, Fiankor & Ntomi, 2016). It remains the most practiced economic activity being that the sector employs over 65% of workforce in most sub-Saharan Africa (SSA) with over 80% of the African population depending on it as a source of livelihood (IFPRI, 2013; WB, 2013; Muguna, 2015, Ndour, 2017). According to the study by IFPRI in 2012, agriculture would remain the dominant potential-source of employment for the rising rural population in SSA (IFPRI, 2013); and the productivity growth in agriculture is critical for food security, economic growth, development and poverty reduction (Nyamkye, Fiankor & Ntomi, 2016). For poor households in Africa, agriculture is a mechanism to provide the means to cover food expenditure and improve nutritional status. In addition, agriculture occupies a foremost place among the Sustainable Development Goals (SDGs) that lead to the economic prosperity of the poorest nations (Ndour, 2017). This notwithstanding, current productivity in the agricultural sector falls below the prospects of Africa; while its contribution to the GDP remains very low at 36% (World Bank, 2014; Ndour, 2017).

In the 1960s, Nigeria was an agricultural economy and among the world's leading producers of cocoa, palm oil, groundnuts, cotton, rubber, and hide & skin (Penda, 2012). At that time, the sector contributed over 60% to the GDP, but today, agriculture contributed only 22.35% of the total GDP in the first quarter of 2021 and this is even seen to be an increase from the last quarter of year 2020 (NBS, 2021). Nigeria's agricultural sector faces many challenges which impact on its productivity, including: poor land tenure system, low level of irrigation farming, climate change, land degradation, low technology, high production cost, poor distribution of inputs, limited financing, high post-harvest losses and poor access to market. Although, the government has embarked on numerous initiative and programmes -- the Agriculture Promotion Policy (APP), Nigeria-Africa Trade and Investment Promotion Programme, Presidential Economic Diversification Initiative, Economic and Export Promotion Incentives, among others -- aimed at increasing agricultural productivity

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for both domestic demand and export (www.fao.org), the result is still below expectation.

Globally, the number of people working in agriculture worldwide reduced by 17% between 2000 and 2020; and in Asia, agricultural employment declined from approximately 800 million people to roughly 590 million, showing that more than one out of every four agricultural workers left the sector for another job outside agriculture in the region. Similarly, Europe witnessed the biggest drop with a 50% drop from 35 million. However, in Africa the number of people working in agriculture continued to grow within the period, with a total number of 161 million in 2000 to 224 million in 2019. In the same vein, Nigeria recorded an increase in the agricultural workforce within the period from 19 million to 20 million in 2019; although with a decrease between 2015 and 2017 (FAO, 2021). Regrettably, increase in the agricultural workforce has not yielded the expected increase in productivity.

Empirical studies found evidence that human capital level is positively related with agricultural productivity (Igliori, 2006); implying that human capital is important to agricultural production, particularly because it increases its productivity and central in economic activities, growth and development (de Castro, de Barros & Menezes-Filho, n.d). Its key role in economic growth and development is based on the central position it occupies in production, distribution and consumption chain. Penda (2012) asserts that "the accumulation of human capital productivity facilitates technological innovations, increases returns to capital and makes growth in agriculture more sustainable" p.90; and investing in the human capital base is regarded as one of the most effective ways to improve agricultural productivity (Nyamkye, Fiankor & Ntomi, 2016). Building on this premise, this paper aims to: i) investigate the role of human capital development on agricultural productivity in Nigeria; and ii) identify the effect of human capital development on agricultural growth.

REVIEW OF RELATED LITERATURE

Conceptual Review

Human Capital Development

Most of the early economic theories refer human capital simply as workforce; one of the factors of production, which is considered to be a fungible resource that can easily be replaced with another (Djomo & Sikod, 2012). Economically, "capital is referred to as a factor of production used for the creation of goods and services, but significantly not consumed in the production process; while the human element takes charge of all the economic activities such as production, consumption and transactions necessary to move the products to consumers" (James, 2021, p. 92). In the article: "The Economic Organization of Agriculture", T.W. Schultz in 1954 was the pioneer in the studies showing that the human capital associated with formal schooling enabled farmers to be more productive. Also, the term was first used in the modern economic literature by Schultz in 1961 (Fleischhauer, 2007; Djomo & sikod, 2012; Evenson, 1988), where he classified expenditures on human capital as investment rather than consumption. Subsequently, its first application as human capital theory in economics was by Becker and Mencer of the Chicago School. According to Becker (1964) cited in Fleischhauer (2007), "human capital is similar to "physical means of production, and investing in human capital means "all activities that influence future real income through the embedding of resources in people"" (Fleischhauer, 2007, p.4).

Human capital is defined as the stock of competencies, knowledge and personality attributes embodied in the ability to perform labour so as to produce economic value. Human capital is vitally important for an organization's success; and it increases through education and experience (Djomo & Sikod, 2012; Crook et al., 2011). It is a means of production, into which additional investment yields additional output. Human capital is substitutable, but not transferable like land, labor, or fixed capital; and in modern growth theory, it is seen as an important growth factor (Djomo & Sikod, 2012). Apart from stock of physical capital, human capital (knowledge and technical know-how) has been identified as one of the components that can contribute positively to productivity growth. It has been identified as aggregate economic view of human beings acting within economies; and it includes traits such as knowledge, talents, skills, abilities, experience, health, intelligence, training, judgment and wisdom (James, 2021). Furthermore, human capital development is classified into six ways: i) health facilities and services: this involves all expenditure that affects the life expectancy, strength and stamina, vigor and vitality of the people; ii) on-the job training which includes old type apprenticeship organized by firms; iii) formally organized education at elementary, secondary and tertiary level; iv) study programmes for adults that are not in agriculture; v) migration of individuals and families to adjust changing job opportunity (factor mobility); and vi) transfer or importation of technical assistance, expertise and consultants (Ogunniyi, 2018).

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Thus, human capital development is associated with investment in man and his development as a creative and productive resource (James, 2021; Jhingan, 2012). Human capital investments include expenditures on education, training, health, information, and labour mobility (Weisbrod, 1966). Accumulation of human capital happens in three different ways, namely: formal schooling (where individual devotes his whole time to learning), on-the-job training (being a post-school training provided by the current employer), and off-the-job training (post-school training provided by "for-profit" proprietary institutions). These investments involve initial costs in order to gain a return on the investments in the future. The return on investment is based on two interrelated channels: increased earnings for the worker and higher productivity for the firm (Fleischhauer, 2007).

Sustainable Agricultural Productivity

Agricultural productivity is the measurement of the quantity of agricultural output produced for a given quantity of input or a set of inputs (Mozumdar, 2012). Generally, productivity is defined as a ratio of a volume measure of output to a volume measure of input use; and at the primary level, it measures the amount produced by a target group given a set of resources and inputs (FAO, 2017; OECD, 2001b). In other words, it measures how efficiently production inputs (i.e. labour and capital) are being used in an economy to produce a given level of output (Krugman, 1994). According to the report of the Food and Agriculture Organizations of the United Nation, agricultural productivity and efficiency is at the centre of many of the debates, policies and measures concerning the agricultural sector. This is because of the emphasis placed on it by the Sustainable Development Goals (SDGs) as a pillar for enhancing economic development of developing countries. Enhancing agricultural productivity is imperative because of its effective contribution to poverty reduction through better food security and increased incomes for farmers, especially in the developing countries where agriculture remains the major economic sector (FAO, 2017).

Productivity can be measured for a single entity (farm, commodity) or a group of farms, at any geographical scale. However, "the quantities of output relative to the quantity of inputs are the conventional measures of productivity. If output increases at the same rate as inputs, then productivity is unchanged. On the other hand, if the output growth rate exceeds the growth rate in the use of inputs, then productivity is positive" (Mozumdar, 2012, p.56). In productivity measurement, the key point is that the measure should reflect the ultimate purpose. For instance, if the objective is to compare productivity between farms, it then means that measures that are micro-based will be required; whereas, evaluating national agricultural policy at the country level will require macro measures. Although the desired purpose may vary, the measurement issues associated with deriving the different indicators are the same (FAO, 2017).

There are two ways of measuring productivity commonly used: (i) the partial factor productivity measure, and (ii) the total factor productivity measure. The first measure states the amount of output per unit of a particular input, such as land or labour; while the second takes into account all the factors of production for its measurement. Although, the most commonly used is the partial factor productivity measure, but sometimes it does not clearly show why production is changing; hence it is better to use the multifactor or total factor productivity, in order to account for the accurate agricultural productivity. However, it is important to state that the different productivity measures are used for different purposes (Mozumdar, 2012; Wiebe, 2003).

Measuring productivity is important for resource reallocation and optimization, geared towards food security, economic growth and sustainable development (O'Donnell, 2010). Sustainability represents a process of using resources in a way that does not lead to depletion or permanent damage, rather remains from generation to generation (Ndibe & Ojiula, 2019). Alluding to that, Mozumdar (2012) asserts that sustainability is an important facet for food security. In his words, "it means that food productions have to carry on upholding with the demand for future generations", p.54. In a situation where agricultural growth is accounted for mostly by land expansion, which is not sustainable in the long run, agricultural productivity can be employed to enhance longer-term sustainability (Osinowo, Tolorunju & Osinowo, 2021). According to Frisvold and Lomax (1991), enhancing and accelerating sustainable agricultural productivity is a central component of a comprehensive strategy to meet the rising demands of food, even as the gap in agricultural productivity between the richest and poorest nations continues to grow, and many poorer nations facing higher food prices and insecure supplies of goods.

Human Capital Development and Agricultural Productivity

Efficient resource use by a farmer can be attributed to socio-economic drivers amongst which are the farmer's knowledge base and the capacity to function (Awoyemi, Odozi, Atekunrin & Ehirim, 2015). Improving efficient resource use requires investment on the farmers (human capital); which is commonly

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measured in two dimensions: schooling and health. Schooling can increase productivity by imparting specific knowledge and/or by enhancing skill in acquiring new knowledge. On the other hand, health status relates with productivity through the channel of capability and functioning (Awoyemi, Odozi, Atekunrin & Ehirim, 2015; Rosenzweig, 2010; Strauss & Thomas, 1998).

The importance of the human factor and characteristics such as having adequate knowledge resources is extremely important in the management process of agriculture. This is due to the development of engineering and technology, information technology, the necessity for innovative management and globalization of the economy (Kijek, 2012; Kołodziejczyk, 2002; Narski, 2001). The link from human capital to productivity gains was well acknowledged by the early classical economists. For instance, Adam Smith noted that the more that people are instructed, the less likely that they are to produce disorder and illiterate nations (Awoyemi, Odozi, Atekunrin & Ehirim, 2015). Similarly, in the economy of the 21st century, education and continuing improvement of skills have become important drivers of the development of countries and respective sectors of the economy (Nowak & Kijek, 2016; Berezka, 2012). And in the case of agriculture, human capital has become important in terms of improving the results of management, particularly, in the aspect of adequate management and organisation of other production factors, i.e. land and capital (Górecki, 2004). Still in agriculture, a relationship can be observed between the quality of human capital (defined by the characteristics of a farm manager) and the implementation of scientific and technological progress. For instance, a better educated farmer is more prone to introduce changes and innovation on the farm, which will enhance productivity (Nowak & Kijek, 2016; Sikorska, 2011).

Besides, the close relationship between the level of education and the inclination towards entrepreneurship, diffusion of innovation, changes in the nature of the farm or the intention to make use of information was also noted by Wawrzyniak (2001) in Nowak and Kijek (2016). Also from the macroeconomic point of view (Penda, 2012; Kijek & Kasztelan, 2013) alluded to the fact that better quality of human resources facilitates development and implementation of technological innovations, increases capital earnings and promotes sustainable development of agriculture. Likewise, Klynhans (2006) noted that improvement in the quality of human capital leads to lower unit costs of production and decreases marginal cost of production, thereby enabling firms to trade higher quality commodities at lower prices. Hence, Nowak and Kijek (2016) suggested that more attention should be paid to both quantity and quality objectives in evaluating human capital in agriculture because of the growing complexity of the environment in which agricultural producers operate.

Theoretical Review

This paper is anchored around the following theories:

Human Capital Theory

Human capital theory suggests that individuals and society derive economic benefits from investments in people. The theory further suggests that education and training are investments that make individuals genuinely more productive. According to the theory, individuals who are more productive are expected to have higher earnings and be more employable. Hence, the investment feature of this theory significantly differentiates human capital expenditures from consumptive expenditures (those providing few benefits beyond immediate satisfaction) (Wuttaphan, 2017; Carneiro & Vignoles, 2010; Sweetland, 1996). Also, this theory shows how education leads to increase in productivity and efficiency of workers by increasing the level of their cognitive skills. According to James (2021), Theodore Schults, Gary Becker and Jacob Mincer introduced the notion that people invest in education so as to increase their stock of human capabilities which can be formed by combining inherent abilities with investment in human beings. Investment in education is seen as a productive investment in human capital -- an investment which proponents of human capital theory considers to be equally or even more equally worthwhile than that in physical capital. Education is a key to creating, adapting and spreading knowledge. It can add to the value of production in the economy and also to the income of the person who has been educated (James, 2021). Although investment in human capital occurs in two ways: i) health and nutrition, and ii) education; education consistently emerges as the prime human capital investment for empirical analysis. This is because education is perceived to contribute to health and nutritional improvements; a second and more empirically important reason is that education may be measured in quantitative monetary costs and years of tenure (Sweetland, 1996).

Modernization theory

This theory puts development as a uniform evolutionary route that all societies follow, from agricultural, rural, and tradition societies to postindustrial, urban, and modern forms (Ynalvez &

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Shrum, 2015). The theory centers on how education transforms an individual's value, belief and behaviour. It emphasizes internal forces and sources of socioeconomic development, such as formal education. Even though, the theory does not rule out external forces and sources of social change and economic development, it focuses less on foreign influences (James, 2021; Ynalvez & Shrum, 2015).

Exposure to modernization institutions such as schools, factories and mass media inculcate modern values and attitudes, which include: openness to new ideas, independences from traditional authorities, willingness to plan and calculate further exigencies and growing sense of personal and social efficacy. The greater the number of people exposed to modernization institutions, the greater the level of individual modernity attained by the society. The assumption is that educational expansion through its effects on individual values and benefits sets in motion the necessary building blocks for a more productive workforce and a more sustained economic growth (James, 2021, Chikwudiebube, 2015).

Endogenous Growth Theory

The endogenous growth theory was developed by Paul Romer in the 1980s. The theory holds that investment in human capital, innovation, and knowledge makes a substantial contribution to economic growth (Gruzina, Firsova & Strielkowski, 2021). According to (Jones, 2019), endogenous growth theory emphasizes that technological change is the result of efforts by researchers and entrepreneurs who respond to economic incentives. In other words, human capital acts as a growth engine of economic activities (Mastromarco & Simar, 2021). Thus, anything that affects their efforts, such as tax policy, basic research funding, and education, for example, can potentially influence the long-run prospects of the economy (Jones, 2019). Furthermore, the proponents of endogenous growth models opined that growth rate of output is endogenously determined within the economic environment; implying that human capital is the driving force in the growth process of an economy (Anyanwu, Adam, Obi & Yelwa, 2015).

Methodology

The overall objective of the paper is to bring to fore the role of human capital development on sustainable agricultural development in Nigeria. Our assumption is that human capital development is positively related to agricultural growth. To achieve the objective, the author reviewed empirical studies related to the topic.

Empirical Literature on Human Capital Development and Agricultural Productivity

In order to find out the link between human capital development and agricultural productivity the author reviewed the following empirical studies as shown in table 1:

Table 1: Empirical Studies on Human Capital Development and Agricultural Productivity

Study	Methodology and Findings	Authors
Drivers of Agricultural Productivity: Evidence from transforming economies	This study employed panel data covering a thirty five (35) year period of 1980 to 2014. The result showed evidence of increased agricultural productivity with investment in human capital. Hence, capacity building of the farmers at farm level was recommended, as that will improve crop, soil and water management; as well as enhance the demand for and use of better and more efficient production inputs in order to increase agricultural productivity.	Osinowo, Tolorunju and Osinowo (2021)
Effect of human capital on agricultural productivity and farmers' income in Cameroon	The study adopted a Cobb-Douglas production function to evaluate agricultural productivity, establish stochastic frontier model and specify returns to human capital. Using data from household survey, the result shows that an additional year of experience and levels of education increases agricultural productivity.	Djomo and Sikod (2012)
Impact of education on agricultural productivity of small scale female maize farmers in Potiskum, Yobe State, Nigeria	The study used a regression analysis to show that education significantly related to output and concluded that education positively impacted on agricultural productivity.	Okpachu, Okpachu and Obijesi (2014)

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Study	Methodology and Findings	Authors
Effect of Human Capital on Maize Productivity in Ghana: A Quantile Regression Approach	The study investigated the effects of human capital on maize production in Ghana and examine whether it differs across ecological zones and quantiles of the conditional distribution of maize output. Adopting a Cobb-Douglas production function in a quantile regression framework, findings show that human capital does not significantly affect maize productivity in Ghana, but human capital has different effects on farmers in the different quantiles. The study attributed the insignificant effect of human capital on productivity primarily due to the fact that the youth and people with higher education are mostly disengaged from agriculture, leaving it to the elderly and the uneducated.	Nyamekye, Fiankor and Ntoni (2016)
Human Capital Development, National Security and Agricultural Sector Growth in Nigeria	The study examined the impact of human capital development and national security on agricultural sector growth in Nigeria, using a time series data from 1981-2017 which were sourced from the Central Bank of Nigeria statistical bulletin for 2018 and from World Bank indicators. Adopting the Autoregressive Distributed Lag (ARDL) model to estimate the relationship among the variables, the findings from the study indicate that life expectancy is a key factor affecting agricultural sector growth in Nigeria.	James (2021)
The effect of human capital on labour productivity of farms in Poland	The objective of the study was to evaluate the effect of human capital on the production results of commodity farms using the Cobb-Douglas function. The results indicated that the output elasticity of the labour factor was significantly higher in the group of farms managed by farmers with higher-level education in two out of four analysed macro-regions and on a national scale. Further finding showed that human capital approximated by the level of education had a positive effect on the average and marginal productivity of the analysed farms.	Nowak and Kijek (2016)
The human capital effect on productivity and the agricultural frontier expansion: evidence from Brazil	The aim of the study was to investigate human capital effect on the agricultural productivity increase and on the agricultural frontier expansion. The results indicate that human capital has a positive effect on agricultural productivity and on the frontier expansion. In addition, the empirical evidences suggest significant heterogeneities with human capital affecting more the productivity in frontier regions, which is characterized by a shortage of skilled labor. However, it does not affect the agricultural area expansion in consolidated agriculture regions.	de Castro, de Barros and Menezes-Filho (n.d)
Effects of human capital on agricultural productivity in Senegal	The paper examined the impact of human capital on the agricultural productivity of 183 farmers in the Senegal River Valley. Using a stochastic boundary model and a simple Tobit model, and a Cobb Douglass production function, the findings showed	Ndour (2017)

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Study	Methodology and Findings	Authors
	that human capital (represented by education and level of experience) has a positive impact on the agricultural productivity of farmers in the Senegal River Valley. In addition, the human capital variables also had positive effects on technical efficiency.	
Schooling and Human Capital Development in Agro-Based Rural Economy in Southern Benue, Nigeria	The study examined the concepts and consequences of schooling, human capital development and their implications for economic development in the agro-based rural communities of Southern Benue, Nigeria. The result shows that schooling and human capital development improves productivity and production. However, in its case, the result was paradoxical in the sense that, in spite of stimulate growth and development of the rural communities, there still exist under employment, loss of workforce, low capacity for effective production and a general disorientation of attitude from their basic means of life sustenance, which is agriculture. These have created economic and social problems instead of development in the agro-based rural community of Southern Benue.	Amali (2012)
Impact of Agricultural Training on Farmers' Technological Knowledge and Crop Production in Bandarawela Agricultural Zone	The objective of the study was to examine the impact of the training on technological knowledge of farmers imparted by In–service Training in Sri Lanka. About 82 farmer trainees were randomly selected for the study. Using nonparametric tests to check the differences in technological knowledge before and after the trainings (Chi-square and Wilcoxon sign rank tests), the result shows that training programs increased the usage of high yielding varieties. Further, finding reveals a significant difference on individual's gross income, meaning that with the right instructions and guidance of the agriculture instructors, farmers achieved higher yields and thereby higher income.	Rasanjali, Wimalachandra, Sivashankar, and Malkanthi (2021)
Human capital development and economic growth: the Nigerian experience	The study employed the augmented Solow human–capital growth model to investigate the impact of human capital development on national output, using quarterly time-series data from 1999-2012. The result shows that human capital development exerts significant positive impact on output level.	Anaduaka and Eigbiremolen (2014)
An analysis of human capital development and productivity growth-case study in Nigeria	The study sought to address the direction of causality between human capital and productivity growth in Nigeria. The study used data from 1970-2010 and followed the endogenous growth model which argued that technical progress through an effective labour force could lead to long-run growth within an economy. The finding shows that while productivity growth caused human capital, human capital development did cause productivity growth.	Adejumo and Adejumo (2017)

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Study	Methodology and Findings	Authors
Revisiting the Role of Education for Agricultural Productivity	The aim of the study was to resolve the discrepancies in results of some of the earlier studies which showed that education had a strong positive effect on agricultural productivity at micro level, but insignificant or negative effect at macro-level (cross-country). Using a panel of 95 developing and middle-income countries from 1961 to 2002 that includes data on educational attainment, the finding shows that education indeed has a highly significant positive effect on agricultural productivity. Thus, the study affirms that the failure to find a positive impact of education in the international context appears to be a data problem related to the inappropriate use of enrolment and literacy indicators. The findings further revealed high returns to education for developed countries implying that education will have larger impacts on agricultural productivity in the presence of rapid technical change since it helps farmers to adjust more readily to the new opportunities provided by technological innovations.	Reimersa and Klasena (2011)

Challenges facing Human Capital Development in the Agricultural Sector of Nigeria

Okezie (2020) and Azu (2021) enumerated the following as the challenges facing human capital development in the Nigerian agricultural sector:

1. Lack of enlightenment in mechanized farming: Mechanized farming is the use of machinery and equipment to make farm work easier and faster in order to increase farm productivity. Most of the local farmers in Nigeria are not enlightened in the mechanized way of carrying out farming which leads to poor output and in turn negatively affects productivity. According to Onwualu and Pawa (2004) in Okezie (2020), 90% of Nigeria's agricultural work is done with hand tools, 7% with animal-drawn tools and only 3% with engine powered technology. This goes to support the need for aggressive enlightenment campaign on the adoption of mechanized farming as the best option to achieve increased and sustainable agricultural productivity in Nigeria.
2. Poor infrastructural facilities: One thing is to enlighten people on mechanized farming; another is to ensure that adequate infrastructural facilities that will enhance productivity and access to products are provided. This is because creation of awareness and provision of infrastructure are concomitant forces that drive agricultural productivity. Presently, poor infrastructural facilities, especially in the rural areas remain a major challenge facing agriculture in Nigeria. A major case of poor infrastructure in the agricultural sector is poor road network. Poor road infrastructure in rural communities does not only affect production and distribution of food, but negatively affects the development of rural areas and food security. In addition, the poor road conditions in rural communities makes it difficult for farmers to have access to interventions and amenities such as training and education, clean and affordable drinking water, health services and other forms of support.
3. Absence of information communication technology: Information technology is the use of computer or any other electronic device to create, process, store, retrieve and exchange makes the access, storage and retrieve all sorts of electronic information or data. In Nigeria and the agricultural sector in particular, unavailability of information and communication Technology (ICT) is a big challenge to human capital development. Access and application of telecommunication would lead to a healthy communication cycle between all critical stakeholders in the agricultural sector. However, the problem with ICT development in the agricultural sector in Nigeria is linked to poor power supply and lack of computer knowledge.
4. Poor Educational System: The problem of human capital development has been accredited to the deplorable state of education in Nigeria. This sector has suffered impediments ranging

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from policy inconsistency, infrastructural decay, poor funding, unethical behaviour and corrupt practices. Presently, Nigerian educational system is not functional or responsive to entrepreneurship development in agriculture. The sector lacks basic infrastructure, and have left much to be desired in raising qualitative, competitive and innovative human capital. This is notwithstanding the huge amount of money being generated by the government from crude oil. Similarly, the executive capacity is low, as most of the employees have inadequate professional and requisite technical skills. It is expected that Nigeria should provide the best educational institution in Africa. Unfortunately, the reverse has been the case; hence, Nigerians are rather compelled by political uncertainties and poor quality of learning environment, to send their children to overseas countries for higher education. A situation that only the ruling class can afford, leaving the low income class (who coincidentally are those working in the agricultural sector) to their fate.

5. Indiscipline: Indiscipline is another impediment to manpower development caused by value re-orientation. According to Azu (2021), "in the 1960s and seventies, the target of education was to train efficient manpower to man the civil service of the newly independent state. This goal was pursued with vigor and discipline was the watchword of stakeholders of Nigerian universities. Then admission to tertiary institutions was not a matter of number, but a matter of quality of graduates to be trained" p. 152. However, the change in our value from quality education to raising fund for the universities in the late 1990 and beyond necessitated a massive increase in the number of admissions into the tertiary institutions. This outcome was more pressure on the already inadequate infrastructure which could no longer accommodate the large number of students. Incidentally, focus shifted from emphasis on quality which then weakened the disciplinary structure of the universities; thereby creating a porous system raising all kinds of unethical conducts, such as cultism, absenteeism, exam mal-practice, money for grade, sex for grade etc. Again, this has affected the quality of our university graduates and also the human capital development in Nigeria.

How to improve Human Capital Development in the Agricultural Sector of Nigeria

In order to improve human capital development in the agricultural sector, the following were proposed by Okezie (2020) and Azu (2021)

1. Creating an enabling environment: Creating an enabling environment will positively affect the productivity of the farmers and those working in the agricultural sector. Thus, the government should ensure the provision of long and lasting infrastructure especially in the agricultural-based areas. Fixing the appalling road conditions in rural areas will directly impact the productivity of farmers; and also ease the transportation of farm materials as well as quicker access of experts and extension workers to farms. Therefore, government should channel certain amounts of the budget to fixing of roads, provision of water and power in the rural areas. This would help create an enabling environment and prevent the scenario where farmers in the process of trying to transport their products especially perishable goods run into deficit due to the bad roads. Uninterrupted power supply will also help them in making storage facilities to perishable goods. Furthermore, the government should ensure the availability of water or renewable energy. This can be achieved by building reservoirs to support irrigation planting.
2. Proper funding of the education sector: The future workforce is captured by providing access to education for children, youths and adults alike; and basic education increases people's capacity to learn and to interpret information. The farmer level of education will definitely impact their output and agricultural productivity. Beyond that, good quality education and standard of school depends largely on the provision, adequacy, utilization and management of educational facilities. The issue with education in Nigeria revolves around poor funding which stems from low budget allocation. In order to resolve this, government should prioritize education because of its importance on human capital development. This could be achieved by increasing the percentage of the country's annual budget for educational sector. Moreover, the agency responsible for implementation should endeavour to tabulate critical areas that require more attention and ensure that funds are made available to them.
3. Adopt Mechanized Farming System: Since it has been established that mechanized farming increases agricultural productivity relative to manual system, there is need for emphasis to be

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placed on the importance of mechanized farming system. To achieve this, government through relevant agencies, such as the Federal Ministry of Agriculture and partnering with international organization should frequently hold webinars, seminars and symposiums for the farmers. The essence would be to educate the farmers on the benefits of mechanized system of farming, its impact on the economy and how it improves productivity. These webinars and seminars would be strategized in such a way and manner that ensure that the farmers are educated and taught how to apply these machines in farming. In addition, native language of the farmers could be adopted in teaching them to ensure that the illiterate ones amongst them understand as well.

4. Provision of Funding/Credit Facilities: Aside from training, it is important to state the need for government to provide funding and credit facilities for those farmers that do not have funds to enable them procure the necessary equipment for mechanized farming. Through agricultural banks, Central Bank of Nigeria (CBN) and other financial institutions, government should create access to loans or funds or even help the farmers acquire the equipment at subsidized rate.
5. Farmers should be encouraged to have computers or smart phones: The farmers are encouraged to have computers or smart phones that would allow them access to the internet. On the other hand, government in collaboration with telecommunications agencies should ensure that access to internet services gets to rural areas. This will facilitate easily interaction between the farmers and those they do business with.

Conclusion and Recommendation:

In this paper we examined the role of human capital development on sustainable agricultural productivity in Nigeria. We adopted a theoretical review approach and supported it with empirical review of extant literature in the area. Following evidences from all the reviewed literature, the role of human capital development on sustainable agricultural productivity was established. In addition, empirical studies found that human capital development has a significant positive relationship with agricultural productivity. Therefore, in order to achieve a sustainable agricultural productivity in Nigeria, the paper recommends amongst the ones already proposed by Azu (2021) and Okezie (2020) that government should carry out a critical assessment of the Nigerian educational sector aimed at revitalizing the sector since it plays a key role in human capital development of any country.

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Profitability and food safety measures adopted among dried fish traders Rivers State, Nigeria

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A R T I C L E I NFO

Key words:

Profitability,

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traders,

ABSTRACT

The fisheries sector provides both food and employment for millions of people globally. Consumption of fish products is making important contribution to human nutrition and well being. Fish trading, especially dried fish is a common business among people in Rivers State. However, safety of fish products sold in the markets is uncertain among consumers in the area due to varying environmental challenges. Therefore, the study assessed the profitability and food safety measures adopted among dried fish traders in Port Harcourt City Local Government Area (PHALGA), Rivers State, Nigeria. Sixty 60 respondents were randomly selected from the market in the study area. Data collected were analysed using descriptive statistics and budgetary technique. Results indicated that majority of the respondents were females (83.3%) with a mean age of 45 years. The result further showed that net profit from the sales of small, medium and big sized fishes were ₦72,122.25, ₦52,254.50 and ₦91,865 per month respectively. Major safety measures adopted by the traders include; cleaning of display surface, drying using varying temperature, regular washing of utensils, sweeping of the surrounding, use of chemical substances etc. However, poor drying techniques, fluctuation in price, insect infestation among others are major challenges faced by the traders. Dried fish traders should be encouraged to adopt the use of hand gloves, sterilization of materials used in selling the product. Also, safe polythene bag should be used for packaging.

INTRODUCTION

Fish products are important components of human nutrition, sought and enjoyed by people for cultural and gastronomic reasons (Jennings, et al., 2016). The fisheries sector provides both food and employment for millions of people globally. More so, a lot of persons are economically engaged in fish processing and marketing activities. Fish consumption and trade has been accompanied by a significant development, in food quality and safety standards, improved nutritional attributes and loss reduction (FAO. 2020). They stated that stringent hygiene measures have been adopted in the past at the national, regional and international levels to meet the food safety and quality standards and ensure consumer protection. Nevertheless, many fish consumers still worry about the quality and the processes through which food products passed before reaching to the point of consumption. This is because inadequacies in food quality, safety, defence, and fraud surveillance have been identified as food integrity risks resulting to increasing sectorial, government and consumer concerns (Galimberti, et al., 2013).

Fishermen, fish processors and trader often rely on simple low-cost equipment in handling dried fish products, majority reside in remote areas where basic services and facilities are not available. They also lack the necessary knowledge and skills and the ability to invest in new innovative techniques required in modern time fish storage. This means that fish is often handled and processed in unhygienic conditions causing spoilage, contamination with disease causing germs and loss of income as fish are sold for a low price.

Marketing being one of the vital aspects of agriculture ensures that goods and services produced get to the final consumer. Agriculture entails the production of goods and services for man's consumption. Hence, production is considered as being incomplete until the commodity reaches the final consumer (Oladejo, 2016). Considering the nature of fish which is highly perishable product, lack of organized marketing system would result in low profit. Fish marketing is constrained by low prices, low fish supply, sales of immature fish, inadequate fund, high transportation cost, inadequate storage facilities and high levy and other taxes. To be more profitable, fish trade requires every activity that increases sales revenue and as well decreasing the cost of marketing.

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Profitability in fish trading is the measure of the business ability to earn profit. The reports of Adedeji, Osundare and Ajiboye (2019) indicated that fish marketing is profitable with a return on investment of 15 kobo. On same vein, Osarenren and Ojor (2014) indicated that dried fish marketing was a profitable venture. It is also, a common knowledge that safety measures in handling food products are necessary to ensure that contaminated food products are not sold to the consumers.

Safety in the food market is one of the key areas of focus in public health, because it affects people of every age, race, gender, and income level around the world Gizaw, (2019). Safety is defined as setting standards for toxicological and microbiological hazards, and instituting procedures and practices to ensure that the standards are achieved (FAO, 2010). Food safety therefore describes the handling, preparation and storage of food in ways that prevent food borne illness, and it is also the assurance that food will not cause harm to the consumer when it is prepared and eaten. This includes a number of routines that should be followed to avoid potentially severe health hazards.

It is important to note that unsafe food which contains harmful bacteria, viruses, parasites, or chemical substance could cause more than 200 diseases ranging from diarrhea to cancers. An estimated 600 million people in the world fall ill after eating contaminated food and 420,000 die every year, resulting in the loss of 33 million disability adjusted life years (DALYs) (Gizaw, 2019). This scenario is worsen with the problems of environmental pollution in the Rivers State occasioned by illegal oil refining ie burning of local "kpo-fire" crude oil for production of diesel and Kerosene which has resulted to black soot noticeable in the environment which constitutes serious threats to human survival. It is more worrisome as most food products are sold in the open markets with absence of safety practices exposing consumers to risks associated with consumption of contaminated food especially fish products with negative health implications. It is therefore, imperative to investigate food safety measures adopted by dried fish traders in the area. The study was designed to analyse profitability and food safety measures adopted among dried fish traders in Port Harcourt Local Government Area (PHALGA) River State, Nigeria.

METHODS

Study Area

This study was conducted in Port-Harcourt (PHALGA) Local Government Area in Rivers State, Nigeria. Rivers states lies between Latitude 4''30°N and 5''45°N approximately longitude 6''30°E of the Greenwich meridian with a total area of 11,077km^2 with a mean annual rainfall which ranges from 4,700 mm on the coast to about 1,700 mm. The state occupies lowland area of Niger Delta with dense and thick tropical rainforest vegetation. It is characterized by high atmospheric (ambient) temperature that ranges between 25°C to 38°C. The projected population figure in 2016 was 756,600 persons National Population Commission of Nigeria NPC (2016).

Sampling procedure and data collection

Three categories (small, big, medium) of dried fish traders were purposely selected from Creek Road Market in Port Harcourt LGA. Twenty dried fish traders were randomly selected from each category to give a total number of 60 respondents.

Method of Data Collection

A well-structured questionnaire was administered to respondents in the study area which was used for primary data collection. The questionnaire was divided into four (4) sections; section A contained the socio-economic characteristics of dried fish sellers; Section B covered the food safety measures adopted among dried fish sellers; section C captured data on the costs and returns involved in dried fish selling while section D contained the constraints encountered by dried fish sellers in the study area.

Data Analysis

Data was analysed using descriptive analysis and budgetary techniques.

Descriptive analysis was used to examine the socioeconomic characteristics, food safety measures and challenges faced amongst dry fish sellers in the study area. Budgetary technique was used to estimate the profitability among dried fish sellers in the study area.

Model Specification

Budgetary technique was used for the study of cost and return analysis. This was used to determine the profitability of dried fish sales in the study area.

Net profit=TR-TC 1
$\Pi = TR - TVC$..... 2
$TR = P*Q$..... 3
$TC = TFC + TVC$..... 4

Where, Π = Total Profit; TR=Total revenue; TC= total Cost; TFC = Total Fixed Cost; TVC = Total Variable Cost; P= Unit price of output; Q= Total quantity of output; TFC= (Depreciation value of tables); TVC= (cost of storage + cost of transportation + cost of rent + cost of polythene bag + market fees).

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RESULTS AND DISCUSSION

Table 1. Socioeconomic distribution of the respondents

Items	Frequency (n - 60)	Percentage	Mean
Age (Year)			
21 – 30	8	13.3	
31 – 40	21	35	
41 – 50	8	13.3	
51 – 60	14	23.3	
60 Years and above	9	15	45years
Gender			
Male	10	16.7	
Female	50	83.3	
Marital Status			
Single	11	18.3	
Married	43	71.7	
Divorce or separated	6	10.0	
Educational Status			
No Formal education	4	6.7	
Informal education	4	6.7	
Primary	11	18.3	
Secondary	14	23.3	
Tertiary	27	45.0	
Marketing Experience (Years)			
1 – 10	32	53.3	
11 – 20	20	33.3	
21 – 30	6	10	
31 – 40	1	1.67	
40Years and above	1	1.67	12 years

Source: Field survey, 2021

The result as presented in the Table 1. shows that (35%) of the respondents were between the age of 31-40 years and the mean age of the respondents were 45 years which showed that most of the traders are in their economic active years. The result shows that majority (83.3%) of the respondents were female and married. This result agrees with Lawal and Idega (2014) who stated that female role was more in the marketing of dried fish than males**.** The result further indicated that majority (45%) of the respondents had tertiary education. The result agrees with Madugu and Edward (2011) who stated that high literacy level would positively influence the sales of dried fish. The result of marketing experience of the respondents shows that majority (53%) had experience between 1-10 years and the mean marketing experience of 12 years. This finding agrees with Ali, Gaya and Jampada (2008) who reported that marketing experience is important in determining the profit levels of the traders, the more the experience they are, the more they understand the marketing system, condition, price trends etc.

Table 2: Monthly cost and returns in small sized dried fish products (40 pcs = 1kg)

Variables	Items	Average total (₦)
Variable cost	Cost of rent	5000
	Cost of storage	10350
	Cost of transportation	32700
	Cost of market dues	4800
	Cost of polythene bags	3720
	Cost of fish purchased	196290
Total variable cost	TVC	252,860
Total fixed cost	Depreciation value of tables	142.75
Total Cost	TFC + TVC	253,002.75
Revenue	Sales from small sized dried fish	325,125
Gross Margin	TR – TVC	72,265
Net Margin (Profit)	TR – TC	72,122.25

Source: Field survey, 2021

The result in Table 2 showed that the sales from small sized dried fish (Revenue) is Three hundred and twenty-five thousand one hundred and twenty-five naira (₦325,125) but incurred a total variable cost of two hundred and fifty-two thousand eight hundred and sixty naira (₦252,860). This indicated that an average trader earned seventy-two thousand two hundred and sixty-five naira (₦ 72,265) as gross margin monthly suggesting that sales of small sized dried fish is a profitable venture. It can also be deduced that net margin (profit) was seventy-two thousand one hundred- and twenty-two-naira twenty-five kobo (₦72,122.25). This result agrees with Madugu and Edward (2011) found that dried fish marketing was a profitable venture.

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Table 3: Monthly cost and return of medium sized dried fish monthly (26 pcs = 1kg)

Variables	Items	Average total (₦)
Variable cost	Cost of rent	6,440
	Cost of storage	8,600
	Cost of transportation	36,200
	Cost of market dues	4,680
	Cost of polythene bags	3,200
	Cost of fish purchased	228,307.5
Total variable cost	TVC	287,427.5
Total fixed cost	Depreciation value of tables	334
Total Cost	TFC + TVC	287,970.5
Revenue	Sales from small sized dried fish	340,225
Gross Margin	TR – TVC	52,797
Net Margin (Profit)	TR – TC	52,254.5

Source: Field survey, 2021

The result in Table 3 showed that the sales from medium sized dried fish was three hundred and forty thousand, two hundred and twenty-five naira (₦340,225.00) but incurred a total variable cost of two hundred and eighty-seven thousand, four hundred and twenty-seven naira (₦287,427.00). This indicated that an average trader earned fifty-two thousand, seven hundred and ninety-seven naira (₦52,797.00) as gross margin monthly suggesting that sales of medium sized dried fish is a profitable venture. It can also be deduced that net margin (profit) is fifty-two thousand, two hundred and fifty-four naira five kobo (₦52,254.50).

Table 4: Monthly cost and return of big sized dried fish product (4-8 pcs = 1kg)

Variables	Items	Average total (₦)
Variable cost	Cost of rent	5,000
	Cost of storage	10,200
	Cost of transportation	32,700
	Cost of market dues	4,800
	Cost of polythene bags	4,500
	Cost of fish purchased	205,575
Total variable cost	TVC	262,775
Total fixed cost	Depreciation value of tables	110
Total Cost	TFC + TVC	262,885
Revenue	Sales from small sized dried fish	354,750
Gross Margin	TR – TVC	91,975
Net Margin (Profit)	TR – TC	91,865

Source: Field survey, 2021

The result in Table 4 showed that the sales from big sized dried fish was three hundred and fifty-four thousand, seven hundred and fifty naira (₦354,750.00) but incurred a total variable cost of two hundred and sixty-two thousand seven hundred and seventy-five naira (₦262,775.00). This indicated that an average trader earned ninety-one thousand nine hundred and seventy-five naira (₦91, 975.00) as gross margin monthly suggesting that sales of big sized dried fish is a profitable venture. It can also be deduced that net margin (profit) was ninety-one thousand eight hundred and sixty-five naira (₦91, 865.00).

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Table 5: Food safety measures adopted among dried fish sellers in the study area

Items	Frequency (N=60)	Percentage
Cleaning of display surface		
Never	1	1.7
Always	38	633
Sometimes	21	35.0
Drying using varying temperature		
Low heat (stove)	6	10
Medium heat (drum)	29	48
High heat (fire wood)	24	40
Use of gloves		
Yes	4	6.7
No	56	93.3
Regular washing of utensils		
Yes	45	75
No	15	25
Sweeping of the surrounding		
Yes	55	91.7
No	5	83
Method of reducing insect infestation		
Fumigation	7	11.7
Insecticide	27	45
Proper storage	10	16.7
Sun drying	14	23.3
Smoking	2	3.3
Estimated shelf life of dried fish in weeks		
1 week	34	56.7
2 Weeks	16	26.7
3 Weeks	10	16.7

Source: Field survey, 2021:

The result as presented in Table 5 shows the various safety measures adopted among dried fish traders in the study area. The result shows that majority (63.3%) of the respondents cleaned their surface where the fish was displayed daily. Majority (48%) of the respondents use medium heat temperature (drums) to dry the fish thereby reducing the moisture content in other to increase the shelf life of the fish and avoid spoilage. This result agrees with Payra, (2016) who reported that drying methods of preservation to prevent spoilage is essential for preservation and utilization of fish products. It was further found that 93.3% of the respondents do not use gloves in handling the dried fish. Majority (91.7%) of them sweep the shop environment daily and (45%) of the respondents applied insecticide to reduce the infestation of insects. This result agrees with Ayuba and Omeji (2006) who reported that insect infestation and lack of proper storage facilities is the cause of the most prominent losses in quality of stored dried fish which leads to decrease in profit.

Table 6: Identified problems associated with stored dried fish products for in the area

Dangers	N	minimum	Maximum	Mean
Discolouration	60	1.00	4.00	2.6333
Presence of mould	60	1.00	4.00	2.9500
Insect infestation	60	1.00	4.00	3.1333
Presence dirt	60	1.00	4.00	2.9167
Change in taste	60	1.00	4.00	2.8667
Change in smell	60	1.00	4.00	2.9167
Decrease in price	60	1.00	4.00	2.9167

Source: Field survey, 2021 Decision rule: Accept as a danger associated with storing dried fish for long period of time if the mean score is ≥ 2.5

The result in Table 6 shows that insect infestation, the presence of mould and change in smell, were the three major dangers associated with storing dried fish for a long period of time.

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Challenges faced by dried fish traders in the study area

The challenges faced by dried fish sellers in the study area are presented in Table

Table 7: Challenges faced by dried fish traders

Challenges	N	Minimum	Maximum	Mean	Rank
Poor transportation	59	1.00	4.00	2.6949	6th
Inadequate Storage facility	59	1.00	4.00	2.9153	4th
Insect infestation	59	1.00	4.00	3.1695	3rd
Poor drying method	59	1.00	4.00	3.4068	1st
Bad smell	59	1.00	4.00	2.7797	5th
Fluctuation in price	59	1.00	4.00	3.2542	2nd

Source: Field survey, 2021. Decision rule: Mean score is ≥ 2.5 is problem, otherwise reject.

From Table 7, the result shows that poor drying techniques, fluctuation in price, insect infestation among others are challenges encountered by dried fish traders in the area. This is not surprise because the high humidity and other environmental challenges in the area could promote quick spoilage of stored fish products.

Conclusion

This study analysed the profitability of dried fish business and food safety measures adopted among the traders Port Harcourt City Local Government Area, Rivers State, Nigeria. Majority of the respondents involved in the sales of dried fish were females. Dry fish trading is highly profitability. Food safety measures adopted by the traders include; cleaning of the surface before display of the products, drying fish using varying temperatures, storing in bags, baskets, basin, regular washing of utensils, sweeping of the surrounding, use of chemical substances etc. However, poor drying techniques, fluctuation in price, insect infestation among others are major challenges faced by the traders.

Recommendations

Based on the findings from this study, the following suggestions were made:

1. Since the business is profitable, unemployed youths are advised to venture into dried fish marketing as a source to generate income.
2. Dried fish traders should be encouraged to adopt the use of hand gloves, sterilization of materials used in selling the product and also the use of polythene bag for packaging.
3. Fish should be dried properly with appropriate temperature to avoid the presence of mould and insect infestation.
4. Dry fish sellers are advised to adopt precautionary measures such as good sanitation practices and the use of suitable packaging to prevent insect infestation.

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Effect of Agricultural Promotion Policy on Rice Production Output among Smallholder Farmers in Adani Uzo- Uwani Local Government Area, Enugu State.

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A R T I C L E I NFO

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Output,

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ABSTRACT

Several agricultural policies have been enacted and implemented over the decades in Nigeria, but the agricultural sector is yet to maximize its potential and bring about the desired development to the nation. The current policy known as Agricultural Promotion Policy (APP) is expected to unlock the sectors potentials, reduce dependence on crude oil export and ignite the growth of the Nigerian economy. This study assessed the APP effect on rice production output among smallholder farmers in Enugu State, Nigeria.

This study was carried out in Adani Uzo- Uwani Local Government Area. It was designed to assess the effects of the Presidential Initiative on Rice Production and Export on the Output of Rice in the study area. The study focused mainly on output effect of the initiative. This was carried out by comparing the level of rice output before and after the commencement of the initiative in 2015. Two stage random sampling method was used to select 80 respondents from a sample frame of rice farmers. The study revealed that most rice farmers (participant and no-participant) were male (60%) with an average household size of six. The estimated output moved 650 tons in 2016-2017 to 737 in 2018-2019. There was a small increase in the output of rice before and initiative. The study therefore recommends that government and its agencies should make improved planting materials available, always target credit facilities to the rice farmers, provide processing machines like rice destoners, rice threshers, rice millers to improve the quality of the local rice to meet with the standard of foreign rice. Framers should be given opportunities to attend workshop/training designed for this initiative.

Introduction

Agricultural Promotion Policy (APP) also known as the green alternative was developed by Federal Government of Nigeria under Buhari Led Government as the national policy framework for driving the growth and development of agricultural sector in Nigeria (PRACU, 2015). Agriculture is the engine that stimulates economic processes when it comes to national development. Historical facts show that before the oil boom in 1970s, agriculture was the mainstay of Nigeria's economy (Ayodele, Obafemi, and Ebong, 2013). Each region was known for a particular agricultural produce- The Northern region was known as groundnut pyramid; Western region for cocoa, one of the world best commercial viable seeds; the Eastern region was the home of palm nut and cassava, and collectively, the proceeds from these agricultural products made Nigeria the beauty of Africa.

Though Nigeria's economy is blessed with various natural resources, yet the citizens suffer in the midst of plenty. Nigeria has a high poverty rate in comparison with other African countries despite its higher Gross Domestic Product (GDP). Currently, Nigeria has over 80% of its land arable but unfortunately less than 40% of the land is cultivated despite the country's teeming population and level of unemployment (Fatokun, 2015). In a bid to put Nigeria's agricultural sector on a path to growth requires action to solve two major problems: produce enough fresh, high- quality foods for the Nigerian market; and serve the export market successfully and earn foreign exchange. The Federal Agricultural Promotion Policy (APP) is a strategy that focuses on

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solving the core issues at the heart of limited food production and delivery of quality standard produce.
The Presidential initiative is another agricultural promotion policy on rice production of the current administration. It is a PPP-type initiative to improve crop production and yields by making inputs available to farmers at significantly reduced prices, by leveraging private sector support for the Administration's priorities. Rice production in Nigeria is dominated by small holders, cultivating between 0.5 and 1.5 hectares per farmer, using largely manual labour for most operations (Emodi *et al*, 2018). The demand for rice in Nigeria has risen very rapid rate over the years from a capital consumption of about 3.0 kilograms in the 1960s to 22.0 kilograms in 1998/99 and 35 kilograms in 2006 (Idiong, I.C, 2007). The annual average demand was estimated at 5.0 million tons of milled rice in 2017 (FAO, 2018).
Rice is a major commodity and an important cereal in world trade, It is widely cultivated throughout the tropics; and where flood controls are effective as in Enugu State and production is high (Nwaeli *et al,* 2014). Rice production in Nigeria is important because farmers find it more adaptable than a high input staple like maize when there is declining soil fertility because of the huge array of varieties they can switch over to every few years. Since it is becoming a staple crop, farmers seem to be willing to grow it all the time no matter the constraints they are facing.
In a move to achieve self –sufficiency in rice production, processing and export, and reduce Nigeria's massive dependence on imported rice and boost its rice production, the Federal Government in 2015 started a Presidential Initiative on Rice. The project focuses on supporting small-scale rice producers to improve production and their household incomes through the transfer of relevant technologies (Ministry of Budget and National Planning, 2017).
This study therefore, assesses the effect of presidential initiative (APP Policy) on rice output among smallholder farmers in the study area.

Method of the study
Sampling procedure and data
Two stage cluster sampling technique was used to select the community and respondents in the following way. Adani Uzo –Uwani was purposively chosen because the inhabitants were small holder farmers with the majority producing rice. A list of rice farmers who were members of rice growers association, and non-members was prepared with the assistances of the agricultural superintendent, and the association's chairman in the community chosen. From the lists provided 50 rice farmers who were members of the growers association and 50 rice farmers who were not members of rice growers association were randomly selected, thereby giving a sample size of 100 respondents. Primary data was employed for this work. Pre-tested questionnaire was developed to elicit information from the respondents with also oral interview. Data was analysed using descriptive tools, such as frequency tables, percentages, means and Histogram.

Results and discussion
Sources and Level of Awareness Among Farmers of Presidential Rice Initiative

Table 1 showed the level of Awareness among rice farmers of the existence of the Presidential Rice Initiative.

Response	Participants Frequency	%	Non-Participants Frequency	%	All Participants Frequency	%
Yes (aware)	40	100	38	95	78	97.5
No (Not aware)	-	-	2	5	2	2.5

Survey, 2019

Table 1 showed that majority of the farmers were aware of the presidential rice Initiative. Hundred percent (100%) of the participants and 95% of non-participants were aware of the Rice Initiative. On the whole, 97.5% of the rice farmers interviewed said they had heard about the initiative while 2.5% had not.

Farmers Sources of Information on the rice initiative Project
There were various information channels through which the farmers accessed information about this government programme. A careful perusal of table 2 showed that, for the participant group, 50% heard about the initiative through contact with extension agents and 40% through neighbours/relatives. Multiple sources of information were available to them.

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Distribution of farmers' Source of information

Response	Participants Frequency*	%	Non-Participants Frequency*	%	All Participants Frequency*	%
Radio	10	25	5	12.5	15	18.8
Neighbour/Relative	16	40	14	35	30	57.5
Poster/fliers	12	30	-	-	2	25.5
Extension agents	20	50	25	62.5	45	56.3
Church	14	35	11	27.5	25	31.3
T.V.	3	7.5	3	7.5	6	7.5

Multiple responses were observed
Survey, 2019

The more important source of information for non-participant were also extension agents, 62.5% and Neigbour/relative. The church (31.3%) and radio (18.8%) were relatively important sources. On the whole, extension agents and neigbours relative were the most prominent sources through television, radio and posters/fliers during the study were not effective. The main reason was because there was no electricity in the area of study, Adani, during the study

Membership of Rice Growers Association

Participants years of enrolment in the rice growers association

Table 3 presented the number of enrolment of participants over years in the rice growers association.

Distribution of Participants According to year of Enrolment

Years of Enrolment	Frequency	%
2012-2013	7	17.5
2014-2015	8	20
2016-2017	10	25
2018-2019	15	37.5
Total	**40**	**100**

Table 3 showed an increase in the number of enrollments over the years, before 2015 and after 2015 when the initiative was launched. The year 20017-2018 witnessed the highest percentage of enrollment (37.5%).

Participants Reason for Joining the Rice Growers Association

Table 4 indicated a higher number of farmers enrolled in the association to make more money from rice production (50%), followed by the reason that they (farmers) wanted to produce more rice (37.55)

Table 4: Distribution of Participants According to Reasons for Joining the Rice Grower Association

Reasons	Frequency	%
To learn new farming method	6	15
To produce more rice	15	37.5
To be self-sufficient	20	50
To engage in large scale farming	10	25

***Multiple responses were obtained**
Survey, 2019

Non-Participants Reason for not joining the Rice Growers Association

Table 5 showed that government inconsistency in its programme ranked tops (62.5%) as reason for non-participation. This is so because, over the years, government programme have been inconsistent that most times they are not implemented and expected purpose for the policies are not met. Also, 30% said that the methods used were laborious

Table 5: Distribution of Non-participants According to Responses

Response	Frequency*	%
Government inconsistency in its programme	25	62.5
The programme is complex and expensive	4	10
It is purely educated	10	25
I'm too old to attend regular meeting	6	15
Method used/taught is laborious	12	30

***Multiple responses were obtained**
Survey, 2019

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Participation in workshops (Training organized on the Rice Project)
There were many workshops/training organized by government agencies and institutions in order to enhance rice productivity under the Presidential Initiative.

Table 6: Distribution of Farmers' Response (participant group) to training and Workshop on Rice Project

Response	Frequency	%
Yes (have attended)	34	85
No (have not attended	6	15
Total	40	100

Survey, 2019

Table 6: indicated that most of the rice farmers (85%) did not attend workshop/training on the project.

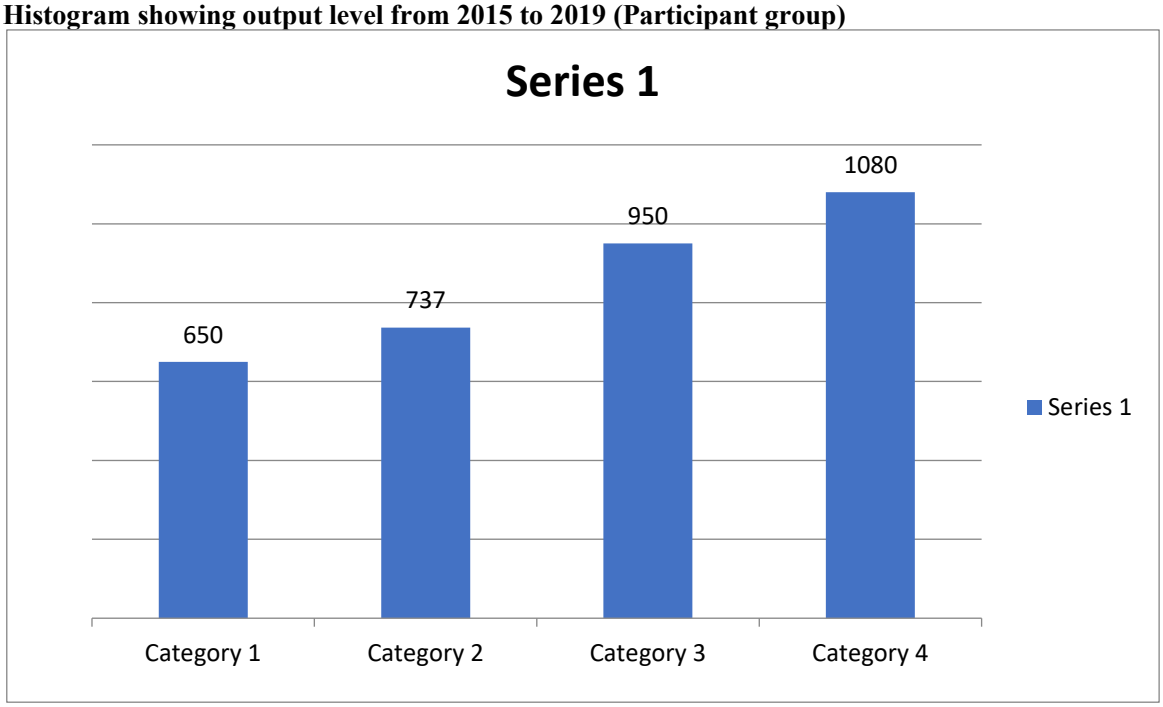
Comparison on Rice Yields before and after the Commencement of the Rice Project
Table 7 below presents the farmers yield before and after the commencement of the rice initiative
Table 7: Estimated Rice Output before and after the Rice Initiative

Years after the Commencement of rice initiative	Estimated Output in tons (X_1)	X_1-X	$(X_1-X)^2$	Years before the rice initiative	Estimated Output in tons (X_2)	X_2-x_2	$(X_2-x_2)^2$
B/W 2016-2017	950	-65	4225	B/F 2015	650	-43.5	1,892.30
B/W 2018-2019	1080	65	4225	B/F 2016	737	43.5	37845
Total (ΣX_1)	2030	0	8450	Total (ΣX_2)	1387	0	37845
Mean	1015			(x_2)Mean	693.5		

Survey, 2019

The table showed that the total output of rice after the commencement of the initiative was higher than output before.

Histogram showing output level from 2015 to 2019 (Participant group)



Survey: 2019.

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Farmers reason for Differences in the Rice Yield before and after the Commencement of the Initiative
Table 8 presented the responses based on the total number of farmers interviewed

Table 8: Respondents reason for Differences in output

Response	Frequency*	%
Increase in land area cultivated	39	48.6
Use of improved varieties	37	46.3
Use of local varieties	11	13.8
Better management skills	30	37.5
Poor management	28	35.0
Use of chemical fertilizer	15	18.8
Low income from previous sale	17	21.3
Disease attack	26	32.5

*Multiple responses obtained
Survey, 2019

In table 8, increase in land area and use of improved varieties ranked highest of all the reasons given. This accounted for 48.6% and 46.3% respectively. Some of the farmers that witnessed decline in output on their farmland individually that disease attacked was the main cause of low output.

Farmers Perception of the initiative and advice to Government
This section sought to ascertain farmers' perception and approval of the initiative and also, farmers' suggestion and advice to government and policy makers with regards to the Rice Initiative.

Table 9: Farmers' Reaction to the Initiative
Table 9 showed that both participant and non-participants believed that the rice Initiative had positive impact on their farming activities.
From the result, it could be seen that the initiative had been of effect in the areas of study.

Sources	Participant Frequency*	%	Non-Participant Frequency*	%	All Respondents Frequency*	%
Initiative has had positive impact	32	80	34	85	66	82.5
Initiative has had no impact at all	8	20	6	15	14	17.5
Total	**40**	**100**	**40**	**100**	**80**	**100**

Survey, 2019

Respondents Reason for approval of the initiative
Table 10 pinpointed the various reasons for the acceptance and implementation of the rice project in the area of study

Table 10: Response on Reasons for the Acceptance of the Rice Project

Response	Frequency*	%
The project will increase rice output	30	37.5
Income and standard of living of farmers will increase	28	35.0
Enough output to meet local and expert needs	20	25.0
Promote consumption of local rice in our country Nigeria	32	40.0
Will help engage youths profitably	11	13.8

***Multiple response were obtained**
Survey, 2019

Table 10 showed that 37.5% of the farmers surveyed felt that the project would increase the output of rice and once the output was increase the output of rice and once the output was increased the income and standard of living of the farmers would rise (35%). This would help to engage the youths profitably (13.8%).

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Farmers' advice to government and policy makers on more achievements of the Presidential Rice Initiative goals

Farmers gave several suggestions on what the government should do to ensure more commitment tom actualize goals of the rice project.

Table 11: Rice Farmers Suggestions on what Government and policy Makers should do to achieve more of the goals of the Rice Project

Response	Frequency*	%
Timely availability of improved seed to farmers	41	51.3
War against Fulani herdsmen attack	78	97.5
Farmers' friendly insurance coverage against natural disasters	55	68.75
Target relevant inputs to real farmers (like tractors, processing machines, destoners)	34	42.5
Easy access of credit facilities to farmers	36	45.0
Provision of fertilizers at subsidized rate	18	22.5
Organizing more workshops/training on the initiative	11	13.8

***Multiple response were obtained**
Survey, 2019

Table 11 clearly showed all the relevant suggestions given by the respondents. Of particular interest among these is the attacks of these farmers by the Fulani herds men which has force so many farmers to quit farming activities which accounted for 97.5% of the respondents recognizing it as a major challenge they have been facing though on the table of the government but need to be properly addressed. About 69% of the respondents also recognized the importance of framers' friendly insurance coverage against natural disaster. Others include timely provision of improved seed varieties to the farmers, easy access to credit facilities to the farmers and mechanized tools to enhance production and processing of rice and to organize more workshops and training of the rice project. These suggestions accounted for 51.3%, 45%, 42.5% and 13.8% respectively.

Conclusion and Recommendation

The Presidential initiative on rice production and export, no doubt is a serious programmed of the past administration geared towards giving rice production (and of course agriculture) its pride of place in the Nigerian economy. In a move to achieve this self sufficiency in rice production, processing and export and reduce massive dependency of Nigeria on imported rice and boost its production, the government collaborated with many agencies and institutions like West African Rice Development Association (WARDA) and National Cereal Research Institute (NCRI) to ensure the success of this project.
To address the negative trend, a lot still needs to be done in order to ensure rapid increase in rice output. The Adani Rice Project needs assistance from the state government by ways of repairing irrigation infrastructures to help the farmers grow irrigated, lowland rice. Also, rapid extension intervention in the areas of training and general educated, coupled with careful supervision of the implementation of the policy objectives of the initiative is encouraged.
The study therefore recommends that government should come up with small-holder producer friendly policies which will make them produce local rice to compete with foreign rice and also institutional support for agricultural development such as credit facilities, co-operative organizations and insurance need to be improved.

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Espousing the Role of Different Kinds of Movies in the Understanding of Climate Change: An empirical review

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A R T I C L E I NFO

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ABSTRACT

Effective climate change communication has remained a challenge due to the complexities of climate change science. However, in recent years, the role of movies in communicating climate change science has been recognised. This study reviewed the use of movies in the understanding of climate change. Different climate change films were theoretically and empirically reviewed as well as literature on the subject matter. The study shows that movies (both documentary and fictions) are powerful revolutionary means of bridging the gap between science and human understanding of climate change. By removing the complexities in climate change communications using vivid, concrete, affect and emotional laden animations dramatized with humour and suspense, climate change movies can trigger pro-environmental attitudes, behaviour modifications, and climate change responsive actions.

Introduction

According to Manzo (2017), the usefulness of climate change movies/films is hinged on their capacity to convey messages, perspectives and values through visual strategies. Climate change movies can also serve as awareness-building tools and change agents in fostering action by the general public as well as influencing individual behaviour (Onyekuru et al., 2020). While the role of movies in climate change communication is increasingly being acknowledged, relatively little is known about how effective they have been in simplifying the complex science of climate change communication in order to move people beyond climate change knowledge/awareness to actual behavioural modification and action.

Therefore, to achieve effective climate change communication, there is a need to use vivid, concrete, affect-laden, emotional laden, dramatic, special effect and anecdotes sceneries, as against pallid ones. also to ameliorate inadequate knowledge and lack of scientific consensus on climate change, scholars agree that the use of films will break these barriers, raise concerns about climate change and bring about behavioural change (Onyekuru et al., 2020; Carmichael et al., 2017). This study, therefore, aims to ascertain the effectiveness of climate change movies in modifying public attitudes and behaviour towards climate change.

Theoretically, this paper is hinged on the reinforcing spirals model. This model offers an understanding of the media – audience relationship (Slater, 2007). It posits that the audience is selective in media content and in turn the media has an effect on the audience. "It acknowledges both the media's potential to influence and the audience's potential autonomy in seeking or avoiding such influence" (Zhao, 2009, p. 699). According to the theory, the media affects both the social and personal attributes of the audience (Bryant and Zillmann, 2002), influence public agenda (McCombs and Shaw, 1972), shapes perceptions of social reality (Gerbner, et al., 2002), encourage the learning of behaviour (Bandura, 1977), and accelerate the spread of innovation (Rogers, 2003).

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Underpinning the theory is the symbiotic and mutually exclusive association between audience characteristics that dictate their choice and the shaping of attitudes and behaviours by the media. Concerning climate change communication, this theory is pivoted on the notion of the media as an information provider about climate change and the understanding of the level of scientific agreement about the facts on the issue.

Methodology

This study adopted the method of a review of empirical literature on the subject matter; the use of films in climate change communication. The researchers started by looking at the theoretical literature on film as a medium of communication, the use of films in climate change communication and other sectors of society. Furthermore, a review of different climate change films was done,

Results and Discussion

A Review of the Different Climate Change Movies

Different climate change movies were reviewed with a focus on their messages and comments from different scholars about them. The movies analysed are *Beast of The Southern Wild (2010), An Inconvenient Truth (2006), The Day After Tomorrow (2004),* and *The Age Of Stupid (2009).*

***Beast of the Southern Wild* (A fiction)**

Directed by Benh Zeitlin, *Beast of the Southern Wild (BTSW)* (2010) is a thrilling apocalyptic film about a happy, vibrant, but obscure poor rural community in a small disaster-prone Island of Mexico – the Bathtub, that is semi-permanently flooded and devoid of any sign of civilization, and lacking in basic infrastructures like roads and electricity. For no fault of theirs, they live like outlaws, like animals among pigs, dogs and chicken in shacks and dirt, without caring for comfort, possessions, status, age, gender, colour or beauty and feeding on raw animals like crabs, but they are content and joyous, with great zeal to preserve, maintain and defend the status quo at any cost. They detest and scorn the industrialized city across the levee for their lack of holidays and for eating canned food.

BTSW has had mixed success. In terms of climate change communication, it tried to convey the message with chains of flood disasters caused by man's inhumanity to man, driven by the quest for comfort by the city dwellers who erected the levee to hold back the water, which torments the Bathubians; a negative externality characteristic of the present-day North-South divide, developed and underdeveloped countries, where the vast proportion of GHG is emitted by the former, but the greatest negative impact will be borne by the poor nations around the world. Yet the developed countries, especially the US are not doing enough to make a change. Rather they are engaged in extreme capitalism and consumerism, a trait the Bathubians criticize.

Theoretically, like most fictional films, the film has been less successful in terms of issue salience and emotional cognition. Thus Marshal (2012) opines that although the film's beautiful imagery makes it attractive, the characters won't last long in one's memory. This is because the emotional force behind the film is not as strong as its visual and audible power. This goes to show that smart cinematography is not enough to connect with a character in a movie. Marshal's stance was also confirmed by Hornaday (2012) who perceived the film as an amateur piece of cultural tourism rather than a well-grounded, human-scaled story. These perceptions are true of the film, as most of its plots are less motivating and stand on the lower rungs of the realism scale.

The BTSW film has been criticized for being alarmist and glamorizing or aestheticizing poverty (Hornaday, 2012; Marshal, 2012). Marshal (2012) noted that celebratory energy in the film is misleading. However, Hornaday (2012) commends the film for possessing all the hallmarks of an art film- lush, imaginative visuals, great fiction with a memorable protagonist. The film is recommended for those that have not watched it to do so for its entertaining spirit. In essence, the reviewers agree that despite the flaws in the film, it has effectively achieved its purpose of communicating global warming to its audience and giving them a sense of entertainment and fulfilment.

The Day After Tomorrow (A fiction)

The Day After Tomorrow TDAT (2004) is a climate change catastrophic fictional film featuring paleoclimatologist - Jack Hall (acted by Dennis Quaid) of the National Oceanic and Atmospheric Administration. The film opens with a splendid first one minute showing a hypnotizing beauty of a vast area of Antarctica with scientists studying the ice core and paleoclimatologist Jack Hall (Dennis Quaid), who was the melodramatic hero of the film. His bravery was introduced when a huge fracture suddenly forms in the ice enclosing the drilled ice cores and he had to jump to save them. What followed was the dramatic breaking off of a magnificent ice shelf which introduces the disaster that followed. This scene perfectly depicts the captivating emotions of the film, leaving the audience sympathising and empathising with the level of vulnerability and breath-taking threat of climate change to the awesome beauty of nature.

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Hall returns to become a climate change ambassador, warning mankind about the impending danger of global warming. He presented his views to the United Nations conference, warning that the world was at the brink of collapse, also warning the US government to take action. The chains of catastrophic events (high temperature, which causes the release of GHG, new ice age occurs, hail in Tokyo, tornadoes devastated Los Angeles, sea-level rise over-ran Manhattan, flooded London) finally led to the evacuation of US citizens to Mexico for safety and in return, the US government cancelled their debts.

Analysis of the film is somewhat tricky, as it lies between science communication of facts and extreme entertainment fantasy. Von Burg (2012) noted that while the film's underlying message has scientific merit, its cinematic depictions of such dangers push the boundaries of scientific credibility. As such some scientists dismissed it for exaggerations, doubting the possibility of a "quick-freeze", storm surge-driven tidal wave of such magnitude (Leiserowitz, 2004). Also Howell (2011) describes it as "… a scientifically inaccurate Hollywood disaster movie" (p. 178).

On the other hand, the movie has been commended for making it clear that carbon emission is the cause of the melting of polar ice sheets (Livesey, 2014). So, in terms of achieving climate change communication von Mossner (2012) commends the film for transforming abstract scientific scenarios into a concrete story about real people and place, while at the same time turning current perceptions of risk—anticipated catastrophes into audio-visual spectacles that have a direct visceral effect on the viewer. Lowe at al. (2006) noted that the film succeeded in changing people's attitudes; by raising viewers' concerns not only about climate change but also about other environmental risks. This attribute of the film therefore conforms to the theory of the reinforcing spiral of the media, whereby the media affects people's behaviour due to heightened issue salience (Zhao, 2009).

Theoretically, it is a film that "aptly combines features of the melodrama and the disaster narrative to engage its viewers cognitively and emotionally" (von Mossner, 2012, p. 97). In the United State, the film was credited with the first film that turned public awareness to the issue of climate change.

Concerning quantity of coverage and media effect theories, Leiserowitz (2004) shows that the film resulted in "more than 10 times the news coverage of the 2001 IPCC report," (p. 34). This infers that films are more effective in climate change communication than the presentation of hard scientific evidence as is exemplified by the IPCC report.

Overall, the movie generated several controversies in the US and around the globe with endorsements and counter endorsements, such that von Burg (2012) worries that "this stretching of scientific fidelity risks destabilizing the metaphoric relationship between the cataclysmic weather depicted in *TDAT* and the actual manifestations of climate change" (p. 14). Due to this heightened controversy, von Burg reports that the controversy gave impetus to global warming sceptics, offering a chance to deride global warming claims as farfetched, reflecting a broader failure in climate science and dismissing climate change science as fundamentally flawed.

Greenpeace International (2004) submit that the weakness of the film is based on its exaggerations, not on the validity of its climate change facts, thus even if the fictional content is dismissed, we can't deny the problems it conveys. Also, the Union of Concerned Scientists (2004) asserts that though fictionalized, the film is based on valid scientific facts. A climatologist at the Hadley Centre for Climate Prediction and Research (Geoff Jenkins), was rather comical in his assertion, that there is no need of being 'too po-faced' with *TDAT* since it is just a movie after all Hollywood will never be able to make any money from a bunch of scientists discussing climate uncertainties' (Von Burg, 2012, p.. quoted in Kirby, 2004). Overall, the rhetorics surrounding *TDAT* demonstrates that a fictional film can help shape public scientific discourses productively.

***An Inconvenient Truth* (A documentary)**

An Inconvenient Truth (2006), as the name depicts, showcases the hard options humanity need to take to address climate change impacts. It presents a character-driven movie of climate change, illustrating how individuals can cooperate with neighbours, relatives, friends and policymakers to make a difference; making a very complex issue seem simple and realistic. Produced by a one-time US vice president Al Gore, it is a thrilling documentary of Al Gore's lectures on climate change, delivered at different fora. The lectures use different charts, graphs and maps of various levels of CO_2 and temperature rise at different times and captivating visuals of climate change extreme events and postulations of impending and terrifying catastrophe, thereby simplifying the issues of climate change science and make it comprehensible. It also depicts the urgency of the matter that we have no much time left to act.

The Inconvenient Truth is very successful, despite some of the criticism of the film for making only a

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little effort at the end of the film to call for action and for being too apocalyptic (Nordhaus and Shellenberger, 2007; Johnson, 2009). Thus, tends to compromise the essence of the message and making the audience feel powerless in their effort to avert the catastrophe (Johnson, 2009).

Nevertheless, concerning climate change communication, the documentary has been highly applauded by Meyer (2006), with regards to the clarity and captivating nature of the presentation, which "… can propel viewers to the conclusion that climate change is a present and fast-paced reality, rather than a far-off and slowly evolving possibility" (p. 95).

In relation to cognitive theory, the movie has been commended by Aufderheide (2006) who opined that the movie offers viewers an emotionally rich, visually entertaining story that addresses climate change politically. According to Aufderheide (2006), it is a flawless media performance, with eyes focused on the audience, presenting the case of climate change as a global problem. This is beautifully depicted with graphs of different temperature and corresponding CO_2 levels over time, vivid images of melting ice, sea-level rise in different major cities of the world, drowning polar bears due to the lack of ice to habit, changing ocean current and the chains of impacts they result to, thus arousing empathy and gut-wrenching emotion. Often Gore went emotive as he appealed to the audience in his assertion that climate change mitigation is not political but "a moral issue.", including his mournful lamentation about his inability to win political support for global warming as a legislature and the failure of his presidential bid; a lost opportunity to reposition America to be 'green'. Johnson (2009) posits that the movie is very persuasive and positions global warming as a personal and emotional issue. In essence, as has earlier been pointed out about the power of documentaries in bringing about issue salience, *An Inconvenient Truth* has delivered on its mandate, by using every form of emotion and facts, with savoury entertainment to awaken the sensibility of the public to support and initiate action against climate change. Building upon the work of Waugh (1984), von Mossner (2013) describes An inconvenient Truth as "committed documentaries that rely on a combination of visual information, scientific knowledge, and emotional appeal to get [its] … message across" (p. 109).

With respect to the quantity of coverage theory (the frequency and prominence given to the issue by the media) and the agenda-setting theory (which states that public opinion about an issue is directly proportional to the level of attention given by the media), Brulle et al. (2012) adjudged the film to be very successful. He noted that "wide release of the movie, and the subsequent Academy Award and Nobel Prize awarded to Vice President Gore, should be expected to confer legitimacy on the seriousness of the issue of climate change to the public and thereby increase aggregate issue salience" (p. 181). Also, the New York Times publication on the film significantly boosted the public's perception of the urgency of climate change, which translated into an increase in the Climate Change Threat Index. In this regard, Antilla (2005) affirm that the construction of social problems, especially climate change is the primary duty of the media.

***The Age of Stupid* (A fictional documentary)**

The *Age of Stupid* (2009) feature actor Pete Postlethwaite as an old man who lives in the year 2055, when climate change has destroyed the world; watching footage of 2008 he wonders why people did not act to save the earth when they had the opportunity to do so. In the beginning, it shows climate change extreme events of a flooded London, Sydney Opera's House on fire and several millions of people in refugee camps. The film combines fictions and some documentaries to present facts about the dangers of global warming. Howell (2011) describes the film as "one of several attempts to harness the advantages of visual communications to raise a concern about climate change through film" (p. 178).

The Age of Stupid is a documentary about ecological risk and environmental injustice in different geographical regions, while at the same time appealing strongly to our emotions by showing us something we are not yet able to see- the possibly catastrophic future consequences of our present behaviour. Through the use of spatial and temporal framing, the film creates a strong cognitive and affective link between the documentation of current social and environmental practices and the imagination of future ecological devastation (von Mosner, 2013).

In terms of climate change representation, the film did a classical work by presenting six documentaries of what von Mossner (2013) called the "happier" time, which is this present consumerist and capitalist generation, "a time in which mindless consumption and wasteful practices seemed to make sense, and in which one seemed to be able to ignore the writing on the wall" (p. 108).

Theoretically, the film is a perfect example of a drama-documentary hybrid (von Mosner, 2013). It represents an interesting fusion of realism and human interest (entertainment), objectivity and subjectivity, the climax of a collision between fiction and

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documentary genres, an admixture of borrowings, or the representation of the poles of different genres in a docu-drama continuum. The result, however, can be very deceptive but also very revealing (Chanan, Undated, p. 5). To achieve emotional cognition, "the film uses images of actually existing geographical spaces in the present with those of an imaginary and dystopian ecological space in a speculative future, to evoke feelings of compassion and a sense of loss and remorse in viewers, to remind them of their carbon emissions and their ethical responsibility for the cultural and ecological spaces that are not yet of the past" (von Mossner, 2013, p, 1068). These emotional feeling that these scenes portray are quite vivid and according to Eitzen's (2005, p. 191) are quite similar to the responses experienced in real life. The film reveals emotional wrenching scenes of devastated beautiful landscapes, bare mountain once covered with ice core and barren lands that were once vegetated and littered with decaying human remains; these are situations in 2055 and the Archivist inviting us to ponder "Why didn't we save ourselves when we could?" – very emotional.

The foregoing suggests that watching climate change movies is an effective tool to convince individuals to action concerning climate change and is vital in informing individuals on the different kinds of positive actions required of them to mitigate and adapt to climate change. Therefore, as has been advocated by different scholars, it has become very pertinent to adopt a multidimensional approach in the fight against climate change by using movies *inter alia* as a potent weapon.

It is, therefore, possible to build climate change information around visuals and individuals watch, understand them and act without actually knowing that they are already being influenced in their habits. Lay people and illiterates understand real-life science better when they are depicted with fictions. On the other hand, despite the conceptual variation in opinion among scholars concerning realism and objectivity, communication scholars still believe that documentary movies are taken more seriously and believable because they seem to represent real-life events (Corner, 2008; Jeffery, 2014). For example, relating to cognitive theory, documentaries arouse more empathy and emotion, thus, " can be particularly powerful precisely because viewers know that it is not acted in the professional sense, that it is not following the script of a fictional story" (von Mossner, 2013, p. 110). Thus "their power to arouse a pleasurable or engaged response is closely tied to an implied entreaty for special attention and concern" (Eitzen. 2005. p. 184). This is because they are real-life events that are put together with little or no alterations. Documentaries are therefore very powerful and convincing as they show what is happening or what has happened, so people do not doubt them. This is why Gore's *Inconvenient Truth, The Age of Stupid* and *The Triumph of Evil* have been adjudged to be very successful in communicating the science of climate change and triggering behaviour modifications. This, according to Mossner (2013), is because, they satisfy the four core attributes of rhetorical forms: (1) openly addresses the viewers, moving them to a new intellectual conviction, to a new emotional attitude, or action. (2) deals with beliefs and arguments, and expression of ideology. (3) appeals to emotions, rather than presenting only factual evidence, and (4) attempts to persuade the viewer to make a choice that will affect his or her everyday life. However, regardless of the genre of movies used, what is important are the messages and the ways they are packaged to make them effective in convincing the audience to act.

Conclusion

This study set out to determine the effectiveness of films in climate change communication. Methodologically, the study critically reviewed the theoretical and empirical literature on climate change communication to draw an inference based on the findings of renowned scholars on the subject. Analysis of the different kinds of climate change movies watched was done, empirical finding on the topic and their influence on the perceptions, attitude and actions of the public towards the environment and climate change, in particular, indicate that watching of climate change movies have been very effective in raising people's awareness about the concept and consequence of global warming, create the consciousness about the need to protect the environment, reduce carbon footprints, understand the need to protect the environment, and a host of changes in the habit by different individuals. The study shows that movies (both documentary and fictions) are powerful revolutionary means of bridging the gap between science and human understanding of climate change, by removing the complexities in its communications, and with animations dramatized with humour and suspense can permeate the deepest parts of the human mind; while entertaining him can break the barrier of his conceptualization of climate change and engender in him the quest for action to protect the environment.

The finding of this study has therefore shown that "if the ultimate goal of communicating to the public about global warming is to bring about a change in behaviour, then simply making people aware of the facts surrounding the issue will not be enough

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(Beattie, 2011). Lessons have shown that it is not enough to give information because there is a lot of other less rational but emotional drivers of human understanding and action or inaction. Therefore, by humanizing the impacts of climate change, with vivid, concrete, emotional images, we can make a difference in appealing to the minds of the audience, triggering pro-environmental attitudes, behaviour modifications, and climate change responsive actions.

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Socio Economic Effects of Fulani and Farmers' Conflict on Maize Farmers' Output in Akinyele Local Government Area of Oyo State

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A R T I C L E I NFO

Key words:

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socio economic

ABSTRACT

This study determined the socio-economic effects of Fulani and farmers conflict on maize farmers' output in Akinyele Local Government Area of Oyo State. Objectives of this study were to; describe the socio-economic characteristics of the respondents, identify the causes of the herdsmen-farmers conflict, determine the output differences before, during and after conflict and identify the farmer's perceived solution to end conflict in the study area. Multi stage sampling technique was used to select 120 respondents for this study. Both descriptive and inferential statistics were used to realize the objectives of the study. The results on socio economic characteristics of the respondents showed that 32.5% of the respondents were between the age of 45-54 years, majority (75.8%) of the respondents were male, most (66.7%) of the respondents were married. 33.3 % of the respondents had secondary education, most (68.3%)of the respondents had farming as their secondary occupation, majority (73.3%) of the respondent had 1-10 years of farming experience, majority (60.0%) of the respondents were not have access to extension services, majority (79.2%) of the respondents earn 10,000-50,000, 51.7% of the respondents were Christians, most (62.5%) of the respondents had 1-5 households, majority (92.5%) of the respondents had 1-5 farm size, most (60.8%) of the respondents were member of cooperative society, 38.3% of the respondents inherited their farmland. The result on causes of the herdsmen-farmers conflict showed that majority (81.7%) experience conflict between farmers and herdsmen, 91.7% of the respondents experienced negative effect of the conflict on maize production, destruction of maize by cattle (36.7%) and killing of farmers (31.7%), as the main causes of the conflict in the study area. The results on output differences before, during and after conflict revealed that farmers produced average of 1,235 (kg/tons), 1,198(kg/tons) and 1,029 (kg/tons) of maize before, during and after the conflict respectively. Also, farmers spent ₦2,677, ₦2,497 and ₦2,389 on maize production (kg/tons) before, during and after the conflict respectively. Moreover, farmers sold maize (kg/tons) for ₦2,500, ₦1,882 and ₦1,777 before, during and after the conflict respectively. Results on perceived solution to end conflict were: government should provide adequate security (40.0%) and making of rules and regulations that will guide grazing (33.3%). Results also revealed that there is significant relationship between the socio-economic characteristics of the farmers and their maize output. From the findings of this study, it is recommended that to prevent further community clashes in farming communities, government and relevant agencies should collaborate with traditional institutions to settle rivalries amicably among parties before it degenerates into serious security challenge. Also, government should provide palliative to the affected farmers in the study area as this will cushion the effect of conflict on them.

1.0 Introduction

The conflict between farmers and herders is one of the social problems that bestow serious security challenge and obstruct with severe threat to entrepreneurship practice and the unity of the Nigerian, particularly Southwestern states. Since the outbreak of farmers and herder's deadly clashes, the relationship that had existed with cordiality and report seems to be suffering with untold setback with several attending apprehensions that beckons for address. Therefore, the unity of the South Western states can only be enjoyed by all when the peaceful coexistence of the sub regions and their means of livelihood, upkeep and sustainability become a success with the presence and existence of reasonable security of lives and property. This is the phenomenological expectation of every sound -minded citizens of the South Western Nigeria (Abbas, 2018).

The South Western Nigeria has experienced and still experiencing conflicts of grave proportions among several ethnic and religiousness communities across the states. These conflicts significantly vary in dimension, process and the groups involved (Adisa,

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2012). Monale, (2003) explained that some conflicts arise between same resource user group such as between one farming community and another, others occur between different user groups such as between farmers and herders or between foresters and farmers. (Popoola, Adewale, Idachaba and Shittu (2019) explained that struggle over grazing land and scarce resources have over the years resulted in perennial and growing violent conflicts in terms of frequency, intensity and geographical scope.

Adisa, (2012) observes that the farmer's herdsmen conflict has remained one of the most preponderant resource-use bloody conflicts in Nigeria. Other studies show that land related issues, especially on grazing fields, account for the highest percentage of conflicts. Putting it straight, studies indicate that struggles over the control of economically viable lands cause more alarm and security hazards as well as violent conflicts among communities. Social and economic factors continue to provoke violent conflicts among the farmers and Fulani pastoralists. The intensity variations of the conflict largely depend on the nature and type of the user groups where the pastoralists graze. These conflicts have constituted serious threats to the means of survival and livelihoods of both the farmers and pastoralists with what both groups are tenaciously protecting. According to Abbas, (2018) the conflicts (though provocative) over access rights to farmland and cattle routes, have become ubiquitous and seems to have no defined solutions. However, Coser, (2000) observed that, the inevitability of conflict in the claim for scarce resources is considered here as the bane for struggles over the inestimable value for land and its resource, with the claim for ownership and the claim for its position as a common resource. However, the complexity of land use system that has changed overtime has culminated in present day tension and conflicts between the host farmer's communities and Fulani herdsmen.

Meanwhile, the usual resultant effects of the conflict are loss of lives, crops, destruction of houses, displacement of persons, decline in income, distrust; as well as threat to food and national security (Popoola *et al*, 2019). It is against this background that the study focused on the aforementioned issues to assess the prevalence of herdsmen-farmers conflict on maize farmers output in Akinyele Local Government area of Oyo State. Specifically,

1. describe the socio-economic characteristics of the respondents in the study area;
2. identify the causes of the herdsmen-farmers conflict in the study area;
3. determine the output differences before, during and after conflict in the study area;
4. identify the farmers perceived solution to end conflict in the study area

1.5 Hypothesis of the study

There is no significant relationship between the socio economic characteristics of the respondents and the maize output

2. Methodology

2.1 Study Area

The study area for the research work was Akinyele Local Government Area of Ibadan Oyo State. Akinyele local government is one of the eleven Local Governments that make up Ibadan suburb. It headquarters are at Moniya. Akinyele local government area was created 1976 and it shares boundaries with Afijio local government to the North, Lagelu local government to the East, Ido local government area to the west and Ibadan North local area to the South. The town is located on latitude 7021'-80N and longitude 4002' - 4028'E. It occupies a land area of 464.892 square km with a population density of 516 persons per square kilometre. Using 3.2% growth rate from 2006 census figures, the 2010 estimated population for the local government is 239,745. Akinyele local government is sub-divided into twelve (12) wards Ikereku, Olanla / Oboda / Labode, Arulogun / Eniosa / Aroro, Olode / Amosun / Onidundu, Ojo-Emo / Moniya, Akinyele / Isabiyi / Irepodun, Iwokoto / Tolonta / Idioro, Ojoo / Ajibode / Laniba, Ijaye / Ojedeji, Ajibade / Alabanta / Elekuru, Olorisa`Oko / Okegbemi / Mele, and Iroko. The local government is governed by an elected chairman and 12 councilors, one elected from each ward. The major crops grown in the state include cassava, maize and yam, the major livestock reared in the state include cattle, sheep, goat, fish production and poultry production.

2.2 Population of the study area

The population of the study consists of maize farmer in Akinyele Local Government Area of Oyo state.

2.3 Sampling techniques and sample size

A multi-stage sampling technique was used for this study. In the first stage Akinyele Local Government was purposively selected due to the predominance of maize farmers in the area. In the second stage, out if 12 wards in Akinyele Local Government Area 6 wards were randomly selected. In the third stage 2 villages each were randomly selected from the 6 wards to give a total number of 10 villages. In the fourth stage 10 maize farmers were selected from each village to give a total number of 120 respondents.

2.4 Data Analysis

Data for this study were analyzed using descriptive statistics such as frequency, mean and percentage while the inferential statistics was used to analyzed the

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hypothesis. Objective 1-4 were analyzed with descriptive statistics while the hypothesis was analyzed with regression

2.5 Model specification

The empirical model for the ordinary least square multiple regression

$C = f(x_1, x_2, x_3, x_4, x_6,)$…….implicit form …….(1)

$C = B_O+B_1 X_I+B_2 X_2+B_3 X_3+B_4 X_4+B_5 X_5+B_6 X_6+B_7 X_7+ \mu$ explicit form …….. (2)

Where

C = maize output (kg)

X_1 = Age of the farmers (in years);

X_2 = Sex (1=male, 2=female)

X_3 =Marital status (married=1, single=2, divorced=3, widowed=4)

X_4 = Educational level (Adult education=1, primary education=2, secondary education=3, Tertiary education=4)

X_5 = Secondary occupation (Farming=1, Trading=2, Civil servant=3)

X_6=Farming experience (Years)

X_7= Access to extension services

X_8=Income (Naira)

μ = Error term

3.0 Results and Discussion

3.1 Socio-economic characteristics of the respondents

Age

Results in Table 1 shows that 32.5% of the respondents were between the age of 45-54 years, 25.8% of the respondents were between 35-44, 20.8% of the respondents were between the age of 55-64 years, 11.7% of the respondents were above 65 years, while 9.2% of the respondents were between 25-34 years of age. The mean age was 50. This implies that majority of the respondents were adult. This finding is conforms with similar findings of Adejare and Arimi (2013) who reported that the majority of agricultural labour force in Nigeria falls between 35 to 55 years.

Sex

Result in Table 1 also shows that majority 75.8% of the respondents were male, while 24.2% of the respondents were female. This implies that majority of the respondents in the study area were male. This may be due to the fact that maize farming involves tedious activities. This agrees with the finding of Olaleye *et al.,* (2010) which revealed that males are more involved in both farming and pastoral activities.

Marital Status

Furthermore the results also showed that most (66.7%) of the respondents were married. 14.2 % of the respondents were single while 12.5 % of the respondents were widowed, while 6.7 % of the respondents were divorced. This implies that most of the respondents in the study area were married. The result is in consonance with the findings of Shittu, (2020) who found that in his study that majority of farmers in Nigeria were married. This is a reflection of the high value placed on marriage in the study area.

Educational Status

Also, Table 1 shows that 33.3 % of the respondents had secondary education, 22.5% of the respondents had tertiary education, 17.5% of the respondents had adult education 14.2% of the respondents had primary education, while 12.5% of the respondent had no formal education. This implies that the respondents in the study area were literate. This finding disagrees with that of Olaleye, Odutola, Ojo, Umar and Ndanitsa. (2010) who reported that the majority of farmers do not have formal education in their study.

Secondary occupation

Table 1shows that most (68.3%)of the respondents had farming as their secondary occupation 19.2% of the respondents had trading as their secondary occupation, 12.5% of the respondents had civil servant as their secondary occupation. This implies that the farmers still plant another crop apart from maize which shows that they earned from other crops planted

Farming experience

Results in Table 1 shows that majority (73.3%) of the respondent had 1-10 years of farming experience, 21.7% of the respondents had 11-20% years of farming experience, while 5.0% of the respondents had above 21 years of farming experience. The mean of farming experience is 10. This implies that majority of the respondents had enough years of farming experience on maize production which will help in adapting to any conflict that may affect their farming activities. This is in line with the work of Aliyu, (2015). who also found more experience farmers in their study which may be translated to higher level of productivity due to the experience gained over time

Access to extension services

Table 1 shows that majority (60.0%) of the respondents were not have access to extension services, while only 40.0% of the respondents have access to extension services. This implies that the respondents in the study area have no access to extension service, this may be due to the fact that the respondents in the study area were semi-literate.

Income

Table 1 shows that majority (79.2%) of the respondents earn 10,000-50,000, while 20.8% of the respondents earn 50,001-100,000. This implies that

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majority of the respondents in the study area were low income earners

Religion
Result in Table 1 revealed that 51.7% of the respondents were Christians, 40.8% of the respondents were Muslims while 7.5% of the respondents were traditionalist. This implies that both Christians and Muslims were involved in maize farming in the study area

Household size
Table 1 shows that most (62.5%) of the respondents had 1-5 households, 30.8% of the respondents had 6-10 households, while 6.7% of the respondents had above 11 households. The mean household is 4. This could likely translate to family labour on the farm. This is in line with the findings of Christopher, (2018) that household size has a great role to play in family labour usage in the agricultural sector.

Farm size (Acres)
Table 1 shows that majority (92.5%) of the respondents had 1-5 farm size, while 7.5% of the respondents had 6-10 farm size. The mean is 3. This implies that majority of the respondents in the study area had low farm size and this shows that farmers operate on small scale

Members of cooperative society
Table 1 also shows that most (60.8%) of the respondents were member of cooperative society while 39.2% were not member of cooperative society. This implies that the respondents in the study area were members of cooperative society and they may have access to loan facilities to boost the financial activities involves in maize farming.

Mode of land ownership
Table 1 shows that 38.3% of the respondents inherited their farmland, 25.0% of the respondents purchased their farmland, 18.3% of the respondents were gifted their farmland, 12.5% of the respondents rented their farm land, while only 5.8% of the respondents leased their farmland. This implies that the respondents in the study area inherited their farm land and they have no cost to be incurred on land

Table 1: Socio-economic characteristics of the respondent

Variables	Frequency	Percentage	Mean
Age			
25-34	11	9.2	50
35-44	31	25.8	
45-54	39	32.5	
55-64	25	20.8	
65 and above	14	11.7	
Sex			
Male	91	75.8	
Female	29	24.2	
Marital status			
Married	80	66.7	
Single	17	14.2	
Divorced	8	6.7	
Widowed	15	12.5	
Educational status			
Adult education	21	17.5	
Primary education	17	14.2	
Secondary education	40	33.3	
Tertiary education	27	22.5	
No formal education	15	12.5	
Secondary occupation			
Farming	82	68.3	
Trading	23	19.2	
Civil servant	15	12.5	
Farming experience			
1-5	61	50.8	
6-10	27	22.5	10
11-20	26	21.7	
21 and above	6	5.0	
Access to extension			
Yes	48	40.0	
No	72	60.0	
Income			
10,000-50,000	95	79.2	
50,001-100,000	25	20.8	

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Variables	Frequency	Percentage	Mean
Religion status			
Islam	49	40.8	
Christian	62	51.7	
Traditional	9	7.5	
Household size			
1-5	75	62.5	5
6-10	37	30.8	
11 and above	8	6.7	
Farm size			
1-5	111	92.5	3
6-10	9	7.5	
Members of cooperative society			
Yes	73	60.8	
No	47	39.2	
Mode of land ownership			
Purchased	30	25.0	
Inherited	46	38.3	
Rented	15	12.5	
Gifted	22	18.3	
Leased	7	5.8	

Source: Field survey, 2022

3.2 The causes of the herdsmen-farmers conflict in the area

Existence of conflict between farmers and herdsmen in their locality

The result shows that majority (81.7%) of the respondents experience conflict between farmers and herdsmen in the study area, while 18.3% of the respondents did not experience conflict between farmers and herdsmen in the study area. This implies that the respondents experience conflict between farmers and herdsmen in the study area.

Negative effect of the conflict on maize production

Table 2 shows that majority (91.7%) of the respondents experience negative effect of the conflict on maize production, while 8.3% of the respondents did not experience negative effect of the conflict on maize production.

Causes of the conflict

Furthermore, table 2 also shows the causes of conflict in the study area. The result shows that destruction of maize by cattle (36.7%) has the highest percentage closely followed by killing of farmers (31.7%), contamination of stream (12.5%), weakness/incompetence of law enforcement agents (11.7%), and disregard for traditional authority (7.5%) were the main causes of the conflict in the study area. The result indicates that destruction of maize by cattle is the major causes of conflict because it causes loss the farmers.

Table 2: Causes of the herdsmen-farmers conflict in the area.

Causes	Frequency	Percentage	Mean
Has there been any conflict between farmers and herdsmen in your locality			
Yes	98	81.7	
No	22	18.3	
Has there been any negative effect of the conflict on maize production			
Yes	110	91.7	
No	10	8.3	
What is the main cause of the conflict			
Destruction of maize by cattle	44	36.7	
Weakness/incompetence of law enforcement agents	14	11.7	
Killing of farmers	38	31.7	
Contamination of stream	15	12.5	
Disregard for traditional authority	9	7.5	

Source: Field survey, 2022

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3.3 Output differences before, during and after conflict

Results in Table 3, shows the output differences before and after conflict. The results revealed that farmers produced average of 1,235 (kg/tons), 1,198(kg/tons) and 1,029 (kg/tons) of maize before, during and after the conflict respectively. Also farmers spent ₦2,677, ₦2,497 and ₦2,389 on maize production (kg/tons) before, during and after the conflict respectively. Moreover farmers sold maize (kg/tons) for ₦2,500, ₦1,882 and ₦1,777 before, during and after the conflict respectively.

This is an indication that farmers produced, spent on production and sold higher before conflict and produced, spent on production and sold lesser after conflict. This might be due to the fact that Fulani/herders conflict damages have negative effect on their production which reduces their profit on maize production

Table 3: Output differences before during and after conflict

Maize produce by the farmer	
Before the conflict (kg/tons)	1,235
During the conflict (kg/tons)	1,198
After the conflict (kg/tons)	1,029
Cost of production kg/tons ₦	
Before the conflict	₦2,677
During the conflict	₦2,497
After the conflict	₦2,389
How much do you sell kg/tons	
Before the conflict	₦2,500
During the conflict	₦1,882
After the conflict	₦1,777

Source: Field survey, 2022

3.4 Farmers perceived solution to end conflict

Table 4 shows the farmers perceived solution to end conflict in the study area. The result shows that government should provide adequate security (40.0%) has the highest percentage, closely followed by making of rules and regulations that will guide grazing (33.3%), provision of grazing land (15.8%), Fulani headers should go to their place (10.8%) were the farmers perceived solution to end conflict in the study area.

The result implies that government should provide adequate security is the main perceived solution to end conflict by the respondents in the study area so as to enforce law and punish whosoever that goes against the law.

Table 4: Farmers perceived solution to end conflict

Solution	**Frequency**	**Percent**
Government should provide adequate security	48	40.0
Fulani headers should go to their place	13	10.8
Provision of grazing land	19	15.8
Making of rules and regulations that will guide grazing	40	33.3

Source: Field survey, 2022

3.5: Regression analysis showing the significant relationship between the socio economic characteristics of the respondents and the maize output

This section determines the significant relationship between the socio-economic characteristics of the respondents and the maize output in the study area. This was achieved by using multiple regression analysis and the hypothesis tested at 5% significant level. The results are presented in Table 5.

Age: Table 4.5 reveals that age of the farmers had positive coefficient value implying that there is a direct effect on their maize output and shows no significant differences (p=0.631) on farmers maize output

Sex: Result in Table 5 reveals that sex of the farmers had positive coefficient value implying that there is a direct effect on their maize output and shows no significant differences (p=0.910) on farmers maize output

Marital status: Result further reveals that marital status of the farmers had positive coefficient value implying that there is a direct effect on their maize

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output and shows no significant differences (p=0.910) on farmers maize output

Educational status: Result also shows that educational status of the farmers had positive coefficient value implying that there is a direct effect on their maize output and shows no significant differences (p=0.138) on farmers maize output

Secondary occupation: Result also shows that secondary occupation of the farmers had negative coefficient value implying that there is an inverse effect on their maize output and shows significant differences (p=0.0.40) on farmers maize output

Farming experience: Result also shows that farming experience of the farmers had positive coefficient value implying that there is a direct effect on their maize output and shows significant differences (p=0.003) on farmers maize output

Access to extension services: Result also shows that access to extension services of the farmers had negative coefficient value implying that there is an inverse effect on their maize output and shows no significant differences (p=0.186) on farmers maize output

Income: Result also shows that farmers income on maize production had positive coefficient value implying that there is a direct effect on their maize output and shows no significant differences (p=0.258) on farmers maize output

Religion status: Result also shows that farmers religion had negative coefficient value implying that there is an inverse effect on their maize output and shows no significant differences (p=0.864) on farmers maize output

Household size: Result also shows that household size of the farmers had negative coefficient value implying that there is an inverse effect on their maize output and shows no significant differences (p=0.125) on farmers maize output

Farm size: Result also shows that farmers farm size had negative coefficient value implying that there is an inverse effect on their maize output and shows no significant differences (p=0.580) on farmers maize output

Members of cooperative society: Result also shows that farmers membership of cooperative society had negative coefficient value implying that there is an inverse effect on their maize output and shows significant differences (p=0.010) on farmers maize output

Mode of land ownership: Result also shows that farmers mode of land of ownership had positive coefficient value implying that there is a direct effect on their maize output and shows no significant differences (p=0.607) on farmers maize output

The adjuster R^2 was 0.789 indicating that 78.9% of the farmer's maize output was explained by the influence of the socio economic characteristics. Since the p-value (0.001)<0.05. Therefore, the null hypothesis was rejected while the alternative was accepted meaning that there is significant relationship between the socio economic characteristics of the respondents and the farmers maize output

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Table 5: Regression analysis showing the significant relationship between the socio economic characteristics of the respondents and the maize output

variables	B	Std. Error	T	Significant	Decision
(Constant)	42345.950	13272.354	3.191	0.002	Significant
Age	71.250	147.817	0.482	0.631	Not Significant
Sex	456.923	4036.885	0.113	0.910	Not Significant
Marital status	191.067	1686.010	0.113	0.910	Not Significant
Educational status	2051.332	1371.069	1.496	0.138	Significant
Secondary occupation	-5518.049	2658.970	-2.075	0.040	Significant
Farming experience	1072.300	357.580	2.999	0.003	Significant
Access to extension	-4948.091	3717.823	-1.331	0.186	Significant
Income	0.095	0.084	1.136	0.258	Significant
Religion status	-459.950	2678.492	-0.172	0.864	Not Significant
Household size	-1289.717	833.900	-1.547	0.125	Significant
Farm size	-504.483	909.245	-0.555	0.580	Not Significant
Members of cooperative society	-9982.430	3780.130	-2.641	0.010	Significant
Mode of land ownership	796.048	1542.384	0.516	0.607	Not Significant
Adjusted R^2	0.789				
F-value	2.982				
P-value	0.001				

Source: Field survey, 2022

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5.0 Conclusion and Recommendations

5.2 Conclusion

From the findings of this study, majority of the maize farmers were male who have average of 50 years, they are married with average household size of 5 members. They have average 5 years of farming experience. It is also concluded that, farmers have negative experienced on the conflict of farmers and herders, the major causes of crisis between maize farmers and herder in the study area are destruction of maize by cattle and killing of farmers. It is also concluded that farmers produced, spent on production and sold higher before conflict and produced, spent on production and sold lesser after conflict. Finally it is concluded that there is significant relationship between the socio economic characteristics of the respondents and the farmers maize output.

5.3 Recommendations

1. To prevent further community clashes in farming communities, government and relevant agencies should collaborate with traditional institutions to settle rivalries amicably among parties before degenerating into serious security challenge.
2. Government should provide palliative to the affected farmers in the study area as this will cushion the effect of conflict on them.
3. Government should collaborate with the village headers, farmers association, religion leaders, local security personnel to ensure maximum security to farmers and headers in the study area.

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Commercial Banks' Credit Allocated to Agricultural Sector and Economic Growth in Nigeria

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A R T I C L E I NFO

ABSTRACT

The empirical literatures on the effect of commercial banks' credit allocated to agricultural sector on economic growth in Nigeria are mixed. The previous studies in Nigeria did not determine the percentage of the commercial banks' credit allocated to agricultural sector and the percentage contribution of agricultural sector to gross domestic product (GDP). The main objective of this paper is to evaluate the effect of commercial banks' credit allocated to agricultural sector on economic growth in Nigeria from 2014q_1 to 2020q_4 using error correction model (ECM). The other objective of the study is to determine the percentage of commercial banks' credit allocated to agricultural sector and the percentage contribution of agricultural sector to GDP in Nigeria from 2014 to 2020 using a descriptive statistics. The ECM results revealed that the commercial banks' credit to agricultural sector had a significant positive effect on economic growth. The ECM results indicated that a 1% increase in commercial banks' credit to agricultural sector led to 23.37% increase in real GDP in Nigeria. The results of the descriptive statistics indicated that agricultural sector was allocated 3.92% of commercial banks' credit and agricultural sector contributed 24.58% to real GDP. The agricultural sector was allocated the lowest percentage of commercial banks' credit than any other sector. With every 1% of sectoral allocation of commercial banks credit, the agricultural sector contributed more to GDP than any other sector. The agricultural sector that is the backbone of Nigerian economy is not accorded the priority in credit allocation. The inefficiency of commercial banks in the allocation of resources has resulted into low level of economic growth in Nigeria. The apex bank should ensure that the commercial banks are efficient in the allocation of resources. The Central Bank of Nigeria should direct the commercial banks to allocate the highest percentage of their credit to agricultural sector in order to achieve a sustainable agri-food system and economic growth by 2025 in Nigeria and Sub-Saharan Africa.

1. Introduction

The contribution of the banking system towards the growth of an economy is primarily credited to the role it plays in savings mobilisation and allocation of resources to deficit sectors of the economy (Nwakoby and Ananwude, 2016). Access to credit enables enterprises to enhance their productive capacity and their potential to grow (Were et al., 2012). The agricultural sector in Nigeria faces difficulty in the accessibility of financial resources especially from the commercial banks that hold about 90% of the total financial sector assets. This trend reduces the chances for agricultural sector to contribute in employment creation, provision of food, supply of raw materials for industries and foreign exchange earnings. The commercial banks in Nigeria are more interested in allocating loans and advances to industrial and services sectors than agricultural sector even though the agricultural sector contributed more to gross domestic product (GDP). The inadequate food supply and low level of economic growth in Nigeria is as a

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result of the inefficiency of commercial banks in the allocation of resources. The inadequate food supply in Nigeria is due to the fact that a high percentage of commercial banks' loans and advances are allocated to sectors that do not spur economic growth.

The results of previous studies on the effect of commercial banks' credit allocated to agricultural sector on economic growth in Nigeria are mixed. For example, the studies by Ubesie, et al. (2019) and Nteegah (2017) indicate that commercial banks' credit allocated to agricultural sector had no significant effect on economic growth in Nigeria and the studies by Akujuobi and Nwezeaku (2015) and Oladapo and Adefemi (2015) shows that commercial banks' credit allocated to agricultural sector had a significant positive effect on economic growth in Nigeria. The previous studies in Nigeria did not determine the percentage of commercial banks' credit that was allocated to agricultural sector and the percentage contribution of agricultural sector to gross domestic product (GDP).

In view of the above statement of the problem, the following research questions are answered in the course of this study. (1) What is the effect of commercial banks' credit allocated to agricultural sector on economic growth in Nigeria? (2) What percentage of commercial banks' credit is allocated to agricultural sector and what is the percentage contribution of agricultural sector to economic growth in Nigeria?

The main objective of this paper is to evaluate the effect of commercial banks' credit allocated to agricultural sector on economic growth in Nigeria from $2014q_1$ to $2020q_4$. The other objective of the study is to determine the percentage of commercial banks' credit allocated to agricultural sector and the percentage contribution of agricultural sector to GDP in Nigeria from 2014 to 2020.

This study is significant because of the followings reasons. It reveals that commercial banks' credit allocated to agricultural sector had a significant positive effect on economic growth in Nigeria. It also reveals that agricultural sector was allocated the lowest percentage of commercial banks' credit and with every 1% of sectoral allocation of commercial banks' credit, the agricultural sector contributed more to GDP than any other sector. It suggests that the Central Bank of Nigeria should direct the commercial banks to allocate the highest percentage of their credit to agricultural sector in order to achieve a sustainable agri-food system and economic growth by 2025 in Nigeria and Sub-Saharan Africa.

This paper consists of five sections. The next section is literature review. Section 3 presents the methodology. Section 4 discusses the results. Section 5 is the conclusions and recommendations.

2. Literature Review

According to Akintola et al. (2020), the link between finance and economic growth continues to be a subject of significant interest in macroeconomics. Financial development is considered to be the principal input for economic growth and an important component that affects growth through adjustment in productivity growth and efficiency of capital. It affects the accumulation of capital through its impact on the savings rate by altering the proportion of savings (Pagano, 1993; Levine, 1997). This theoretical support can be traced to the work of Schumpeter (1911), the first to argue that the development of the financial sector spurs technological innovation and economic growth (Agnes, 2009; James, 2011; Bah et al., 2016). Schumpeter posited that innovation in business is the major reason for increased investments and business fluctuations. These innovations could be in terms of new ideas and the commercial applications of new technology, new materials, new methods and new sources of energy. This was later buttressed in the seminal works of McKinnon (1973) and Shaw (1973) which underscored that financial liberalisation will increase savings and then capital accumulation that would be invested and lead to economic growth.

The theoretical underpinning of this study is built on three competing theories of the finance and economic growth nexus - supply-leading, demand-following and the feedback hypothesis purported by Greenwood and Jovanovic (1990). Firstly, the supply-leading or finance-led growth hypothesis posits a causal relationship from financial growth to real growth. The deliberate creation of financial institutions and markets increases supply of financial services and catalyses growth in the real sector. This view which was advanced by Patrick (1966), states that the existence of a well-functioning financial sector in channeling the limited resources from surplus units to deficit units would provide efficient allocation of resources, thereby leading economic sectors in their growth process. Secondly, demand-following or growth-led hypothesis postulates a causal relationship from real growth to financial growth. As the real sector develops, the increased demand for financial services induces growth in the financial sector. This view was advanced by Robinson (1952), and in summary, it states that financial development follows economic growth and where enterprise leads, finance follows. Thirdly, the feedback hypothesis or the "bi-directional causality view". This view postulates that

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the finance and economic developments are mutually causal, that is, they have bi-directional causality. According to this hypothesis, a country with a well-developed financial system could promote high economic expansion through technological changes, product and services innovation. This in turn will create high demand on the financial arrangements and services (Levine, 1997). As the banking institutions effectively respond to these demands, higher economic growth will be achieved. Both financial growth and economic developments therefore are inter-dependent, and their relationships could lead to bi-directional causality (Choong et al., 2003).

There were previous studies on banks' credit and economic growth in other countries of the world. Wambugu (2019) evaluated the effect of sectoral distribution of commercial banks' credit to building and construction, agriculture, manufacturing, trade and transport, storage and communication sectors on economic growth in Kenya from 1970 to 2017 utilising autoregressive distributed lag (ARDL) bound approach. It was found that commercial banks' credit to agricultural sector had a significant positive effect on economic growth. Belinga et al. (2016) examined the relationship between bank credit and economic growth in Cameroon from 1969-2013 using vector error correction model (VECM). They found that there is a unidirectional causal relationship from domestic credit to the private sector by banks to gross domestic product per capita. Timsina (2014) analysed the impact of bank credit on economic growth in Nepal from 1975-2013 using error correction model ECM). The results indicate that bank credit to the private sector has a positive impact on economic growth in Nepal in the long run. The growth in real private sector credit by 1 percentage point contributes to an increase in real gross domestic product by 0.40 percentage point in the long run. The feedback effect from economic growth to private sector credit was found in the short run. Vazakidis and Adamopoulos (2009) examined credit market development and economic growth in Italy from 1965-2007 VECM. They found that economic growth had a positive effect on credit market development. Liang (2007) examined whether the quality of legal institutions matters in the banking sector development and economic growth in China from 1990 to 2001 using generalized method of moment (GMM) technique. The results of the investigation show that, without an effective and well-developed legal system, banking sector development only partially contributed to China's economic growth. Koivu (2002) investigated whether the efficient banking sectors accelerate economic growth in transition countries from 1993-2000 using a fixed-effects panel model and unbalanced panel data. The results show that the interest rate margin has a significant negative relationship with economic growth and an increase in credit did not increase economic growth and in some cases it led to a decline in growth rates.

There were previous studies on banks' credit allocated to agricultural sector and economic growth in Nigeria. Obi-Nwosu et al. (2022) ascertained the effect of commercial banks' credit to agriculture on the agricultural sector's contribution to real gross domestic product in Nigeria from 1986 to 2020 utilising the ARDL model. They found that commercial banks' credit to agriculture does not affect the sector's contribution to real gross domestic product. Ubesie, et al. (2019) evaluated the effect of allocation of deposit money banks' credit to agricultural, industrial, building and construction and wholesale and retail trade on economic growth in Nigeria from 2008Q1 to 2017Q4 using ordinary least squares (OLS) regression model. They found that that deposit money banks' credit to agricultural sector had no significant effect on economic growth in Nigeria. Nteegah (2017) evaluated the effect of the allocation of banks' credit to selected sectors on economic growth in Nigeria from 1981-2015 employing VECM. The results showed that banking credit to agricultural sector had no significant effect on economic growth in Nigeria. Ihemeje and Ikwuagwu (2016) determined the effect of deposit money banks' credit to various sectors on economic growth in Nigeria from 1985-2014 employing ECM and OLS regression model. They found that deposit money banks' credit to agricultural sector had a positive effect on economic growth in Nigeria. Makinde (2016) examined the implications of commercial bank loans to industrial, manufacturing, agriculture and the service sectors on economic growth in Nigeria from 1986 to 2014 using OLS regression model. The findings revealed that only the agricultural sector had being enjoying much of bank credit and it has been making positive impact on economic growth in Nigeria. Akujuobi and Nwezeaku (2015) determined the effect of bank lending on economic development in Nigeria from 1980-2013 using OLS regression model. They found that the commercial banks' credit to production sector had a significant positive effect on economic development in Nigeria. Oladapo and Adefemi (2015) analysed the impact of sectoral allocation of banks' loans and advances to production, general commerce, services and 'other' sectors on economic growth in Nigeria from 1960-2012 using OLS regression model. They found that banks' credit allocated to production had a significant positive impact on economic growth during intensive regulation and deregulation. Nwaeze et al. (2014) determined the effect of commercial

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banks' loans and advances to agricultural and manufacturing sectors on economic growth in Nigeria from 1994 to 2013 using OLS regression model. They found that a 1% increase in commercial banks' loans and advances to agricultural sector led to 0.4097% increase in real GDP.

The results of previous studies on the effect of commercial banks' credit allocated to agricultural sector on economic growth in Nigeria are mixed. For example, the studies by Ubesie, et al. (2019) and Nteegah (2017) indicate that commercial banks' credit allocated to agricultural sector had no effect on economic growth in Nigeria and the studies by Akujuobi and Nwezeaku (2015) and Oladapo and Adefemi (2015) shows that commercial banks' credit allocated to agricultural sector had a significant positive effect on economic growth in Nigeria. The previous studies in Nigeria did not determine the percentage of commercial banks' credit that was allocated to agricultural sector and the percentage contribution of agricultural sector to gross domestic product (GDP).

3. Methodology

3.1 Theoretical Framework of the Study

The theoretical framework of the study is the supply-leading or finance-led growth hypothesis. This hypothesis posits a causal relationship from financial growth to real growth. The deliberate creation of financial institutions and markets increases supply of financial services and catalyses growth in the real sector. This view which was advanced by Patrick (1966), states that the existence of a well-functioning financial sector in channeling the limited resources from surplus units to deficit units would provide efficient allocation of resources, thereby leading economic sectors in their growth process.

3.2 Method of Data Analysis

The descriptive statistics is used to determine the percentage of commercial banks' credit that was allocated to agricultural sector and the percentage contribution of agricultural sector to GDP. Specifically, tables, multiple bar charts, percentages, averages and ratios are used to illustrate the percentage of commercial banks' credit that was allocated to agricultural sector and the percentage contribution of agricultural sector to GDP in Nigeria from 2014 to 2020. The effect of commercial banks' credit allocated to agricultural sector on economic growth in Nigeria from $2014q_1$ to $2020q_4$ is evaluated using error correction model.

3.3 Model Specification

Based on the theoretical framework of the study, gross domestic product, and commercial banks' credit allocated to agriculture, industry, construction, trade/general commerce, government and services are included in the model. The functional form of the model for this study is stated in equation (1) below.

$$\mathrm{GDP} = \mathrm{f}(\mathrm{CBA}, \mathrm{CBI}, \mathrm{CBC}, \mathrm{CBT}, \mathrm{CBG}, \mathrm{CBS}) \quad (1)$$

Where GDP is gross domestic product, CBA is commercial banks' credit to agriculture, CBI is commercial banks' credit to industry, CBC is commercial banks credit to construction, CBT is commercial banks' credit to trade/general commerce, CBG is commercial banks' credit to government, CBS is commercial banks' credit to services and f is functional notation. The effect of commercial banks' credit to agriculture, industry, construction, trade/general commerce, government and services on economic growth in Nigeria is expressed with error correction model specification in equation (2).

$$\Delta \mathrm{GDP}_{t-1} = \beta_0 + \beta_1 \Delta \mathrm{CBA}_{t-1} + \beta_2 \Delta \mathrm{CBI}_{t-1} + \beta_3 \Delta \mathrm{CBC}_{t-1} + \beta_4 \Delta \mathrm{CBT}_{t-1} + \beta_5 \Delta \mathrm{CBG}_{t-1} + \beta_6 \Delta \mathrm{CBS}_{t-1} - \Pi_1 \mathrm{ECM}_{t-1} + \mathrm{e}_t \quad (2)$$

Where Δ is the first difference operator, β_0 is coefficient of constant term, β_1 to β_6 are the short run regression coefficients. The coefficients, β_1 to β_6 measure the short run effect of a change in commercial banks' credit to agriculture, industry, construction, trade/general commerce, government and services on economic growth in Nigeria respectively. Π_1 is coefficient of the estimated lagged residual of equation (2) or error correction coefficient and shows how much of the disequilibrium is being corrected. ECM_{t-1} is error correction term lagged for one period, subscript t is current time, and e_t is white noise error term with zero mean and constant variance and all other variables are as previously defined. Based on the theoretical framework of the study, the coefficients of commercial banks' credit to agriculture, industry, construction, trade/general commerce, government and services are expected to be positive. The coefficient of ECM_{t-1} is expected to be negative. If the coefficient of ECM_{t-1} is zero, it shows that the model is in equilibrium. Suppose the coefficient of ECM_{t-1} is positive, it shows that the model is diverging from equilibrium and it will be restored to equilibrium but only after a long period of time. Conversely, a negative coefficient of ECM_{t-1} shows that the model is converging towards the equilibrium and it will be restored to equilibrium within the short period. The first differences of the variables are used for ECM specification because all the variables are stationary at the first differences.

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3.4 Model Estimation Procedure

The time series properties of the data are analyzed using Phillips-Perron (PP) unit root test of Phillips and Perron (1988). The long-run relationships among the variables are verified using the Johansen (1988) cointegration test. The ordinary least squares regression model is estimated in order to determine the effect of commercial banks' credit to agriculture, industry, construction, trade/general commerce, government and services on economic growth in Nigeria. The statistical reliability of the model is evaluated using Breusch-Godfrey serial correlation LM test, Cusum of squares test and histogram-normality test. The data are analyzed using e-view 10.

3.5 Sources and Description of Data

The empirical analysis is conducted using both quarterly and annually data. The time span covered is $2014q_1$ to $2020q_4$. The choice of 2014 as a base year is due to the fact that the classification of Nigerian economy into agricultural, industrial, construction, trade/general commerce, government and services sectors started in that year. Before 2014, Nigerian economy was classified into production, general commerce, services and others sectors. The choice of 2020 as a terminal year is premised on the fact that the time series data of the variables that are used for the study are available up to that year. The gross domestic product at 2010 constant basic prices and commercial banks' credit to agriculture, industry, construction, trade/general commerce, government and services are used in this study. The gross domestic product is a proxy of economic growth and commercial banks' credit to agriculture, industry, construction, trade/general commerce, government and services are proxies of financial growth. All the data are in billions naira. The data of all the variables are obtained from Central Bank of Nigeria Statistical Bulletin.

4. Results and Discussion

4.1 Percentage of Sectoral Distribution of Commercial Banks' Loans and Advances

The percentage of sectoral distribution of commercial banks' loans and advances in table 1 is computed from the sectoral distribution of commercial banks' loans and advances in appendix 1. The average percentage of commercial banks' loans and advances allocated to agriculture, industry, construction, trade/general commerce, government and services from 2014 to 2020 are 3.92%, 36.89%, 4.21%, 7.03%, 8.10% and 39.85% respectively. The services sector was allocated the highest percentage of commercial banks' loans and advances. The industrial sector is next to the services sector in the percentage allocation of commercial banks' loans and advances. The construction, trade/general commerce and government sectors were allocated a smaller percentage of commercial banks' loans and advances than industrial sector. The agricultural sector was allocated the lowest percentage of commercial banks' loans and advances.

Table 1: Percentage of Sectoral Distribution of Commercial Banks' Loans and Advances

Year	Agriculture	Industry	Construction	Trade	Government	Services	Total
2014	3.72	30.95	4.32	8.11	5.68	47.23	100
2015	3.43	33.33	4.06	7.53	7.05	44.59	100
2016	3.26	38.82	3.91	6.11	8.45	39.44	100
2017	3.36	39.56	4.17	6.50	8.84	37.57	100
2018	4.03	40.99	4.06	7.11	9.00	34.80	100
2019	4.49	37.37	4.21	7.26	8.96	37.71	100
2020	5.15	37.19	4.74	6.59	8.71	37.62	100
Total	27.44	258.21	29.47	49.21	56.69	278.96	700
Average	3.92	36.89	4.21	7.03	8.10	39.85	100

Source: Authors' Computation

The percentage of sectoral distribution of commercial banks' loans and advances in table 1 is presented in a multiple bar chart in figure 1. The horizontal axis is the period of time and the vertical axis is the percentage of commercial banks' loans and advances allocated to the various sectors. The heights of the bars are proportional to the percentages of commercial banks' loans and advances allocated to the various sectors in each year. The multiple bar chart reveal that the services sector was allocated the highest percentage of commercial banks' loans and advances for most of the period, followed by industrial sector, government sector, trade/general commerce sector, construction sector and agricultural sector.

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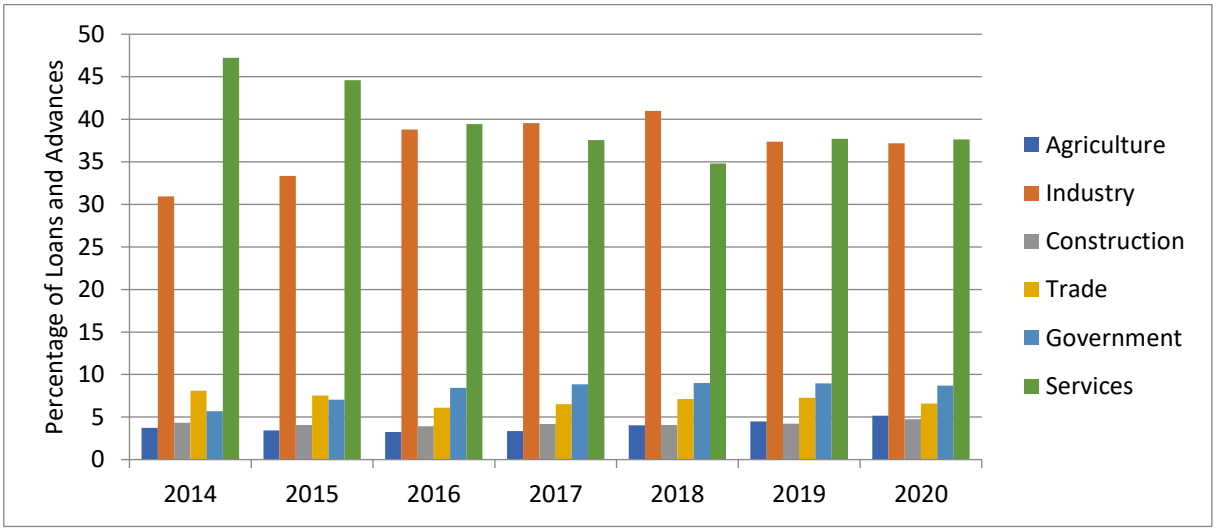

Figure 1: Percentage of Sectoral Distribution of Commercial Banks' Loans and Advances

4.2 Percentage of Sectoral Contribution to Gross Domestic Product

The gross domestic product, a proxy of economic growth comprises of the output of five activity sectors. These five activity sectors are agriculture, industry, construction, trade/general commerce and services. The percentage of sectoral contribution to gross domestic product in table 2 is computed from the gross domestic product at 2010 constant basic prices in appendix 2. The average percentage contributions of agricultural, industrial, construction, trade/general commerce and services sectors to GDP from 2014 to 2020 are 24.58%, 18.95%, 3.73%, 16.42% and 36.33% respectively. At a glance, one is tempted to conclude that the services sector contributes more to GDP than each of the four other sectors but the ratio analysis below proved otherwise.

The ratio of the average percentage contribution of the agricultural sector to GDP to the average percentage of commercial banks' loans and advances allocated to the agricultural sector is 24.58%:3.92% which is equal to 6.27:1. This means that 1% of commercial banks' loans and advances allocated to the agricultural sector contributed 6.27% to GDP from 2014 to 2020. The ratio of the average percentage contribution of the industrial sector to GDP to the average percentage of commercial banks' loans and advances allocated to the industrial sector is 18.95%:36.89% which is equal to 0.51:1. This implies that 1% of commercial banks' loans and advances allocated to the industrial sector contributed 0.51% to GDP from 2014 to 2020. The ratio of the average percentage contribution of the construction sector to GDP to the average percentage of commercial banks' loans and advances allocated to the construction sector is 3.73%:4.21% which is equal to 0.89:1. This shows that 1% of commercial banks' loans and advances allocated the construction sector contributed 0.89% to GDP from 2014 to 2020. The ratio of the average percentage contribution of the trade/general commerce sector to GDP to the average percentage of commercial banks' loans and advances allocated to the trade/general commerce sector is 16.42%:7.03% which is equal to 2.34:1. This means that 1% of commercial banks' loans and advances allocated to the trade/general commerce sector contributed 2.34% to GDP from 2014 to 2020. The ratio of the average percentage contribution of the services sector to GDP to the average percentage of commercial banks' loans and advances allocated to the services sector is 36.33%:39.85% which is equal to 0.91:1. This means that 1% of commercial banks' loans and advances allocated to the services sector contributed 0.91% to GDP from 2014 to 2020. With every 1% of sectoral allocation of commercial banks credit, the agricultural sector contributed more to GDP than any other sector. The contributions of the so called 'priority sectors', the industrial and services sectors to GDP are very low.

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Table 2: Percentage of Sectoral Contribution to Gross Domestic Product

Year	Activity Sector					Total
	Agriculture	Industry	Construction	Trade	Services	
2014	22.90	21.11	3.82	16.57	35.60	100
2015	23.11	19.83	3.88	16.95	36.23	100
2016	24.45	18.25	3.71	17.18	36.41	100
2017	25.08	18.53	3.72	16.86	35.81	100
2018	25.13	18.51	3.73	16.44	36.19	100
2019	25.16	18.53	3.72	16.01	36.58	100
2020	26.21	17.86	3.50	14.94	37.50	100
Total	172.04	132.62	26.08	114.95	254.32	700
Average	24.58	18.95	3.73	16.42	36.33	100

Source: Authors' Computation

The percentage of sectoral contribution to GDP in table 2 is presented in a multiple bar chart in figure 2. The horizontal axis is the period of time and the vertical axis is the percentage contributions of the agricultural, industrial, construction, trade/general commerce and services sectors to GDP. The heights of the bars are proportional to the percentage contributions of agricultural, industrial, construction, trade/general commerce and services sectors to GDP in each year. The multiple bar chart reveal that the services sector contributed more to GDP than each of the four other sectors but this is not true given the ratio analysis of the percentage contributions of agricultural, industrial, construction, trade/general commerce and services sectors to GDP in this sub-section.

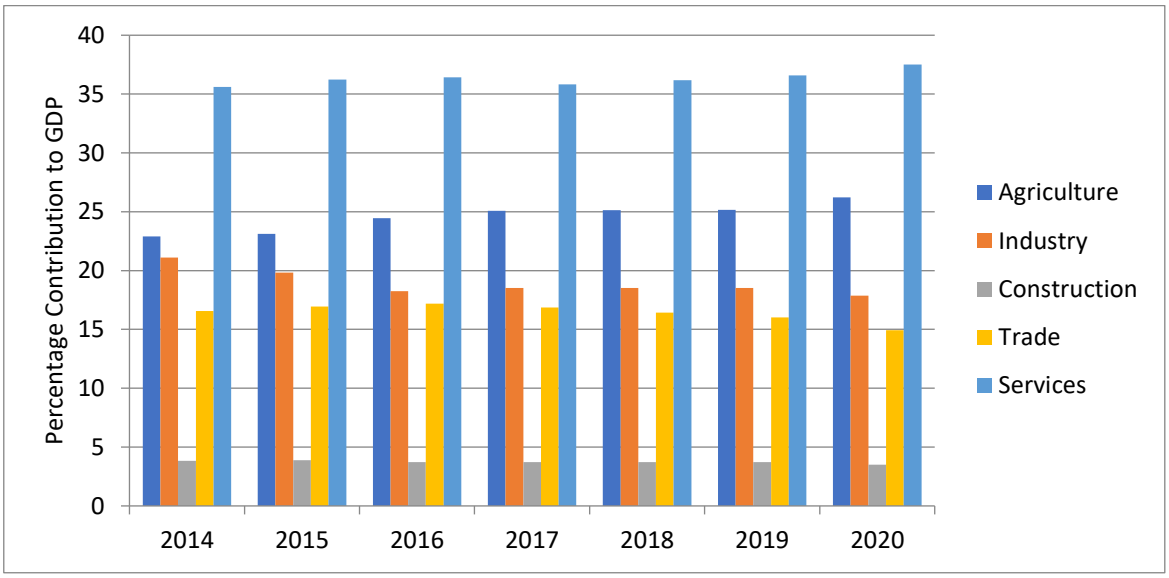

Figure 2: Percentage of Sectoral Contribution to Gross Domestic Product

The results obtained in this study are in line with empirical evidence in Kenya. The Kenya National Bureau of Statistics (1970, 1975, 1980, 1985, 1990, 1995, 2000, 2005, 2010, 2017) as cited by Wambugu (2019) confirmed that the agricultural sector is not favoured in the sectoral allocation of private credit. The Kenya National Bureau of Statistics (1975, 1980, 1985, 1990, 1995, 2000, 2005, 2010, 2017) as cited by Wambugu (2019) also confirmed that the agricultural sector contributed the highest percentage to GDP.

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4.3 Pre-Estimation Tests

The results of Phillips-Perron (PP) unit root test are presented in table 1. Only GDP is stationary at level. All the other variables are non-stationary at levels because PP test statistic is less than test critical values in absolute terms at 1 percent, 5 percent and 10 percent levels of significance and p-value is greater than 5 percent. All the variables are stationary at first differences because PP test statistic is greater than test critical value in absolute terms at 5 percent level of significance and p-value is less than 5 percent.

Table 1: Results of Phillips-Perron Unit Root Test

Variables	Levels		First Differences		Order of Integration
	PP test statistic	Prob*	PP test statistic	Prob*	
GDP	-4.2732	0.0025	-7.0510	0.0000	I(0) & I(1)
CBA	2.2603	0.9999	-4.2385	0.0029	I(1)
CBI	-1.4587	0.5387	-4.0868	0.0041	I(1)
CBC	-0.4481	0.8868	-5.4952	0.0001	I(1)
CBT	-1.9833	0.2919	-6.5394	0.0000	I(1)
CBG	-0.7218	0.8247	-3.0777	0.0409	I(1)
CBS	-1.9019	0.3265	-8.1380	0.0000	I(1)

Test critical values: 1% level -3.7115
5% level -2.9810
10% level -2.6299
*Mackinnon (1996) one sided p-values
Source: Authors' Computation Using E-view 10

The results of Johansen test for cointegrating vectors are presented in table 2. The Trace statistic is greater than 5 percent Critical Value and p-value is less than 5 percent for all except at most 6 hypothesized numbers of cointegrating equations. The Trace test denotes rejection of 6 hypothesized numbers of cointegrating equations at 5 percent level. The Trace test indicates 6 cointegrating equations at the 5 percent level. The Max-Eigen statistic is greater than 5 percent Critical Value and p-value is less than 5 percent for none, at most 1, at most 2 and at most 5 hypothesized numbers of cointegrating equations. The Maximum Eigenvalue test denotes rejection of 4 hypothesized numbers of cointegrating equations at the 5 percent level. The Maximum Eigenvalue test indicates 3 cointegrating equation at the 5 percent level. Both the Trace and Maximum Eigenvalue tests indicate that the variables that are used for this study are cointegrated.

Table 2: Johansen Test for Cointegrating Vectors

Hypothesized No. of CE(s)		Trace			Maximum Eigenvalue		
Trace	Maximum Eigenvalue	Trace Statistic	0.05 Critical Value	Prob**	Max-Eigen Statistic	0.05 Critical Value	Prob**
None*	None*	307.553	125.615	0.000	105.820	46.231	0.000
At most 1*	At most 1*	201.733	95.754	0.000	94.440	40.078	0.000
At most 2*	At most 2*	107.293	69.819	0.000	43.796	33.877	0.002
At most 3*	At most 3	63.497	47.856	0.001	26.302	27.584	0.072
At most 4*	At most 4	37.195	29.797	0.006	18.730	21.132	0.105
At most 5*	At most 5*	18.465	15.495	0.017	15.597	14.265	0.031
At most 6	At most 6	2.8683	3.8415	0.0903	2.8682	3.8415	0.090

*denotes rejection of the hypothesis at the 0.05 level
** Mackinnon- Haug- Michelis (1999) p-values
Source: Authors' Computation Using E-view 10

4.4 Error Correction Estimates

The error correction estimates of D[GDP(-1)] are presented in table 3. Only the coefficient of commercial banks' credit to agricultural sector is positive and statistically significant. The commercial banks' credit to agricultural sector has a significant positive effect on economic growth. A 1% increase in commercial banks' credit to agricultural sector led to 23.37% increase in real GDP in Nigeria. The finding that commercial banks' credit to agricultural sector

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has a significant positive effect on economic growth in Nigeria is in conformity with the supply-leading or finance-led growth hypothesis. This finding is also in conformity with the results of previous researchers. For example, Wambugu (2019) found that commercial banks' credit to agricultural sector had a significant positive effect on economic growth in Kenya and Oladapo and Adefemi (2015) found that banks' credit allocated to production had a significant positive impact on economic growth during intensive regulation and deregulation in Nigeria.

The coefficient of error correction term is negative and statistically significant. The negative sign of the coefficient of error correction term indicates a backward movement toward long run equilibrium from short run disequilibrium. Table 3 shows that the deviation of the model in the short run from long run equilibrium is corrected by 102 percent in one year. The coefficient of determination is 0.5678. This implies that 56.78 percent variation in a change in gross domestic product is explained by a change in commercial banks' credit allocated to agriculture, industry, construction, trade/general commerce, government and services and 43.22 percent variation in a change in gross domestic product is explained by a change in other factors outside the model. The F-statistic of 3.3785 and p-value of F-statistic of 1.76 percent shows that the overall regression model is statistically significant. The Durbin-Watson statistic is 2.0030. The estimated error correction model is free from autocorrelation because the Durbin-Watson statistic is approximately equal to 2.

Table 3: Error Correction Estimates of D[GDP(-1)]

Variable	Coefficient	Std Error	t-Statistic	Prob.
C	-245.9251	322.5020	-0.7626	0.4556
D[CBA(-1)]	23.3739	8.8855	2.6306	0.0170
D[CBI(-1)]	-1.1495	0.9057	-1.2692	0.2205
D[CBC(-1)]	-3.1654	5.7285	-0.5526	0.5873
D[CBT(-1)]	2.0220	2.8159	0.7181	0.4819
D[CBG(-1)]	0.8040	2.5437	0.3161	0.7556
D[CBS(-1)]	-1.0433	0.4959	-2.1040	0.0497
ECM(-1)	-1.0243	0.2470	-4.1471	0.0006

R-squared: 0.5678 F-statistic: 3.3785 Prob(F-statistic): 0.0176 D-W stat: 2.0030
Source: Authors' Computation Using E-view 10

4.5 Post-Estimation Tests

The results of Breusch-Godfrey serial correlation LM test are presented in table 4. The error correction model assumes that there is no autocorrelation among the error terms. The Breusch-Godfrey serial correlation LM test statistic is used to verify the assumption of no serial correlation, or no autocorrelation. In an application, if p-value of chi-square of Breusch-Godfrey serial correlation LM test is less than 5 percent, one can accept the hypothesis that there is no residual autocorrelations. The p-value of chi-square of Breusch-Godfrey serial correlation LM test is equal to 0.01 percent. This result shows that there is no autocorrelation among the error terms.

Table 4: Breusch-Godfrey Serial Correlation LM Test

F-statistic	20.52686	Prob. F(2,19)	0.0000
Obs*R-squared	19.14126	Prob. Chi-Square(2)	0.0001

Source: Authors' Computation Using E-view 10

The Cusum of Squares test is used to verify whether the error correction model is stable. The error correction model is stable if the Cusum of squares lies within 5 percent critical bound dotted red lines. As we can see in Figure 1, the Cusum of squares lies within 5 percent critical bound dotted red lines. The Cusum of squares test indicates that the error correction model is stable at 5 percent level of significance.

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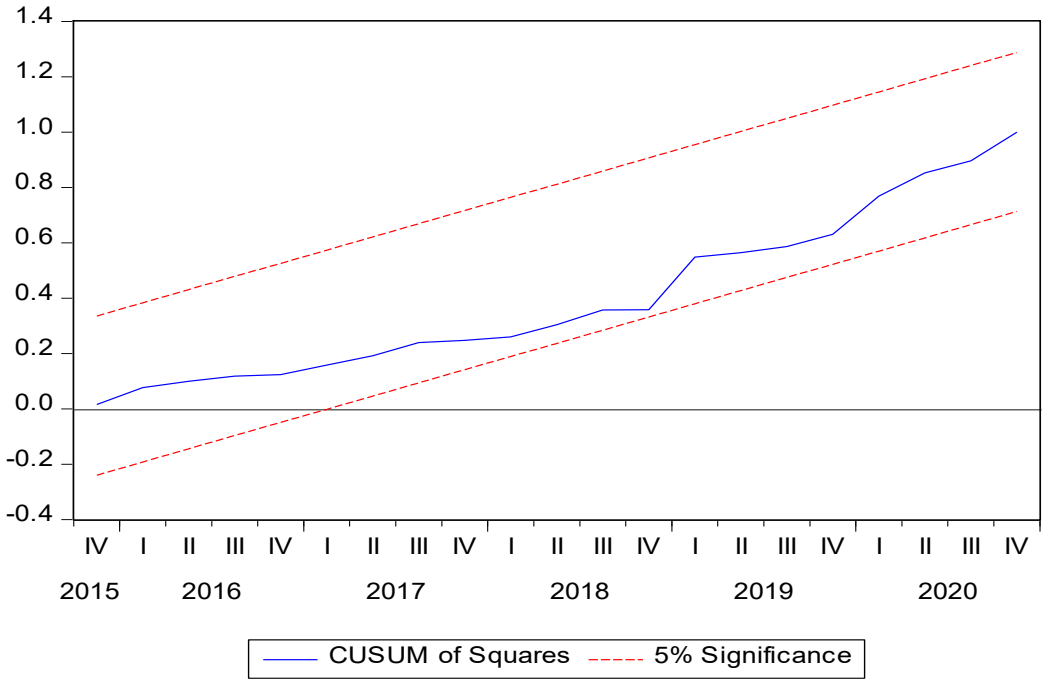

Figure 1: Cusum of Squares Test

The Jarque-Bera statistics is a goodness-of-fit test of whether sample data have the skewness and kurtosis matching a normal distribution. The Jarque-Bera statistics is close to zero and the probability of Jarque-Bera statistic is greater than 5 percent. These results show that the estimated error correction model is normally distributed.

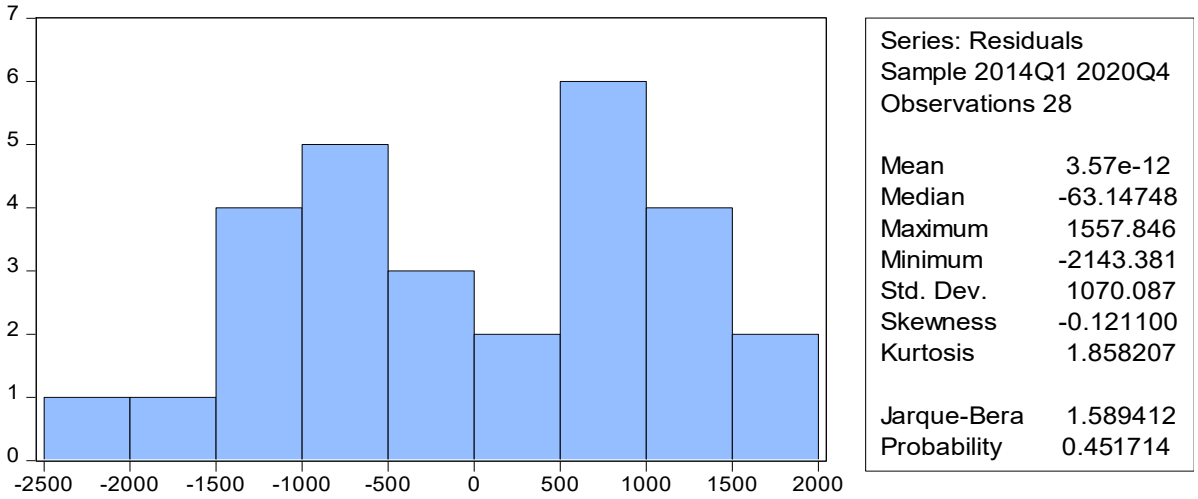

Figure 2: Histogram-Normality Test

5. Conclusions and Recommendations

The commercial banks' credit to agricultural sector had a significant positive effect on economic growth in Nigeria. The agricultural sector was allocated the lowest percentage of commercial banks' credit than any other sector. With every 1% of sectoral allocation of commercial banks credit, the agricultural sector contributed more to GDP than any other sector. The agricultural sector that is the backbone of Nigerian economy is not accorded the priority in credit allocation. The inefficiency of commercial banks in the allocation of resources has resulted into low level of economic growth in Nigeria. The apex bank should ensure that the commercial banks are efficient in the allocation of resources. The Central Bank of Nigeria should direct the commercial banks to allocate the highest percentage of their credit to agricultural sector in order to achieve a sustainable agri-food system and economic growth by 2025 in Nigeria and Sub-Saharan Africa.

Future studies should evaluate the effect of sectoral allocation of commercial banks' credit on economic growth in Nigeria.

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Table 5: Sectoral Distribution of Commercial Banks' Loans and Advances, ₦' Billion

Year	Agriculture	Industry	Construction	Trade	Government	Services	Total
2014	478.91	3,988.99	556.19	1,045.19	732.04	6,088.09	12,889.42
2015	449.31	4,361.02	531.74	985.69	922.89	5,835.55	13,086.20
2016	525.95	6,257.21	631.09	984.90	1,361.85	6,356.27	16,117.29
2017	528.24	6,226.85	657.08	1,023.78	1,391.38	5,913.26	15,740.59
2018	610.15	6,203.19	614.51	1,076.72	1,362.58	5,267.05	15,134.20
2019	772.38	6,423.32	723.15	1,247.37	1,539.22	6,482.31	17,187.77
2020	1,049.68	7,576.76	965.19	1,343.59	1,774.03	7,664.24	20,373.49

Source: Central Bank of Nigeria (CBN) Statistical Bulletin, 2020

Table 6: Gross Domestic Product at 2010 Constant Basic Prices- Annually, ₦' Billion

Year	Activity Sector					GDP
	Agriculture	Industry	Construction	Trade	Services	
2014	15,380.39	14,173.69	2,568.46	11,125.80	23,904.44	67,152.79
2015	15,952.22	13,686.44	2,680.22	11,697.59	25,007.46	69,023.93
2016	16,607.34	12,397.30	2,520.85	11.669.06	24,736.69	67,931.24
2017	17,179.50	12,692.29	2,545.99	11,546.45	24,526.76	68,490.98
2018	17,544.15	12,918.14	2,605.29	11,473.79	25,258.58	69,799.94
2019	17,958.58	13,229.81	2,652.54	11,430.55	26,116.35	71,387.83
2020	18,348.18	12,505.00	2,448.72	10,459.70	26,252.78	70,014.37

Source: Central Bank of Nigeria (CBN) Statistical Bulletin, 2020

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Determinants of Agropreneurs Accessibility to Credit Sources in Egbeda Local Government Area of Oyo State

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A R T I C L E I NFO

Key words:

Agropreneurs,

Accessibility to credit,

Credit sources

ABSTRACT

This study was conducted to ascertain the determinant of Agropreneurs accessibility to credit sources in Egbeda Local Government Area of Oyo State. Specific objectives of this study were designed to; described the socio economic characteristics of Agropreneurs, identified the credit sources among Agropreneurs, identified the Agropreneurs ventures existing, determined the demand for business loan for Agropreneurs, examined the factors that influence Agropreneurs participation in credit market in the study area and determined the factors militating against access to credit by Agropreneurs in the study area, Multi stage sampling technique was used to select 120 respondents for this study. Questionnaires were used to elicit information from the respondents. Both descriptive and inferential statistics were used to achieve the objectives of the study. The results on socio economic characteristics of the respondents showed that 34.2% of the respondents were within the age of 31-40 years, majority (76.7%) of the respondents were married, above average (55.8%) were Christians, above average (58.3%) were male, half (55.0%) of the respondents had tertiary education, most (65.8%) of the respondents had 1-5 household members, average (50.0%) of the respondents had farming as their secondary occupation, majority (86.7%) were member to cooperative society, 40.8% of the respondents had 11 and above years of experience, majority (56.7%) of the respondents had no access to extension services. The result on credit sources among Agropreneurs further revealed that personal savings (95.0%) was major respondents sources of credit, results on Agropreneurs ventures existing showed that livestock feed business(93.3%) was the most Agropreneurs ventures existing in the study area and interest rate (74.2%) the major factor that influence Agropreneurs accessibility to credit source. Also, majority (86.7%) demanded for ₦151,000 and above. Results on factors militating against access to credit by Agropreneurs showed that strict terms and condition of the financial institution (mean=2.34) and fear of risk (mean=2.29) were the very serve factors militating against access to credit by Agropreneurs. The results of the hypothesis showed that there were significant relationship between the socio economic characteristics of the respondents and their demand for business loan by Agropreneurs in the study area with R^2 of . From the finding of this study, it is recommended that; financial institution should reduce their strict terms and conditions as this will enable the Agropreneurs to acquire credit they need for their business.

Introduction

Agropreneurs are innovators who drive change in the economy by initiating new idea and creating new ways of carrying out different activities in input supply, production and marketing in agriculture (Olatomide and Omowumi, 2015). In fact, Agripreneurs should be proactive, curios, determined, persistent, visionary, hardworking, honest, integrity with strong managerial and organizational skills in order to identify and exploit available opportunities in agriculture (Olatomide and Omowumi, 2015).

Agropreneurship which simply means entrepreneurship in agriculture can be seen as a process whereby farmers become determined, creative, innovative, willing to take calculated risk, always looking for opportunities to improve and expand their farm business (Sancho, 2010). Agropreneurship is the profitable fusion of agriculture and entrepreneurship as it turns farm into an agribusiness. It is synonym with entrepreneurship in agriculture and refers to agribusiness establishment in agriculture and allied sector. agropreneurship is a concept specific to agriculture and drawn from wider entrepreneurship (Shailesh *et al.,* 2013). The concept is used to describe dynamic process of creating incremental wealth from agricultural sector (Shailesh

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et al., 2013). The wealth is created by individuals who take the major risks in terms of equity, time and carrier commitment of providing value to some products or services. The product or service itself may or may not be new or unique but value must somehow be infused by an agropreneur who secures and allocates the necessary skill and resources (Olatomide and Omowumi, 2015).

Despite the participation of rural households in agropreneurial activities, its development has not been fully embraced. Employing entrepreneurship skill in farming lead to reduction in poverty among the rural households, but the extent of poverty reduction is still very insignificant, which is an indication that farmers have not fully taken advantage of some of the agropreneurial activities or have participated to a less extent (Olatomide and Omowumi, 2015).

According to Omonona *et al.* (2010), access to credit enhances the production efficiency of Agropreneurs thereby reducing rural poverty and food insecurity. It influences farm productivity since credit-constrained farmers are more likely to use lower levels of input in production compared to those who are not. Improving access to credit therefore has the capacity to facilitate optimal input use leading to a positive impact on productivity (Omonona *et al.* (010). Despite the importance of credit to farmers and some credit institutions created by the government, Agropreneurs still face challenges in the acquisition of credit which makes most of them to get easily discouraged and relent in their effort to contribute to the productivity of the agricultural sector (Olatomide and Omowumi, 2015). Based on the above fact, this research analyzed the determinants of agropreneurs accessibility to credit sources in Egbeda Local Government Area of Oyo State and specifically,

i. described the socio economic characteristics of Agropreneurs in the study area,
ii. identified the credit sources among Agropreneurs in the study area,
iii. identified the Agropreneurs ventures existing in the study area,
iv. determined the demand for business loan for Agropreneurs in the study area,
v. examined the factors that influence Agropreneurs participation in credit market in the study area,
vi. determined the factors militating against access to credit by agropreneurs in the study area,

Hypothesis of the study

Ho: There is no significant effect of socio-economic characteristics of Agropreneurs on their demand for business loan in the study area

Methodology

Study area

The study was carried out in Egbeda Local Government Area. Egbeda Local Government was created in 1989 with the administrative Headquarters situated at Egbeda. *Egbeda. The study area is on latitude* 7°22'46.55"N and *longitude* 3°58'2.88"E or 7.379596 and 3.967468 respectively It covers a landmass of 185.508 square kilometers with a population density of 1,722 persons per square kilometer. The estimated figure population of the Local Government as at 2010 was 319,388 people based on a growth rate of 3.2% using 2006 census figure. The Local Government Area shares boundaries with Osun State to the east, Ibadan North Local Government area to the north, Ibadan North East Local Government Area to the west and OnaAra Local Government to the south.

However, it has 11 wards namely; Erunmu, Ayede/Alugbo/Koloko, Owo Baale/Kasumu, Olodan/Ajiwogbo, Olodo/Kumapayi I, Olodo II, Olodo III, Osegere/Awaye, Egbeda, Olode/Alakia, and Olubadan Estate. The Local Government is dominated by Yoruba's and endowed with a wide expanse of land for the production of livestock and arable farming such cassava, maize e.t.c. About half of the Local Government Area is rural in nature and suburb to Ibadan Metropolis. Subsistence farming is common among the people. The fertile soil and climate favoured the growing of maize, cassava, yams, cocoa, oil palm vegetables and citrus fruits.

Study Population.

The population of the study consists of agropreneurs in Egbeda Local Government area of Oyo State

Sampling techniques and sample size

Multi-stage sampling techniques was used for this study. In the first stage out of 11 wards in Egbeda Local Governments area namely: Erunmu, Ayede/Alugbo/Koloko, Owo Baale/Kasumu, Olodan/Ajiwogbo, Olodo/Kumapayi I, Olodo II, Olodo III, Osegere/Awaye, Egbeda, Olode/Alakia, and Olubadan Estate. 6 wards namely: Kereku, Erunmu, Ayede/Alugbo/Koloko, Owo Baale/Kasumu, Olodan/Ajiwogbo, Olodo/Kumapayi I, Olodo II were purposively selected due to the predominance of agropreneurs in the area. In third stage 2 villages were randomly selected from each of the 6 wards to give a total number of twelve (12) villages. In the fourth stage, twelve (10) respondents each were randomly selected from each village to give a total number of One Hundred respondents (120) respondents used for this study.

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Instruments for Data Collection

Primary data were used for this study and these were collected through a well-structured questionnaire.

Data Analysis

Data for this study was analyzed using descriptive statistics such as frequency, mean and percentage while the inferential statistics was used to analyzed the hypothesis. Objective i, ii, iii, iv, v and vi were analyzed with descriptive statistics while the hypothesis was analyzed with regression.

Model specification

The empirical model for the ordinary least square multiple regression

$C= f(x_1, x_2, x_3, x_4, x_6,)$……..implicit form ….. (1)

$C = B_O+B_1 X_1+B_2 X_2+B_3 X_3+B_4 X_4+B_5 X_5+B_6 X_6+B_7 X_7+ \mu$ explicit form ……..(2)

Where

C = demand for business loan among agropreneurs in credit market (naira)

X_1 = Age of the farmers (in years);

X_2 = Sex (1=male, 2=female)

X_3 =Marital status (married=1, single=2, divorced=3, widowed=4)

X_4 = Educational level (Adult education=1, primary education=2, secondary education=3, Tertiary education=4)

X_5 = Secondary occupation (Farming=1, Trading=2, Civil servant=3)

X_6=Farming experience (Years)

X_7= Access to extension services

μ = Error term

Results and Discussion

Socio economic characteristics of the respondents

Age

Result in Table 1 revealed that 34.2% of the respondents were within the age of 31-40 years, 30.0% were within the age of 41-50 years, and 21.7% were within the age of 51 years and above 14.2% were within the age of 20-30 years. The mean age is 38 years. This implies that youth Agropreneurs dominated the study area and being young will give them the ability to improve their business and they will have the ability to source for credit facilities

Marital status

Result in Table 1 showed that majority (76.7%) of the respondents were married, 11.7% were single, 6.7% were divorced while 5.0% were widowed. This implies majority of the Agropreneurs are married. Timothy (2010) who reported that married people have more responsibilities in taking care of their family members

Religion

The results in Table 1 revealed that above average (55.8%) were Christians, 42.5% were Muslims and 1.7% were traditionalist. This implies that both Christians and Muslims were Agropreneur

Sex

Results further showed that above average (58.3%) were male while 41.7% were female. This implies that majority of the respondents are male. This could be explained by the fact that, agriculture in most of developing countries is dominated by male farmers (Yegbemey *et al.,* 2014). In addition, male farmers in developing countries have more access to agricultural resources (Khan *et al.,* 2017).

Educational status

Table 1a revealed that half (55.0%) of the respondents had tertiary education, 37.5% had tertiary education. 5.8% had primary education while few (0.80%) of the respondents had no formal and primary education. This shows that nearly all of the respondents had were literate who had one form of education or the other. This could possibly make them understand the terms and condition of credit accessibility. Farmers with formal education have the ability to understand the credit scheme and their terms and conditions (Hananu et al., 2015).

Household size

Results on household size showed that most (65.8%) of the respondents had 1-5 household members, 31.7% had 6-10 household members, 2.5% had 11 and above household members. The mean household size was 5 which is lesser than the national average household size of seven (7) people (Salami A, Arawomo (2013). Although, a higher household size (large family) could increase farmers' poverty status (Olatomide, and Omowumi, 2015), in the study area on the contrary, it is a key source of labor that helps support the respondents in their activities

Secondary occupation

Results on secondary occupation showed that average (50.0%) of the respondents had farming as their secondary occupation, 40.8% had trading as their secondary occupation while 8.3% were artisan. This implies that the Agropreneurs have farming as their secondary occupation and this will bring another source of income to fasten the credit repayment.

Member of cooperative society

Results in Table 1 showed that majority (86.7%) were member to cooperative society while 13.3% were not member cooperative society. This implies majority of the respondents are members of cooperative society and this will always give them access to credit facilities

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Years of experience

The result in Table 1 showed that 40.8% of the respondents had 11 and above years of experience, 35.0% had 1-5 years of experience while 24.2% had 6-10 years of experience. The mean year of experience is 12 years. This implies that higher experience will enable them to strategies and make decision on credit sources, access and mode of repayment.

Mode of land ownership

Result of mode of land ownership in Table 1 showed that half (43.3%) of the respondents purchased the land they used for their farming activities, 39.2% inherited their lands, 12.5% were rented their farm land, 1.7% gifted their land while 3.3% leased the land they used for their farming activities.

Access to extension services

Table 1 showed that majority (56.7%) of the respondents had no access to extension services while 43.3% have access to extension services. This could possibly decrease the chances of the respondents in having aces credit from government. This is in accordance with the work of Salami (2013) supported Food and Agricultural Organization (FAO) recommendation that farmers are expected to be visited at least once in every two weeks (fortnightly), which translates to a minimum of 15 extension contacts in a farming season.

Table 1: Socio-economic characteristics of the respondents

Variable	Frequency	Percentage	Mean
Age			
20-30	17	14.2	
31-40	41	34.2	38years
41-50	36	30.0	
51 and above	26	21.7	
Marital status			
Single	14	11.7	
Married	92	76.7	
Divorced	8	6.7	
Widowed	6	5.0	
Religion			
Islam	51	42.5	
Christianity	67	55.8	
Traditional	2	1.7	
Sex			
Male	70	58.3	
Female	50	41.7	
Educational status			
No formal education	1	0.8	
Primary education	7	5.8	
Secondary education	45	37.5	
Tertiary education	66	55.0	
No formal education	1	0.8	
Household size			
1-5	79	65.8	5
6-10	38	31.7	
11 and above	3	2.5	
Secondary occupation			
Farming	61	50.8	
Trading	49	40.8	
Artisan	10	8.3	
Member of cooperative society			
yes	104	86.7	
no	16	13.3	
Years of experience			
1-5	42	35.0	
6-10	29	24.2	
11 and above	49	40.8	12
Mode of land ownership			
purchased	52	43.3	
inherited	47	39.2	
rented	15	12.5	
Gifted	2	1.7	
leased	4	3.3	
Access to extension services			
Yes	52	43.3	
No	68	56.7	

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Source: Field survey, 2022

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Credit sources among Agropreneurs

Results in Table 2 showed the credit sources among Agropreneurs. The results revealed that personal savings (95.0%) had the highest percentage, closely followed by farmers group/cooperative societies (87.5%), agricultural banks (75.0%), private money lender (73.3%), , commercial banks (60.8%), micro finance institution (58.3%) and government aided scheme (53.3%). Furthermore family and friends (32.5%) had the least percentage as the credit source among agropreneurs. This implies majority of the respondents source their credit from their personal savings and group/cooperative societies, this might be due to the fact that personal saving requires no collateral or interest rate while group/cooperative societies provide them long term loan with little or no interest

Table 2: Credit sources among agropreneurs

Credit Sources	Yes	No
Personal Savings	114(95.0)	6(5.0%)
Family & Friends	39(32.5)	81(67.5)
Commercial banks	73(60.8)	47(39.2)
Agricultural banks	90(75.0)	30(25.0)
Government aided scheme	64(53.3)	56(46.7)
Micro finance institution	70(58.3)	50(41.7)
Private money lender	88(73.3)	32(26.7)
Farmers group/cooperative societies	105(87.5)	15(12.5)

Source: Field survey, 2022 **Multiple responses**
Figures in parenthesis are in percentage

Agropreneurs ventures existing in the study area

Results in Table 3 showed that the agropreneurs ventures existing in the study area. The results showed that livestock feed business (93.3%) had the highest percentage. Others agropreneurs ventures existing were small scale poultry business (87.5%), fish farming (84.2%), vegetable farming (80.0%), farm input (chemicals, fertilizer e.t.c) (78.3%), food processing (71.7%), field crop farming (65.8%), dairy farming (65.0%) and snail farming (62.5%). The results implies that livestock feed business, small scale poultry business and fish farming are the agropreneurs ventures existing

Table 3: Agropreneurs ventures existing in the study area

Agropreneurs ventures existing	Yes	No
Small scale poultry business	105(87.5)	15(12.5)
Livestock Feed business	112(93.3)	8(6.7)
Fish farming	101(84.2)	19(15.8)
Snail farming	75(62.5)	45(37.5)
Bee keeping	60(50.0)	60(50.0)
Honey production	65(54.2)	55(45.8)
Farm input (chemicals, fertilizer e.t.c)	94(78.3)	26(21.7)
Vegetable farming	96(80.0)	24(20.0)
Dairy farming	78(65.0)	42(35.0)
Field crop farming	79(65.8)	41(34.2)
Food processing	86(71.7)	34(28.3)
Oil production	54(45.0)	66(55.0)
Nursery operation	70(58.3)	50(41.7)

Source: Field survey, 2022 **Multiple responses**
Figures in parenthesis are in percentage

Factors that influence Agropreneurs **accessibility to credit source**

Results in Table 4 revealed the factors that influence Agropreneurs accessibility to credit source. The results showed that interest rate (74.2%) had the highest percentage, closely followed by net income (65.0%), collaterals demanded (60.8%), business type trade (55.8%), occupation (53.3%) and types of agribusiness (50.0%). Mores education level (38.3%) and household size (30.8%) had the least percentage. This implies that interest rate was the major factor that influence Agropreneurs accessibility to credit source, this might be due to the low interest will prompt the

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respondents to acquire the loan while high interest rate will make them not to acquire the loan, if they acquire it with high interest they might default the loan repayment which might causes chaos in the venture

Table 4: Factors that influence agropreneurs accessibility to credit source

Factors	Yes	No
Age	52(43.3)	68(56.7)
Marital status	41(34.2)	79(65.8)
Household size	37(30.8)	83(69.2)
Occupation	64(53.3)	56(46.7)
Net income	78(65.0)	42(35.0)
Education level	46(38.3)	74(61.7)
Types of agri business	60(50.0)	60(50.0)
Business location	53(44.2)	67(55.8)
Business activities	53(44.2)	67(55.8)
Business Age	49(40.8)	71(59.2)
Market traded	52(43.3)	68(56.7)
Interest rates	89(74.2)	31(25.8)
Collaterals demanded	73(60.8)	47(39.2)
Business location	58(48.3)	62(51.7)
Business type Trade	67(55.8)	53(44.2)

Source: Field survey, 2022 **Multiple responses**
Figures in parenthesis are in percentage

Demand for business loan by Agropreneurs **in the study area,**

Results in Table 5 showed the demand for business loan BY Agropreneurs in the study area. The results showed that majority (86.7%) demanded for 151,000 and above. The mean amount of loan demanded was ₦ 157, 322. More so few (6.7%) demanded for ₦ 1,000-50,000 while 3.3% demanded for ₦ 51,000-100,000 and ₦ 101,000-150,000. This implies that respondents demand for higher loan and this might be due to the fact that they want to maximize their business.

Table 5: Demand for business loan for agropreneurs in the study area,

Variables	Frequency	Percentage	mean
What amount of loan can you access from your credit source			
₦1,000-50,000	8	6.7	
₦ 51,000-100,000	4	3.3	
₦ 101,000-150,000	4	3.3	
₦ 151,000 and above	104	86.7	₦ 157, 322

Source: Field survey, 2022

Factors militating against access to credit by Agropreneurs

Results in Table 6 showed the factors militating against access to credit by Agropreneurs. The results showed that strict terms and condition of the financial institution (mean=2.34) has the highest mean and was ranked first. Other factors include, fear of risk (mean=2.29), long distance from financial institution (mean=2.28), delays in loan acquisition and lack of collateral (mean=2.19) and high interest rate (mean=2.17) which were ranked second, third, fourth and sixth respectively. Furthermore, lack of education (mean=1.88) and gender biases (mean=1.79) had the least percentage and were the least factors militating against access to credit by Agropreneurs.

This implies that strict terms and condition of the financial institution are the major factors militating against access to credit by Agropreneurs, this might be due to the fact that loan institution lay down strict terms and condition because of those who may default the loan process. Lack of education and gender bias remain the least factors and shows that both factors have nothing to do with loan access, loan access only determine by how the Agropreneurs comply with the terms and conditions.

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Table 6 : Factors militating against access to credit to Agropreneurs

Factors	Very severe	Severe	Not severe	Mean	Rank
Long Distance from Financial Institution	49(40.8)	56(46.7)	15(12.5)	2.28	3
Delays in Loan Acquisition	38(31.7)	67(55.8)	15(12.5)	2.19	4
Fear of risk	51(42.5)	53(44.2)	16(13.3)	2.29	2
Strict terms and condition of the financial institution	54(45.0)	53(44.2)	13(10.8)	2.34	1
Cumbersome Process	35(29.2)	60(50.0)	25(20.8)	2.08	8
High interest rate	40(33.3)	60(50.0)	20(16.7)	2.17	6
Loan Diversion	21(17.5)	81(67.5)	18(15.0)	2.03	9
Lack of Collateral	37(30.8)	69(57.5)	14(11.7)	2.19	4
Lack of information on different loan sources	35(29.2)	69(57.5)	16(13.3)	2.16	7
Ignorance	31(25.8)	59(49.2)	30(25.0)	2.01	10
Credit Default Rate	29(24.2)	61(50.8)	30(25.0)	1.99	11
Gender Biases	24(20.0)	47(39.2)	49(40.8)	1.79	13
Lack of Education	26(21.7)	53(44.2)	41(34.2)	1.88	12

Source: Field survey, 2022
Figures in parenthesis are in percentage

Regression analysis shooing the effect of socio-economic characteristics of the Agropreneurs on their demand for business loan in the study area

This section determines the significant relationship between the socio-economic characteristics of the Agropreneurs on their demand for loan in the study area. This was achieved by using multiple regression analysis and the hypothesis tested at 5% significant level. The results as presented in table 7, revealed that age Sex**,** Household size, Membership to cooperative society, Years of experience, Mode of land ownership, Access to extension service had positive coefficient values which had direct positive influence on demand for business loan for Agropreneurs in the study area and marital status, Religion, Educational status, Household size, Secondary occupation of the respondents had negative coefficient implying that there is an inverse effect on demand for business loan of Agropreneurs.
The adjusted R^2 was 0.685 indicating that 685% of the demand for business loan was explained by the influence of the socio economic characteristics. Since the p-value (0.000)<0.05), the null hypothesis was rejected while the alternative was accepted meaning that there is significant relationship between the socio economic characteristics of the respondents and demand for business loan by Agropreneurs in the study area.

Table 7: regression analysis shooing the effect of socio-economic characteristics of the Agropreneurs **on their demand for business loan in the study area**

Variable	B	Standard error	T	Significant	Decision
(Constant)	623949.994	312393.327	1.997	0.048	significant
Age	25949.438	29554.919	0.878	0.382	Not significant
Marital status	-81079.581	32953.909	-2.460	0.015	Significant
Religion	-62946.660	41050.958	-1.533	0.128	Not significant
Sex	96797.921	51225.291	1.890	0.011	significant
Educational status	-195021.836	225218.002	-0.866	0.388	Not significant
Household size	73844.637	46228.050	1.597	0.013	Significant
Secondary occupation	-7404.216	26963.089	-0.275	0.784	Not significant
Membership to cooperative society	34511.122	68956.731	0.500	0.618	Not significant
Years of experience	17605.308	22100.547	0.797	0.427	Not significant
Mode of land ownership	58536.280	33056.248	1.771	0.079	Not significant
Access to extension services	-146248.089	41856.219	-3.494	0.001	significant
Adjusted R^2	0.685				
F-value	3.460				
P-value	0.000				

Source: Field survey, 2022

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Conclusion

From the findings of the study, it is concluded that majority of the respondents are married male Agropreneurs with the mean age of 38 years. It is also concluded that personal savings are the respondents source of credit, Agropreneur existing venture in the area are livestock feed business, small scale poultry business, fish farming, vegetable farming, farm input (chemicals, fertilizer e.t.c) and food processing. The Agropreneurs demands for average loan amount of ₦157, 322. It is also concluded that strict terms and condition of the financial institution and fear of risk are factors militating against access to credit by Agropreneurs in the study area. It is also concluded that there is significant relationship between the socio-economic characteristics of the Agropreneurs and their demand for business loan in the study area.

Recommendations

From the finding of this study it is recommended that:

1. Financial institution should reduce their strict terms and conditions as this will enable the Agropreneurs to acquire credit they need for their business
2. Proximity of loan financial institution should be considered as this will give long distance Agropreneurs access to instant loan
3. Financial institution should reduce their collateral as many agropreneurs may not afford it
4. Little interest rate should be added to loan acquired as this will prompt fast repayment of their loan.

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Economic Analysis of Tomato Marketing in Ibadan South East Local Government Area of Oyo State

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A R T I C L E I NFO

Key words:

Tomato,

Marketing,

Economic

ABSTRACT

The study was carried out to analyze the costs and returns of tomato marketing in Ibadan South east local government of Oyo state. The targeted population for the study is the tomato marketers markets in Ibadan south east Local Government of Oyo State. Multi stage sampling techniques was used to select 120 respondents for this study. The results shows that majority (91.7%) of the respondents were female, 39.2% of the respondents were between 41-50 years of age, majority (96.7%) of the respondents were married, most (60.8%) of the respondents were Muslims, average (50.0%) of the respondents have above 11 years of education, majority (74.2%) of the respondents have 1-5 household size, 25.0% of the respondents have 6-10 households, almost all (97.5%) of the respondents was traders, 40.0% of the respondents had 11-20 years of experience, majority (94.2%) of the respondents have access to credit, almost all (98.3%) of the respondents have access to market information, almost all (99.2%) of the respondents belongs to association, and 40.0% of the respondents earned ₦20,001 –₦40,000 monthly from tomato marketing. Furthermore majority (70.8%) of the respondents used farm gate–wholesaler-retailer-consumer as marketing channel for their tomato marketing, tomato marketing was profitable with gross margin of ₦507,102. Road access problem high cost of purchasing from farm gate and poor credit access were the major problems faced by tomato marketers. Moreover, socio economic characteristics have significant effect on the profitability of tomato marketing in the study area with the p-value of (0.000). From the findings of this study it is recommended that from the fee paid by the marketers to the marketer association should be make to provide infrastructural facilities especially electricity, which may help to extend the period of marketing of fresh tomatoes and improved method of storage by refrigeration and government should reconstruct or renovate the damaged road as the will prevent the tomatoes from being damaged

Introduction

Tomato (*Solanum lycopersicum)* is one of the most popular and widely grown fruit in the world including Africa (Agrios, 2013). It is native to South America (Osemwegi, 2013), but was introduced into West Africa by Portuguese traders and freed slaves from West Indies (Jones, 2000). It is the second most important vegetable worldwide, in terms of the amount of vitamins and minerals it contributes to the diet (Enrique and Eduardo, 2006). Genetic evidence shows that the progenitors of tomatoes were herbaceous green plants with small green fruit and a centre of diversity in the high lands of Peru (Smith, 2001). Tomato is the edible, often red fruit/berry of the Nightshade (*Solanum lycopersicum*) commonly known as a tomato plant.

Tomatoes are important in the daily meal preparation since it can be eaten raw or cooked. Larger quantities are used to produce soups, juice and sauces, ketchups, purees and paste. The seeds which are extracted from the pulp and its residues contain 24% oil which is used for salad dressing and in the manufacturing of margarine and soap. The residual press cake is used as stock feed as well as fertilizer. In addition, vegetable such as tomato apart from being consumed at home also earns foreign exchange to the producer countries, due to exportation(Enrique and Eduardo, 2006)..

Among different vegetables grown in Nigeria, tomato clearly stands out as the most important both in scale of production and level of consumption (Adejobi *et al.,* 2011). Tomato (*Solanum lycopersicum*) is grown by most dry season market gardeners who regard it as the principal crop. Most other vegetables have restricted demand in Nigeria, demand for tomato is universal. Tomato has the great poverty alleviation capacity. Its production, handling, transportation, distribution and marketing will definitely employ a large number of people. Tomato can be processed and exported to other West African nations or sold within

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the country. Haruna I.B., Odeleye, Babalola, and Afolayan (2012) have reported that the concept of marketing subsumes a set of different innovative advertising instruments which aim at having a large effect with a small budget.

Agricultural marketing articulates all processes that take place from when the farmer plans to meet specified demands and market prospects to when the producers finally gets it to the consumers (Haruna *et al.,*2012). Marketing task involves transferring goods from producers to consumers (Olukosi *et.al,* 2007). It is the marketing function that ensures that consumer acquires the product in the form, places and time desired (Haruna *et al.,* 2012). Marketing functions are specialized activities performed in accomplishing the marketing process. These functions are broadly classified as follows: physical functions, exchange functions, facilitating functions (Haruna *et al.,*2012). The role of marketing in economic development is viewed from the improvement of trade, in raising the level of living of all concerned and of the economic wealth of the community and nation at large.

Marketing stimulates production, enterprise and specialization, hence resulting in an improved productivity of all sectors of the national economy. As the economy of a nation grows, the gap between farmers and consumers widened and the task of marketing becomes more complex (Abbott, 2002)

The unique characteristics of agricultural products including tomatoes pose some problems both to the farmers, marketers and final consumers. Its seasonality, bulkiness and perishability exert pressure on handling, packaging, transportation and sales with an attendant effect on the market price. On the other hand, storage facilities for tomato are lacking. This hinders large purchase by sellers and decreases production by producers. Improper handling of tomatoes after harvest lowers quality and causes losses (Olukosi and Isitor, 2004). Based on the above scenarios, the main objective of this study is to analyze the cost and returns of tomato marketing in Ibadan south east Local Government area of Oyo state and specifically, to:

- **(i)** describe the socio economic characteristics of the respondents in the study area;
- **(ii)** identify the marketing channels used by the respondents in the study area;
- **(iii)** estimate the costs and return of tomato marketing in the study area;
- **(iv)** identify the constraints faced by tomato marketers in the study area

Hypothesis of the study

Ho1: There is no significant effect of the socio economic characteristics of the respondents on profitability of tomato marketing.

Methodology

Study Area

Ibadan southeast is a local government area domiciled in the city of Ibadan, Oyo state which is in the southwest geopolitical zone of Nigeria. The headquarters of the LGA are in the Mapo Hall district of Ibadan city and the LGA shares borders with Ibadan southwest, Ibadan Northeast, and Oluyole LGAs. Several districts constitute Ibadan Southeast LGA and these include Boluwaji, Ring road, Challenge, Odinjo, Felele, Molete, and Owode. Ibadan south east lies within 7.3293° N, 3.9114° EIbadan Southeast LGA hosts the Ibadan Southeast Local Council Development Area. The estimated population of Ibadan Southeast LGA is 201,441 inhabitants with the most populous ethnic group in the area being the Yoruba. The Yoruba and English languages are commonly spoken in the LGA while the religions of Christianity and Islam are widely practiced in the area. Notable landmarks in Ibadan Southeast LGA include the Ibadan Grammar School. Ibadan Southeast LGA occupies a total area of 17 square kilometres and has an average temperature of 28 degrees centigrade. The average humidity level of the area is 61 percent while the total annual precipitation of the LGA is 2100 mm of rainfall. Ibadan Southwest LGA witnesses two distinct seasons which are the dry and the rainy seasons.

Population of the study

The targeted population for the study is the tomato marketers in Ibadan South east Local Government area, Oyo State.

Source of Data Collection

Primary data was obtained through the use of well-structured questionnaire

Sampling Procedure and Sample Size

Multi stage sampling was used for this study. In the first stage out of 9 market in Ibadan south east Local Government namely; Bere, Oje, Oritamerin, Oritaaperin, Ojaoba, Agbeni, Ogunpa, Molete and Bode market, 5 major markets were purposively selected namely; Oritamerin, Oritaaperin, Ojaoba, Agbeni, Ogunpa because of predominance of tomato marketers in the study area. In the second stage twenty four (24) marketers were randomly selected from each markets making a total number of 120 respondents.

Data analysis

Data were analyzed using descriptive statistics, Gross margin and Ordinary Least Square Multiple

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Regression. Objective i, ii, and iv were analyzed using descriptive statistics, objective iv was analyzed using gross margin and while the hypothesis was analyzed with Ordinary Least Square Multiple Regression

Model specification

Ordinary Least Square Multiple Regression

Ordinary least square multiple regression was used to analyze socio economic characteristics effect on profitability of tomato marketing

The empirical model for the ordinary least square multiple regression specified as follows:

$C = f(x_1, x_2, x_3, x_4, x_6)$
implicit form……(1)

Where $C = B_O+B_1 X_I+B_2 X_2+B_3 X_3+B_4 X_4+B_5 X_5+B_6 X_6+B_7 X_7+B_8 X_8+ \mu$ explicit form ……..(2)

Where

C= profit of tomato marketing (₦)

X1 = Age of the marketers (in years);

X2 = Sex (Male=1, Female=2);

X3= Marital status (Single = 1, Married = 2, Divorced = 3, Widow = 4.)

X4= Education (in years)

X5 =Household size (No. of persons);

X6 = Secondary occupation (Farming =1, Trading = 2, Civil servant = 3, Others = 4)

X7 = Marketing Experience (years)

μ = Error term

2.5.2 Gross Margin Analysis:

GM = TR –TVC……...(1)

Where GM = Gross Margin

TR = Total Revenue

TMVC = Total Marketing Variable Cost

Results and Discussion

Socio economic characteristics of the respondents

Gender

Results Table 1 shows that majority (91.7%) of the respondents were female while only few (8.3%) of the respondents were male. This is an indication that female were more involved in tomato marketing than their male counterpart in the study area. However, this result corroborates the work of Haruna *et al.* (2012) in Bauchi State, Nigeria which found that majority of the fresh tomato marketers were women.

Age

Results Table 1 revealed that 39.2% of the respondents were between 41-50 years of age, 31.6% of the respondents were between 31-40 years of age, 21.7% of the respondents were between51-60 years of age, 6.7% of the respondents were between 21-30 years of age, and 0.8% of the respondents were above 61years of age. The mean age is 42 years.. This indicates that the respondents in the study area were youth who may have the ability to carry out difficult task associated with tomato marketing

Marital status

Results Table 1 revealed that majority (96.7%) of the respondents were married, while only few (3.3%) of the respondents were single. This implies that majority of the respondents were married. This implies there are more married folks involved in tomato marketing.

Religion status

Table 1 revealed that most (60.8%) of the respondents were Muslims, while 39.2% of thbe respondents were Christians. This implies that Muslim dominated the study area.

Years of formal education

Table 1 revealed that average (50.0%) of the respondents have above 11 years of education, 32.5% of the respondents have 6-10years of education, while 17.5% of the respondents have 0-5years of education. This implies that average of the respondents were educated. Being educated will help the respondents in adopting marketing techniques which may boost their tomato marketing and will improve their income. This finding substantiated the findings of Haruna *et al.,*(2012) who observed that the level of education attained by the marketers to a large extent determine the strategies, which he/she may use to solve his/her marketing problem and to adopt new innovation without difficulties that will increase his profit as soon as they became available to him/her

House hold size

Table 1 revealed that majority (74.2%) of the respondents have 1-5 household size, 25.0% of the respondents have 6-10 households, while 0.8% of the respondents have above 11 households. The mean household size is 4. This shows that tomato marketers in the study area do not have large household members who may help in marketing tomato and this might result in the usage of hired labium

Secondary occupation

Table 1 revealed that almost all (97.5%) of the respondents was traders, 1.7% of the respondents were farmer, and 0.8% of the respondents were civil servant. This indicate that almost all the respondents had trading as their secondary occupation and this will facilitate another income to improve their tomato marketing business

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Marketing experience

Table 1 revealed that 40.0% of the respondents had 11-20 years of experience, 30.9% of the respondents had 21-30 years of experience, 28.3% of the respondents have 1-10 years of experience, while 0.8% of the respondents have above 31 years of experience. This implies that respondents in the study area were experienced in tomato marketing and may likely to combat constraints associated with tomato marketing

Access to credits

Table 1 revealed that majority (94.2%) of the respondents have access to credit, while only few (5.8%) of the respondents have no access to credit. This implies tomato marketers have access to credit and this will help in maximizing the business which may facilitate more profit

Access to information

Table 1 revealed that almost all (98.3%) of the respondents have access to market information, while only few (1.7%) of the respondents have no access to market information. This implies that almost all the respondents in the study area have access to market information.

Association

Table 1 revealed that almost all (99.2%) of the respondents belongs to association, while only few (0.8%) of the respondents were not belongs to association. This implies that almost all the respondents in the study area belongs to associations and this will allow them to have access to marketing information regarding to tomato

Monthly income

Table 1 revealed that 40.0% of the respondents earned ₦20,001 –₦40,000monthly from tomato marketing, 29.8% earned ₦40,001-₦60,000 monthly from tomato marketing, 18.3% earned ₦60,001 –₦80,000 monthly, 5.8% earned ≤30,001- ₦40,000 while 4.2% earned above ₦80,001 from tomato marketing. This implies that majority of the respondents were low income earner.

Table 1: Socio economic characteristics of the respondents

Variables	Frequency	Percentage	Mean
Sex			
Male	10	8.3	
Female	110	91.7	
Age			
21-30	8	6.7	
31-40	38	31.6	
41-50	47	39.2	42
51-60	26	21.7	
61 and above	1	0.8	
Marital status			
Single	4	3.3	
Married	116	96.7	
Religion			
Islam	73	60.8	
Christianity	47	39.2	
Years of formal education			
0-5	21	17.5	
6-10	39	32.5	
11 and above	60	50.0	
Educational status			
No formal education	5	4.2	
Quranic education	1	0.8	
Primary	41	34.2	
Secondary	73	60.8	
Household size			
1-5	89	74.2	4
6-10	30	25.0	
11 and above	1	0.8	
Secondary occupation			
Farming	2	1.7	
Trading	117	97.5	
Civil servant	1	0.8	
Marketing experience			
1-10	34	28.3	
11-20	48	40.0	12
21-30	37	30.9	
31 and above	1	0.8	
Access to credit			
Yes	7	5.8	
No	113	94.2	
Access to market information			
Yes	2	1.7	
No	118	98.3	
Do you belong to any association			
Yes	1	0.8	
No	119	99.2	
Monthly income			
≤ 20,000	7	5.8	
20,001-40,000	47	40.0	
40,001-60,000	39	29.8	
60,001-80,000	22	18.3	
80000 and above	5	4.2	

Source: Field survey, 2022

Tomato marketing channel

The result in table 2 revealed the tomato marketing channel used by the respondents. The table shows that (70.8%) of the respondents used farm gate–wholesaler-retailer-consumer, above average (59.2%) used farm gate-wholesaler-consumer, average (50.8%) used farm gate-retailer-consumer while (18.3%) used farm gate -consumer. The mostly used marketing channel in the study area is farm gate–wholesaler-retailer-consumer. This result corroborates the work of Haruna *et al.* (2012) that the channel mostly used by the respondents in marketing their product was farm gate–wholesaler-retailer-consumer

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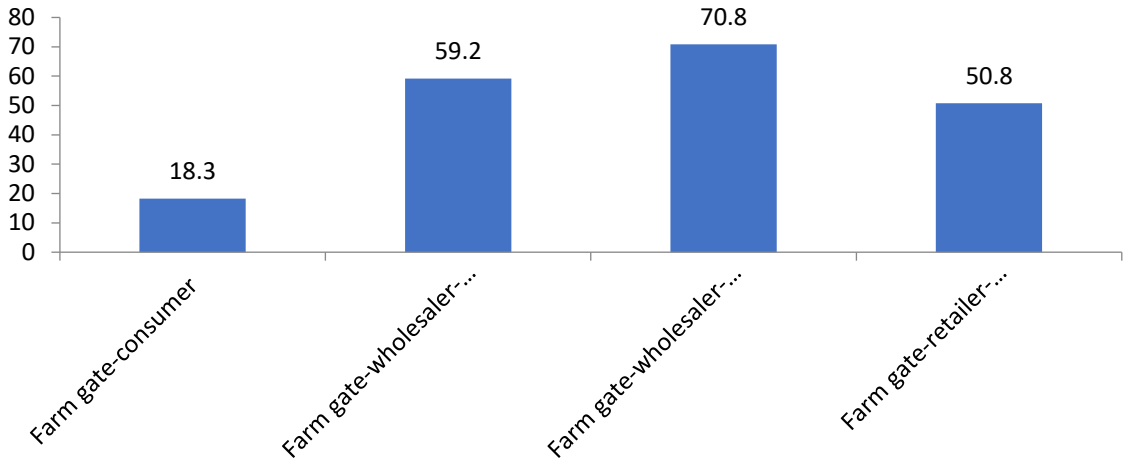

Figure 1: Tomato marketing channel

Costs and return of tomato marketing

Table 4 shows the total variable marketing cost incurred and total returns of the respondents in the marketing of tomato. The table indicates that ₦203, 522 was total marketing variable cost of tomato while ₦710,624 was obtained as revenue (which was quantity of tomato sold multiplied by price per bowl/basket). The profit made by the respondent was ₦507, 102

GM = TR – TMVC

TR = ₦710, 624

GM = ₦710, 624– ₦203,522

=₦507, 102

Since gross margin (₦507, 102) is positive, therefore tomato marketing in the study area is profitable.

Table 3: **Costs and return of tomato marketing**

Variable	Average cost, bowl/ basket	Percentage
Cost of tomato bought for sale	176,617	
Market Dues/levy cost	3,231	
Government due/levy	2,456	
Storage cost	3,103	
Cost of market labour	7,545	
Cost of transportation	3,216	
Cost of loading	3,201	
Cost of unloading	4,153	
Total variable cost	**203,522**	
How do you sell your tomato		
Basket	30	25.0
Bowl	90	75.0
What quantity do you sell per week	212	
How much do you sell per Basket	3,352	
Total revenue (TR)	**710,624**	
Gross margin (GM)	**710,624 - 203,522**	
	507,102	

Source: Field survey, 2022

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Constraints faced by tomato marketing

Table 4 revealed the constraints faced by tomato marketers. The result shows that perishability (mean=2.63) has the highest mean and was therefore ranked first, closely followed by road access problem (mean=2.57) and was ranked second, high cost of purchasing from farm gate (mean=2.53) was ranked third, poor credit access (mean=2.47) was ranked forth, while inadequate capital(mean=2.30), poor marketing information (mean=2.21), and high market levy (mean=1.59) was ranked seventh, eigth, and nineth respectively. This implies that perishability, road access problem, high cost of purchasing from farm gate and poor credit access are major problems faced by tomato marketers and these problem may hindered the marketers in maximizing their tomato business and this may affect their income.

Table 4: Constraints faced by tomato marketing

Constraints	Very severe	Severe	Not severe	Mean	Rank
High cost of purchasing from farm gate	77(64.2)	30(25.0)	13(10.8)	2.53	3
Poor Credit Access	59(49.2)	58(48.3)	3(2.5)	2.47	4
Inadequate capital	44(36.7)	68(56.7)	8(6.7)	2.30	7
Price fluctuation	50(41.7)	68(56.7)	2(1.7)	2.40	6
Storage problem	59(49.2)	56(46.7)	5(4.2)	2.45	5
Poor marketing information	49(40.8)	66(55.0)	5(4.2)	2.21	8
Perishability	76(63.3)	43(35.8)	1(0.8)	2.63	1
Road access problem	71(59.2)	46(38.3)	3(2.5)	2.57	2
High market levy	25(20.8)	21(17.5)	74(61.7)	1.59	9

Source: Field survey, 2022 All figures in parenthesis are in percentage

Regression analysis showing the effect of socio economic characteristics on profitability of tomato marketing

This section determines the effect of socio economic characteristics on profitability of tomato marketing in the study area. This was achieved by using multiple regression analysis and the hypothesis tested at 5% significant level. The results are presented in table .5.

Sex: Table 5 shows that sex of the respondents had negative coefficient implying that there is an inverse effect on the on profitability of tomato marketing and show no significant difference (p=0.876) on the profitability of tomato marketing

Age: Table 5 shows that age of the respondents had negative coefficient implying that there is an inverse effect on the on profitability of tomato marketing and show no significant difference (p=0.791) on the profitability of tomato marketing

Marital status: Results in Table 5 shows that marital status of the respondents had negative coefficient implying that there is an inverse effect on the on profitability of tomato marketing and show significant difference (p=0.001) on the profitability of tomato marketing

Religion: Results in Table 5 revealed that religion of the respondents had positive coefficient implying that there is a direct effect of religion on the on profitability of tomato marketing and show significant difference (p=0.001) on the profitability of tomato marketing

Years of formal education: Table 4.7 shows that years of formal education also had negative coefficient implying that there is an inverse effect on the on profitability of tomato marketing and show no significant difference (p=0.109) on the profitability of tomato marketing

Educational status: Results in Table 5 revealed that religion of the respondents had positive coefficient implying that there is a direct effect of educational status on the on profitability of tomato marketing and show no significant difference (p=0.1801) on the profitability of tomato marketing

Household size: Table 4.7 shows that household size of the respondents had negative coefficient implying that there is an inverse effect of household size on the on profitability of tomato marketing and show no significant difference (p=0.420) on the profitability of tomato marketing

Secondary occupation: Results in Table 5 shows that secondary occupation of the respondents had positive coefficient implying that there is a direct effect of secondary occupation on the profitability of tomato marketing and show no significant difference (p=0.202) on the profitability of tomato marketing

Marketing experience: Results in Table 5 shows that marketing of the respondents had positive coefficient

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implying that there is a direct effect of marketing experience on the profitability of tomato marketing and show no significant difference (p=0.053) on the profitability of tomato marketing

Access to credit: Results in Table 5 shows that marketing of the respondents had positive coefficient implying that there is a direct effect of access to credit on the profitability of tomato marketing and show no significant difference (p=0.070) on the profitability of tomato marketing

Access to market information: Results in Table 5 shows that respondents access to market information also had negative coefficient implying that there is an inverse effect on the on profitability of tomato marketing and show no significant difference (p=0.115) on the profitability of tomato marketing

Association: Results in Table 5 shows that respondents association had positive coefficient implying that there is a direct effect of association on the profitability of tomato marketing and show no significant difference (p=0.070) on the profitability of tomato marketing

income: Results in Table 5 shows that respondents income had negative coefficient implying that there is an inverse effect of income on the profitability of tomato marketing and show significant difference (p=0.000) on the profitability of tomato marketing

The adjusted R^2 was 0.333 indicating that 33.3% of the profitability of tomato marketing was explained by the influence of socio economic characteristics in the regression model. Since the p-value (0.000)<0.05. Therefore, the null hypothesis was accepted meaning that socio economic characteristics have significant effect on the profitability of tomato marketing in the study area

Table 5: regression analysis showing the effect of socio economic characteristics on profitability of tomato marketing

Variable	B	Std. Error	T	Significant
Constant	175400.167	78646.124	2.230	0.028
Gender	-1855.417	11826.336	-.0157	0.876NS
Age	-171.007	645.148	-0.265	0.791NS
Marital status	-51205.132	15492.117	-3.305	0.001*
Religion	62.753	5784.630	0.011	0.991NS
Years of formal education	-1454.831	900.044	-1.616	0.109NS
Educational status	5169.884	3834.511	1.348	0.180NS
Household	-2166.222	2674.201	-0.810	0.420NS
Secondary occupation	4405.130	3431.053	1.284	0.202NS
Marketing experience	1079.146	551.155	1.958	0.053NS
Access to credit	21460.436	11709.861	1.833	0.070NS
Access to market information	-36805.899	23172.879	-1.588	0.115NS
Do you belong to any association	6622.260	28588.590	0.232	0.817NS
Monthly income	-0.795	0.169	-4.711	0.000*
Adjusted R^2	0.333			
F-value	5.249			
P-value	0.000			

Source: Field survey, 2022 * = Significant NS= Not significant

Conclusion

From the findings of this study it is concluded that tomato marketers were dominated by females, with an average age of 42 years. The respondents were married with the mean household size of 4members and had an average experience of 12years. The mostly used marketing channel in the study area is farm gate–wholesaler-retailer-consumer. The costs and returns analysis indicated that tomato marketing was profitable in the study area with a monthly gross margin of ₦507,102. From the regression result it is concluded that socio economic characteristics have significant effect on the profitability of tomato marketing in the study area with the p-value of

Recommendations

1. From the fee paid by the marketers to the marketer association should be make to provide infrastructural facilities especially electricity, which may help to extend the period of marketing of fresh tomatoes and improved method of storage by refrigeration

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2. Government should reconstruct or renovate the damaged road as the will prevent the tomatoes from being damaged
3. Policies and strategies that lower the costs of marketing should be vigorously pursued to enhance better market performance and profitability
4. Marketers should strengthen themselves by forming cooperative groups to enjoy the benefit of economies of scale and improve their access to credit.
5. Markers should also be encouraged to acquire formal education as this will contribute to efficient marketing.

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Cocoyam Marketing in Nigerian Economy: Issues and Challenges

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A R T I C L E I NFO

Key Words:

Cocoyam,

Marketing,

Households

ABSTRACT

This study examined the current status of cocoyam (Colocasia and Xanthosoma spp) in Nigeria. The research found out that cocoyam is ranked after cassava and yam as one of the most important staple food crops among the roots and tubers cultivated and consumed in the country. The crop (cocoyam) is an important source of income and employment for the rural farming households especially in Southeast part of the country. Compared to cocoyam production, cocoyam marketing has received less attention by researchers and policy makers. On the cocoyam global market, China is the leading exporter of cocoyam followed by Mexico, USA and Canada, even though cocoyam production levels in these countries are not as high as those of the top five producers in African countries namely; Nigeria, Cameroon, Ghana, Madagascar and Burundi respectively. Research shows that China (with export value of $417.18 million) remained the number one exporter of cocoyam, followed by Mexico ($264.49 million), USA ($161.01 million) and Canada ($141.96 million). The low value addition of the cocoyam in the country makes is export competition very low comparable to other nations like China, USA among others. The research recommends that there is need for development of a comprehensive cocoyam marketing strategy in Nigeria.

Introduction

In Nigeria, cocoyam (*Colocasia and Xanthosoma spp*) is ranked after cassava and yam as one of the most important staple food crop among the roots and tubers cultivated and consumed in the country (Okoye, Asumugha, Okezie, Tanko, and Onyenweaku, 2008). With about 40% of the total world production, Nigeria is the largest producer of the crop in the world. Cocoyam production in Nigeria rose from about 0.73millions metric tons in 1990 to as much as 5.068 million metric tons in 2007, and in 2012 the average production figure for Nigeria is 5.400 metric tonnes which accounts for about 37% of total world have output of cocoyam (FAO, 2012). On the average, Nigeria currently produces about 3.7 million metric tonnes of cocoyam annually. Cocoyam is not only a major source of food but also an important source of income and employment for the rural farming households (Fadipe, Adenuga, and Raji, 2015).

Despite its nutritional qualities and the potentials to improve the livelihoods of many smallholder farmers, the crop has received little attention from both government and research communities. It is of interest to note that among root and tuber crops in Nigeria, cocoyam is the only fully edible because the corms and cornels are eaten in various food forms while the leaves and flowers are commonly used as a spice to garnish and flavour food. The corms are good sources of carbohydrates with easily digestible starch. Cocoyam is nutritionally superior to major competitors like cassava and yam, in terms of digestibility, contents of crude protein and essential minerals (Ubalua, 2020).

In spite of its economic and nutritional significance, the marketing system for cocoyam in the country like Nigeria is not well developed. Compared to cocoyam production, cocoyam marketing has received much less than sufficient attention by researchers and policy makers. The agricultural marketing system plays a major role in economic development in countries whose resources are primarily agricultural. As the process of urbanization progresses in Nigeria, an increasing share of marketing activities takes place at locations other than where food is produced. The nutritional content and production capacity of cocoyam in Nigeria, its uses and potentials expose it a good raw material in industries for production of different products and a good potential agricultural business product. This is because the crop has been recommended as composite material for production of different products which include bread and biscuit baking, production of pasta, starch, salad cream and

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sausage binder (Igbozulike, 2015). These value addition processes by cocoyam is economic sources of income and employment of urban, semi-urban and rural households in Nigeria.

Cocoyam has better nutritional qualities than other root and tuber crops such as cassava and yam, with higher protein, vitamin and mineral content. A versatile staple, cocoyam can also be used as weaning food, while the leaves can be cooked as vegetable. However, these benefits, along with the wide adaptability of the crop and its role in the economy and livelihood of millions of rural poor, have been under-estimated, under-reported, and therefore poorly appreciated. Those who depend heavily on the crop for survival – the most vulnerable groups – have neither the resources nor the voice to influence its future. Following an old eastern Nigeria tradition, female farmers normally have cocoyam farms that sons-in-law are expected to help with. Women are the custodians of cocoyam farming in most African countries including in Nigeria as reported by (Onyeka, 2014).

Colocasia esculenta popularly known as cocoyam is a tropical, perennial crop. It is a starchy tuber crop with three parts namely; corm, stem and leaves, which is grown basically for edible root. It can also be grown as an ornamental plant for the beautification of the environment as well as a medicinal plant. Cocoyam has its origin from Asia or Southeast Asia as some researchers have found out and it is a known staple crop in most developing countries of Africa. It can also be found in India, USA, Japan as well as Singapore (Elenwoke, 2018). Cocoyam can be processed in several ways. It contains digestible starch, protein and other valuable nutrients. Consumption of cocoyam is very high all over Nigeria (Alegbejo, Ameh, Ogala, and Ibrahim, 2008).

Cocoyam is reported to have superior nutritional value over major root and tuber crops, especially in terms of their protein digestibility and mineral composition, but yet its marketing potentials are still low. In many tropical areas, cocoyam plays major role in the lives of many as a food security crop, mainly for smallholder farmers. Cocoyam has overtaken cocoyam (related aroid), in terms of proximate and mineral contents. Cormels of cocoyam are boiled, baked or partly boiled and fried in oil before consumption. The corms are peeled, dried and ground to flour for pastry that can be stuffed with meat or other fillings. The young leaves can be boiled and used as vegetable similar to spinach (Lim, 2015). Recent research shows that marketing of these stated produce/products from cocoyam will help to reduce poverty especially in southern parts of the country where its production and usage are higher comparable to other locations. Therefore, the study seeks to ascertain the effects, other related issues and predicaments of cocoyam marketing in Nigeria economy.

Concept of cocoyam and Nigerian economy

Cocoyam (*Colocasia esculenta*) is a tuber crop cultivated in many parts of the tropics. It belongs to the family *Araceae* with two members (*Colocasia and Xanthosoma*) that are used as staple foods in Africa, Asia and pacific countries. Cocoyam in some Southeast Nigerian village and town communities' offer socio-cultural and entertainment values (Talwana, Serem, Ndabikunze, Nandi, Tumhimbise, Kaweesi, Chumo, and Palapala, 2009). Production of cocoyam in some town communities of southeast Nigeria is gendered-culturally regarded women's crop and immortalized with annual festivals that bore its name such as *"Ede Aro" and/or "Ede Opoto"*. Some of those cocoyam festivals appear raucous, but with entertaining activities that are entwined with cultural exhibitions. For example, in Abagana, a town community in Anambra State of Nigeria, it is observed that cocoyam (*colocasia esculenta*) festival is celebrated in the last week of every December. The cultural activities include cooking and serving of cocoyam meal to family members, friends and august visitors. Meanwhile, during the event, youth and masquerade flogging contests and cultural show day which attracts spectators from many different places are displayed (Enible, Nwobodo, Nworji, and Okonkwo, 2019).

The economy of Nigeria is a middle-income, mixed economy and emerging market, with expanding manufacturing, financial, service, communications, technology and entertainment sectors. The Nigerian economy is one of the largest in Africa. Since the late 1960s it has been based primarily on the petroleum industry. A series of world oil price increases from 1973 produced rapid economic growth in transportation, construction, manufacturing, and government services. Because this led to a great influx of rural people into the larger urban centres, agricultural production stagnated to such an extent that cash crops such as palm oil, peanuts (groundnuts), and cotton were/are no longer significant export commodities.

In addition, from about 1975 till date Nigeria was forced to import such basic commodities as rice and cassava for domestic consumption. This system worked well as long as revenues from petroleum remained constant, but since the late 1970s the agricultural sector has been in continuing crisis

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because of the fluctuating world oil market and the country's rapid population growth.

Added to these are the problems of insecurity by farmer-herdsmen crisis among others like kidnapping. Although much of the population remained engaged in farming, too little food was produced, requiring increasingly costly imports. The various governments (most of them military-run) and even present and past administration have dealt with this problem by banning agricultural imports and by focusing, albeit briefly, on various agricultural and indigenization plans (Britannica, 2021).

Challenges of cocoyam marketing

In Nigeria and even other developing countries, the benefits of cocoyam along with the wide adaptability of the crop and its role in the economy and livelihood of millions of rural poor, have been under-estimated, under-reported, and therefore poorly appreciated. Those who depend heavily on the crop for survival – the most vulnerable groups – have neither the resources nor the voice to influence its future. It is also possible that farmers face certain constraints that may hinder them from going into the cultivation of cocoyam on a commercial scale. An understanding of such challenges and their level of severity will assist policymakers in mitigating them and also in creating an enabling environment for the economy growth through cocoyam marketing (Jervis, 2021).

Despite the fact that South Africa is regarded to be self-sufficient in food and even able to export some food items, hunger and malnutrition are still common in many rural and urban areas (Van den Heever 1995). Unlike Asia, the Pacific and other African countries, where cocoyam is a commercialized staple (Miyasaka et al. 2003), the crop is not commercially popular in South Africa. Although several landraces of the crop have been cultivated in some remote parts of KwaZulu-Natal Province for centuries, where they are collectively called *Amadumbe*, cocoyam are not well known like maize (*Zea mays*) and potato, which are the main staples in the country. Rather, the crop is cultivated in association with other subsistence food crops such as sweet potatoes, landrace potatoes and green beans mainly for subsistence. The species is considered as food for the poor, and the commercial farmers have not shown much interest in the crop. Consequently, there is very little information on scientific research carried out on cocoyam in South Africa compared with conventional root and tuber crops such as sweet and landrace potatoes. There is therefore the need for a systematic investigation on the nutritional values of cocoyam in South Africa by comparing this species with potato based on their nutritional values and anti-nutritional factors.

Cocoyam's business and utilization appears to be dwindling and suffer neglect irrespective of its many uses and the country's leading position in its annual production which is estimated at about 40% of annual world output. Tapping the potential of cocoyam as a food and cash crop implies identifying and addressing many constraints, including two important diseases that affect cocoyam production in West and Central Africa: Cocoyam root rot disease (CRRD) and Cocoyam leaf blight (TLB). These diseases impacts move beyond one season of damage because cocoyam's vegetative mode of propagation supports transmission of diseases from one generation to the next. The recycling of infected planting materials from farmers' fields leads to reduced yield and build-up of diseases (Durroux-Malpartida, 2014).

In the study of Nenna, Ugwumba, Obiekwe, and Akubuilo, (2017), on strategies for improving cocoyam production among farmers in Anambra state, Nigeria. They found that the challenges of cocoyam production include high cost of hired labour, Scarcity of fund, high incidence of pests and disease, low soil fertility, inadequate extension services and unavailability of organic fertilizer. It could be inferred generally that most of the factors had links with scarcity of fund and high cost of agricultural inputs. Credit plays a vital role in the economic development of a nation. It is a crucial input required by smallholder farmers to establish and expand farm enterprises with the aim of increasing household income (Idoge, 2013). In the study of Fadipe, Adenuga, and Raji, (2015) on analysis of cocoyam marketing in Sagamu local government area, Ogun State, Nigeria, they found that the challenge of cocoyam marketing include inadequate capital, lack of credit, storage problem, high transportation, seasonality, long distance to market and bad road.

Major challenges of cocoyam marketing among farmers in Nigeria include but not limited to the followings. They are: - poor access to land, lack of access to fund to improve production, processing and marketing activities, high cost of labour, lack of extension contact, poor knowledge of extension agent on adapting cocoyam to climate change, high cost of fertilizers, scarcity and poor access fertilizer. Others are high cost of farm inputs, lack of improved cultivars of cocoyam, lack of disease/pest resistant cultivars, high cost of transportation, poor state of feeder roads, shortage of planting materials and even lack of government support. Furthermore, other critical predicaments are - far distance of fertile farm lands from residential homes, poor knowledge of using improved farm production method, low demand for crop, low price of cocoyam in the market, poor of

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improved storage facilities, low soil fertility, limited range of varieties, land tenure system problem, shortage of cultivable land for production expansion, lack of mechanized farming, poor recognition of cocoyam as food, old age may affect cocoyam farming activities and non-existence of cooperative societies in some areas for the crop. Finally, as reported by Ifeanyi-Obi, Togun, Lamboll, Adesope, and Arokoyu, (2017), ineffectiveness of existing cooperative societies in some areas, lack of collateral to secure available credit facilities, existence of some traditional believes and practices that hinders effective adaption, poor access to information sources, lack of sufficient farming experience to tackle some climate exigencies and poor access to weather forecast information are equally listed as serious problems of cocoyam marketing in Nigeria.

Economic importance of cocoyam in Nigeria

Cocoyam (*Colocasia esculenta and Xanthosoma mafafa*) are important carbohydrate staple food particularly in the southern and middle belt areas of Nigeria. Nutritionally cocoyam is superior to cassava and yam in the possession of higher protein, mineral and vitamin contents in addition to having more digestible starch. Cocoyam which ranks third in importance and extent of production after yam and cassava is of major economic value in Nigeria (Udealor, Nwadukwe, Okoronya, 1996). Edible cocoyam cultivated in the country is essentially species of *Colocasia* (cocoyam) and *Xanthosoma* (tannia). The average production figure for Nigeria is 5,068,000mt which accounts for about 37% of total world output of cocoyam (Food and Agricultural Organization (FAO) 2011). Small scale farmers, especially women who operate within the subsistence economy grow most of the cocoyam in Nigeria. It is highly recommended for diabetic patients; the aged, children with allergy and for other persons with intestinal disorders (Plucknet, 1970). According to Ene, 1992, boiled cocoyam corms and cormels are peeled, cut up, dried and stored or milled into flour. The flour can be used for soups, biscuits, bread and puddings for beverages. The peels can also be utilized as feed for ruminants Despite the importance of cocoyam, more research attention has been given to cassava and yam (Tambe, 1995).

Skott, Best, Rosegrant, Bokanga (2000), observed that research on cocoyam has trailed behind cassava and yam as root crops in Nigeria and other countries. According to Ezedinma, (1987), the totality of published scientific work on cocoyam is insignificant when compared with those of rice, maize, yam and cassava. However, Skott, Best, Rosegrant, Bokanga, (2000), asserted that it was only in the last decade that policy makers and national agricultural research systems began to show systematic interest in the crop because of concern over biodiversity. There is a declining trend in cocoyam production as well as a shortage of its supply in domestic markets as a result of a number of technical, socio-economic and institutional constraints, which need to be addressed. Cocoyam farmers are generally found on a small scale and its production has been undermined.

Arising from the forgoing, there is need to have a look into the production and marketing of cocoyam, one of the major roots and tuber crops in Nigeria which is fast becoming an extinction crop. This is due to the general believed that most families no longer consume it because it is not readily available for consumption even during its season, as a result of reduction in its production and marketing level. Production of cocoyam has not been given priority attention in many countries probably because of its inability to earn foreign exchange and its unacceptability by the high-income countries for both consumption and other purposes (Onyenweaku and Ezeh, 1987). Most of what is produced is consumed locally (Mbanaso and Enyinnaya, 1989). The production is labour intensive with most operations carried out manually at the traditional level. There is a dearth of information on the economics of cocoyam production in Nigeria.

Production process of cocoyam

Cocoyams are herbaceous perennial plants belonging to the family *Araceae* and are grown primarily for their edible roots, although all parts of the plant are edible. Cocoyams that are cultivated as food crops belong to either the *genus Colocasia* or the genus *Xanthosoma* and are generally comprised of a large spherical corm (swollen underground storage stem), from which a few large leaves emerge. The petioles of the leaves stand erect and can reach lengths in excess of 1 m (3.3 ft). The leaf blades are large and heart-shaped and can reach 50 cm (15.8 in) in length. The corm produces lateral buds which give rise to tubers or cormels and suckers or stolons. Cocoyams commonly reach in excess of 1 m (3.3 ft) in height and although they are perennials, they are often grown as annuals, harvested after one season. Colocasia species may also be referred to as cocoyam, old cocoyam, arrowroot, eddoe, macabo or dasheen and originates from Southeast or Central Asia. *Xanthosoma* species may be referred to as *tannia, yautia*, new cocoyam or Chinese cocoyam and originates from Central and South America.

Cocoyam is most commonly grown for its starchy edible roots. Colocasia is grown for its corm which is consumed after boiling, frying or roasting. The corms can be dried and used to make flour or sliced and fried

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to make chips. The leaves of the plant are also edible and are usually consumed as a vegetable after cooking in dishes such as stews. Xanthosoma species produce tubers much like potato and are boiled, baked, steamed or fried prior to consumption. The corm of some varieties is also consumed. Young leaves are eaten as a vegetable (Anon, 2008).

Table 1: Status of cocoyam by States in Nigeria

State	Total No. of farm families	2010 cocoyam production in ('000 tons)	Proportion (%) of farm families in cocoyam production	Estimated no of cocoyam farm families
Abia	309,199	142.38	35	108220
Adamawa	494,144	-	-	-
Akwa-Ibom	572,002	192.43	35	200201
Anambra	447,454	137.80	35	156609
Bauchi	671,790	8.13	5	33590
Bayelsa	178,537	48.38	25	44634
Benue	657,767	-	-	-
Borno	676,474	-	-	-
Cross River	532,005	141.87	35	186202
Delta	588,842	102.25	25	147211
Ebonyi	384,855	247.80	35	134699
Edo	434,051	146.19	30	130215
Ekiti	208,161	161.69	25	52040
Enugu	443,973	228.98	35	155391
Gombe	315,479	7.38	5	15774
Imo	475,460	142.61	35	166411
Jigawa	605,963	-	-	-
Kaduna	896,761	10.75	5	44838
Kano	1,031,290	0.94	-	-
Katsina	853,187	-	-	-
Kebbi	474,062	2.33	-	-
Kogi	277,482	6.36	5	13874
Kwara	396,239	-	-	-
Lagos	160,848	-	-	-
Nasarawa	247,230	-	-	-
Niger	627,524	-	-	-
Ogun	489,392	124.70	25	122348
Ondo	432,835	605.71	30	129851
Osun	507,479	189.34	25	126870
Oyo	767,146	107.11	25	191787
Plateau	522,864	102.87	25	130716
Rivers	632,648	99.09	25	158162
Sokoto	516,285	-	-	-
Taraba	301,705	-	-	-
Yobe	438,291	-	-	-
Zamfara	451,502	-	-	-
FCT Abuja	155,155	-	-	-
Total	**18,176,082**	**2,957**		**2,449,640**

Source: Status of Cocoyam by States in Nigeria, (2010)

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Table 2: Cocoyam and top producers

	1983-1992		1993-2002		2003-2012	
	Mean	**%**	**Mean**	**%**	**Mean**	**%**
World	4.88		8.04		10.72	
Africa	2.74	56.26	5.88	73.13	8.25	76.96
China	1.20	24.62	1.40	17.47	1.61	15.04
Cameroon (C)	0.49	10.14	0.88	10.98	1.40	13.02
Ghana (N)	1.01	20.64	1.53	19.04	1.57	14.62
Nigeria	0.52	10.61	2.60	32.36	4.28	39.91
Total of Cameroon, Ghana and Nigeria	**2.02**	**41.39**	**5.01**	**62.37**	**7.24**	**67.54**

Source: Joseph, (2014)

Table 3: Cocoyam production and economic values in West Africa Countries

Country	Area harvested (ha)	Production (tone)	Price (US$/tonne)	Value (US$1,000)
Cote d'lvoire	68,000	93,639	193.9	18,157
Ghana	251,850	1,688,330	338	570,656
Nigeria	728,000	5,387,000	333.3	1,795,487
Togo	13,221	15,500	616.3	9,553
Total	**1,061,071**	**7,184,469**	**1,481.5**	**2,393,853**

Source: FAO, (2009)

Global cocoyam production outlook from 2000 to 2019

In many parts of the world, roots and tubers such as cassava, sweet potato, yam, and cocoyam are important staple crops. They are commonly cultivated by smallholder farmers and used as food security and income crops especially in Africa and even in Nigeria. According to FAOSTAT (2021), global cocoyam production stood at 9.76 million tonnes in 2000 and reached 10.54 million tonnes in 2019 (table 4) with Nigeria, Cameroon, China (mainland) and Ghana ranked 1st, 2nd, 3rd and 4th respectively as shown in table 5 below.

Table 4. World cocoyam production from 2000–2019

Year	Production (Tons)	Area Harvested (Ha)	Yield (Tons/Ha)
2000	9,763,562	1,400,008	6.97
2001	9,947,668	1,434,219	6.94
2002	10,525,900	1,508,598	6.98
2003	10,799,794	1,514,534	7.13
2004	10,981,473	1,521,614	7.22
2005	11,509,450	1,546,206	7.44
2006	11,905,642	1,604,675	7.42
2007	11,619,775	1,615,377	7.19
2008	12,13,3765	1,562,163	7.77
2009	9,611,224	1,319,917	7.28
2010	9,441,809	1,351,094	6.99
2011	9,535,315	1,252,564	7.61
2012	9,852,145	1,428,827	6.90
2013	9,627,651	1,414,931	6.80
2014	10,274,254	1,519,899	6.76
2015	10,282,311	1,725,630	5.96
2016	10,378,696	1,780,637	5.83
2017	10,524,371	1,831,379	5.75
2018	10,460,010	1,881,127	5.56
2019	10,541,914	1,957,358	5.39

Source: Authors' Compilation using data from FAOSTAT (2021).

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Table 5. Top ten (10) countries producers of cocoyam in 2019

Global Rank	Country	Total Production (Tons)	Percent of Global Production
1	Nigeria	2,860,909	27.14
2	Cameroon	1,909,738	18.12
3	China (mainland)	1,908,830	18.11
4	Ghana	1,518,436	14.40
5	Papua New Guinea	271,981	2.58
6	Madagascar	226,438	2.15
7	Burundi	217,510	2.06
8	Rwanda	171,803	1.63
9	Lao People's DR	154,644	1.47
10	Central African Republic	140,957	1.34
	Rest of the world	1,160,668	11.00
	World	10,541,914	100.00

Source: Authors' Compilation using data from FAOSTAT (2021).

According to FAOSTAT (2021), there are 47 major cocoyam producing countries in 2019. These countries are from Africa, America, Asia and Oceania regions. In Africa, Nigeria is the highest producer of cocoyam (cocoyam) globally with about 2.86 million tonnes and 27.14% share of world total production in 2019 while Maldives had the least production level of 8 tonnes as reported by FAOSTAT (2021). Nigeria, Nicaragua, China (mainland) and Papua New Guinea had the highest production level in Africa, Americas, and Asian and Oceanian regions respectively in 2019 FAOSTAT (2021). Globally, cocoyam production in terms of total area harvested has increased substantially in the last two decades, moving from 1.40 million tonnes in 2000 to 1.96 million tonnes in 2019. Asian region had its highest average yield of cocoyam in 2019 from Palestine (37.00 tons/ha) while the average yield of 9.60 tons/ha from Madagascar was Africa's highest according to FAOSTAT (2021). From the Americas, the highest average yield was from St. Lucia (25.00 tons/ha) while the highest yield of Oceania was 17.57 tons/ha from Kiribati.

Furthermore, as reported by Onyeka (2004), FAO's projection that 70% growth in global agricultural production is required to feed the growing population of an additional 2.3 billion people by 2050 can only be achieved by increasing yields and crop production levels on available farmlands, rather than by increasing lands used for agricultural production. This is not the case in the African region. The increased production level noticed in the African region depended largely on increased farmland for cocoyam cultivation rather than increased crop yield per hectare.

7.0 Global cocoyam imports and exports outlook

On the cocoyam global market, China is the leading exporter of cocoyam followed by Mexico, USA and Canada, even though cocoyam production levels in these countries are not as high as those of the top five producers in African countries namely; Nigeria, Cameroon, Ghana, Madagascar and Burundi respectively. Meanwhile, China had the highest cocoyam export value in 2018 with $417.18 million (17.0% world share in US dollars) and about 177 thousand metric tonnes, followed by Mexico $264 million (10.8% global share in US dollars) with a total of 112.96 thousand metric tonnes (quantity exported) while USA had $161 million cocoyam export value (6.6% global share in US dollars) and 50.97 thousand metric tonnes quantity exported in 2018 as reported by (Tridge, 2020).. The implication of the above information might be that the cocoyam production in these named African countries cannot be exported across the globe due to low value addition to the produce/product.

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Table 6. Top twenty (20) countries exporters of cocoyam in 2018

Rank	Country	Export value (USD)	Exporting share (%)	Exporting quantity (Metric tons)
1	China	$417.18 M	17.0	177.43 K
2	Mexico	$264.49 M	10.8	112.96 K
3	USA	$161.01 M	6.6	50.97 K
4	Canada	$141.96 M	5.8	-
5	Philippines	$117.97 M	4.8	61.39 K
6	Thailand	$112.66 M	4.6	59.75 K
7	Peru	$71.18 M	2.9	46.08K
8	India	$67.94 M	2.8	64.21 K
9	Costa Rica	$67.78 M	2.8	73.97 K
10	France	$63.93 M	2.6	23.87 K
11	Germany	$63.05 M	2.6	22.77 K
12	Netherlands	$53.41 M	2.5	21.50 K
13	Chile	$52.63 M	2.2	21.62 K
14	South Africa	$52.81 M	2.2	20.10 K
15	Italy	$46.15 M	1.9	23.42 K
16	South Korea	$42.38 M	1.7	6.07 K
17	Ireland	$41.58 M	1.7	64.10 K
18	Indonesia	$39.55 M	1.6	20.10 K
19	Guatemala	$38.82 M	1.6	48.99 K
20	Belgium	$32.53 M	1.3	12.34 K
World (total)	$2.46 B			

Source: Author's compilation from Tridge, 2020, Note: M = Million, K = Thousand

Surprisingly, no African countries made the top 20 exporters of cocoyam in 2018 despite being the world leading producers of cocoyam for decades. China and Thailand have consistently maintained their exporting and importing capability on the global crop market just like in cassava global market where Thailand was ranked 1st in export with a total export value of $1.19 billion and China ranked 1st in cassava import globally with a total import value of $1.37 billion in 2017 Otekunrin and Sawicka (2019).

However, China's total cocoyam export value increased steadily from $338.29 million in 2009 to $417.18 million in 2018 as reported by (Tridge, 2020). Information on the international trade of cocoyam from Africa seem to be very scarce. This may partly be due to the fact that these leading African producers like Nigeria, Cameroon, and Ghana do not have good documentation of trade in cocoyam and also indicative of the fact that cocoyam production in Africa (especially Sub-Saharan Africa) is mainly hinged on meeting the food security needs at national levels as viewed by Onyeka, (2021).

The global cocoyam import value stood at $2.46 billion in 2018. United States of America (USA) imported a total value of $768.68 million in 2018 while Japan, United Kingdom, Netherlands and France are among the top ten (10) leading cocoyam importing countries as recorded by Onyeka (2021). Table 7 revealed the top twenty (20) cocoyam importing countries and their import shares and quantities (metric tons). USA had the highest import value of cocoyam in 2018 with about $768.68 million (31.3% world share in US dollars) and about 393.68 thousand metric tonnes of importing quantities, followed by Japan with $227 million (9.3% global share in US dollars) with a total of 93.21 thousand metric tonnes (quantity imported) while United Kingdom had $157 million cocoyam import value (6.4% global share in US dollars) and 75.85 thousand metric tonnes quantity exported in 2018..

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Table 7. Top twenty (20) countries importers of cocoyam in 2018

Rank	Country	Import value (USD)	Importing share (%)	Importing quantity (Metric tons)
1	USA	$768.68 M	31.3	393.68 K
2	Japan	$227.10 M	9.3	93.21 K
3	United Kingdom	$157.17 M	6.4	75.85 K
4	Netherlands	$131.61 M	5.4	74.36 K
5	France	$131.61 M	5.2	-
6	China	$63.29 M	2.6	52.50 K
7	Germany	$61.77 M	2.5	26.27 K
8	Australia	$59.11 M	2.4	-
9	South Korea	$54.23 M	2.2	32.43 K
10	Russia	$49.32 M	2.0	28.03 K
11	Italy	$47.02 M	1.9	23.54 K
12	Poland	$45.93 M	1.9	47.23 K
13	Canada	$43.94 M	1.8	-
14	Belgium	$29.61 M	1.2	17.34 K
15	Spain	$28.79 M	1.2	-
16	Israel	$28.79 M	0.9	12.15 K
17	Mexico	$22.74 M	0.9	12.61 K
18	Denmark	$22.64 M	0.9	12.25 K
19	New Zealand	$22.55 M	0.9	-
20	Sweden	$21.9 M	0.9	8.78 K
World		$2.46 B		

Source: Authors' compilation from Tridge (2020), Note: M = Million, K = Thousand.

Cocoyam viewpoints in African economy

In many parts of the world, (especially, African countries), roots and tubers such as cassava (*Manihot esculenta*), sweet potato (*Ipoemea batatas*), yam (Dioscorea sp), and cocoyam (*Colocasia esculenta* and *Xanthosoma sagittifolium)*, are important staple crops commonly cultivated by smallholder farmers and used as food security and income crops.

Cocoyam production in Africa (especially SSA) is commonly by smallholder, resource-limited and mostly female farmers according to Onyeka (2021). However, the crop is mostly referred to as "poor man's crop" because its consumption is mainly by the low income households in the society as reported by Onyeka (2021). As mentioned above, Africa contributed to over 70% of global cocoyam production consistently in the past two decades and accounted for about 76 percent of world share in 2000 but, witnessed a slight decline in production levels in two decades attaining 72.27% (7.6 million tonnes) share of world total production in 2019. Despite the global recognition of cocoyam production in Africa, the crop has suffered serious neglect, receiving little attention from agricultural researchers and government policymakers Onyeka (2021).

The world is faced with enormous task of providing sufficient food for over seven billion people, with 690 million people suffering from hunger globally, Africa region accounted for 73 million out of the 135 million people suffering from acute food insecurity in 2019 according to FAO et.al (2020). Hunger and malnutrition continue to escalate as the world's food system is being threatened by the emergence of COVID-19 pandemic in December 2019.

The attendant total and partial lockdowns in many countries has led to increased level of hunger and food insecurity. The situation in Africa is the one referred to as "a crisis within a crisis" with very high prevalence of hunger and malnutrition in most Africa countries. African governments need to intensify efforts in boosting agricultural production and keeping the food value chain active in order to stem the tide of hunger and food insecurity in the continent as reported by Otekunrin (2020).

However, one of the means of reducing the level of hunger and protein-energy malnutrition in Africa (especially SSA) is through increased production and consumption of indigenous staples of high energy content such as cocoyam according to Agbelemoge (2013). Cocoyam is recognized as a cheaper yam substitute, notably during period of food scarcity (hunger season) among many households in SSA (especially Ghana and Nigeria) and its production

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remained an integral part of many smallholder farming households in many parts of West and Central African countries. It is worthy of note that, most of the output that placed Nigeria as number one cocoyam producer globally and other high producing African countries like Cameroon, Ghana, Madagascar and Burundi are carried out by smallholder rural farmers employing primitive technology and traditional farming practices with limited intensive management system, Onyeka (2021). Cocoyam leaves and tubers possess excellent nutraceutical and healing properties. Thus, its increased production and consumption should be encouraged because of these properties in addition to its usefulness as a food security staple.

Recent cocoyam productivity and yield potential in Africa

Total output of cocoyam has witnessed significant increase in Africa, (mostly in West and Central Africa) where total production level in 2019 reached 7.62 million tonnes (the highest in 2 decades). However, these were largely due to increased harvested area rather than increase in yield per land area according to FAOSTAT, (2021). The average yield per land area (tons/ha) in Africa has consistently remained relatively low, from 6.10 tons/ha in 2000 to abysmally low 4.34 tons/ha in 2019 while Nigeria the leading cocoyam producer was not spared in the declining trend of cocoyam yield per land area in Africa, decreasing from 6.62 tons/ha in 2000 to 2.88 tons/ha in 2019 as recorded by FAOSTAT (2021).

Consequently, while other cocoyam producing regions experienced significant increase in their yield per land area from 2000 to 2019, Africa recorded a monumental decrease in cocoyam yield per land area in this period as recorded by FAOSTAT (2021). African region recorded the lowest cocoyam yield per land area in 2019 as reported by FAOSTAT (2021) when compared with other regions such as Asia (16.50 tons/ha), America (10.41 tons/ha), and Oceania (8.73 tons/ha). This unprecedented yield difference in Africa is indicative of the fact that current yield of cocoyam (cocoyam) in the region (especially West and Central Africa) is far below its potential yield. This could be attributed to the fact that cocoyam production in Africa is largely with limited input and mostly cultivated on marginal lands. The culture of merely increasing production level through increased area of farmland is obviously unsustainable, because it resulted in high demand for available land.

Increased cocoyam production is a worthwhile venture. There are industrial, nutraceutical and healing uses for the crop both within and outside any of the producing countries. Exporting cocoyam to other countries will boost the revenue base of the producing countries; livelihoods of the smallholder farmers and other actors along the value chain would also be enhanced.

Cocoyam trade potentials in Africa

The unprecedented increase in total output of cocoyam in Africa (especially, West and Central Africa) in the last two decades indicated that there could be further increase in another decade to come. The estimate from Tridge (2020) shows that in 2018 indicated that China (with export value of $417.18 million) remained the number one exporter of cocoyam, followed by Mexico ($264.49 million), USA ($161.01 million) and Canada ($141.96 million).

However, no top cocoyam producing countries from sub-Saharan Africa, which accounted for over 70% of global share of cocoyam production in two decades (2000–2019), was listed among the top 20 cocoyam exporting countries. This may be due to the difficulty in obtaining consistent and reliable data on cocoyam import and export for most African countries.

Although 65% of the global cocoyam production is accounted for by Africa in 2019 as recorded by FAOSTAT (2021), there is insufficient information on the contribution of cocoyam from these top producing countries to the international cocoyam market. Apart from poor data on trade in cocoyam in Africa, it could also be due to the fact that cocoyam production in SSA is mainly for meeting local needs for food security as reported by Onyeka (2021).

In 2018, the three major importers of cocoyam are USA ($768.68 million), Japan ($227.10 million) and United Kingdom ($157.17 million) as stated by FAOSTAT (2021). Like cocoyam exports, no top producing African countries was listed among the top 20 importers of cocoyam in 2018. There is enormous trade potentials for cocoyam markets in Africa both within (between countries in Africa) and outside the region. There is urgent need to improve cocoyam production and marketing structures in Africa in order to maximize of its gains for economic empowerment according to Nzeh, et. al (2014).

Challenges of cocoyam in Africa

The non-existent of effective research and policy interventions for the increased production and marketing (international trade) of cocoyam in most African countries (especially SSA) has left the crop as an unpopular and under-utilized root and tuber crop when compared with other root and tuber crops such as cassava, yam and potato. The consistent increase in

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production levels (although with increasing reduction in yield per land area — of cocoyam in most high producing Africa countries (Nigeria, Cameroon and Ghana) has not attracted the international market for more than three decades as reported by Onyeka (2021) and Nzeh et. al (2014). Cocoyam production in most major African growing areas has remained at subsistence level with farmers depending mainly on traditional farming inputs.

To further worsen the challenges of cocoyam production, consumption and commercialization in Africa, is the emergence of cocoyam leaf blight (CLB) (*Phytophthora colocasiae*) in West Africa in 2009. The outbreak of CLB was opined to have accounted for more than US$1.4 billion economic loss annually with enormous impact on the genetic erosion of gene pool in the region as recorded by FAOSTAT (2021) and Onyeka (2021). Cocoyam production is facing continuous decline due to rapid prevalence of CLB. This has resulted in continuous low yield, poor quality corms and reduced commercialization in most cocoyam producing countries including Nigeria and even in Enugu State as found out by Nzeh, et. al (2014).

Conclusion and Policy Recommendations

In conclusion, the scarcity and high cost of cocoyam is not only affecting the ability of rural poor across the country, who often depend on cocoyam to feed adequately, but it is also affecting how they live by imposing on them the need to change their feeding culture. Also, diseases are of significant predicaments in developing countries like Nigeria and even Cameroon and Ghana.

Based on these issues and challenges in cocoyam concepts in the country, it is hereby recommended among others that there is need for - development of a comprehensive cocoyam/cocoyam leaf production and marketing strategy in Nigeria and dissemination of existing improved cocoyam/cocoyam leaf varieties through effective extension activities is recommended. Further research on varietal improvement should focus on superior qualities of cocoyam such as early maturing, high yielding, and resistance to disease/pest. Irrigation facilities should also be provided for intensive crop management practices and commercial cocoyam production in the dry season when demand is extremely high. Further research into semi-processing and preservation techniques is needed to enhance commercial production and marketing of cocoyam leaf in the dry season.

The cocoyam production and marketing has been in continuing crisis due to fluctuating world oil market and currently herdsman issues, thereby, government should try in diversifying the economy by supporting those rural farmers of cocoyam for increase in production and marketing which will help in boosting the gross domestic product of the country.

It is also suggested that farmers should put more effort in cultivation of cocoyam not just for family and locally consumption but for commercialization within and beyond the country. This is because poor effort for cultivation will lead to poor job creation.

There is need for rural road construction for easy transportation of the produced cocoyam to the right destination which if not conveyed on time may lead to damages and decline in income generation.

Furthermore, implications of cocoyam for increased production and international trade need not to be overemphasized. Therefore, **i**ncreased production of cocoyam has huge implications on African and Nigerian economies and livelihoods. These include substantial foreign earnings from international trade, major addition to available foods commonly used in addressing food insecurity problems in Africa, industrial use as well as nutritional/medicinal values. Therefore, strategies have to be put in place to enhance its production and utilization on the African continent. These strategies as highlighted can include but not limited to:-

- Sensitization on the nutritional/medicinal values and food forms diversities of cocoyam.
- Improving the genetic base of cocoyam in Africa through germplasm exchange
- Cocoyam production should not be targeted only for local consumption (as food security crop) but towards attracting the international (export) market.
- Development of appropriate control measures to eliminate field and storage losses due to TLB and other diseases.
- Fabrication of sustainable storage facilities to extend the shelf-life of cocoyam after harvesting.
- Establishment of regional network to foster effective collaboration and development of robust strategic approach to cocoyam disease management.
- Provision of research funds for agriculture-based institutes and institutions to enable them carry out result oriented researches that will improve the livelihood of both rural and urban households.

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APPENDIX

NAPReJ MANUSCRIPT SUBMISSION GUIDELINE

All articles submitted to the journal are subject to blind peer-review. Article published in NAPReJ must be relevant to practice. Articles should be type –written in English, double spaced only one side of A4 (210 by 297mm) paper and not more than 15 double spaced pages (Using one –inch margins and Times New Roman, 12 –point font), inclusive of references tables, figures and appendixes. The total word count of each paper should be about 7000 words.

- Indicate on the cover page the title of manuscript and name (initials followed by surname and address)
- Capitalize first letter of each word of the title
- Type initials and surname of authors below the title.
- Capitalize only the first letter of the surname
- Include the email address of the corresponding author.

Each manuscript must be accompanied by a statement that it has not been published elsewhere and that it has not been submitted simultaneously for publication elsewhere. Authors are responsible for obtainin g permission to reproduce copyrighted material from other sources and are required to sign an agreement for the transfers of copyright to the publisher. All accepted manuscript, artwork and photographs become the property of the publisher.

The body of submitted research papers should be divided into the following major sections:

(I) Introduction

(II) Research Methods

(III) Results and Discussion

(IV) Conclusion

(V) References

(VI) Acknowledgment (Optional)

References:

References, *citations* and general style of manuscripts should be prepared in accordance with the APA publication Manual 6th ed. Cite in the text by author and date (Onoja, 2010) and include an alphabetical list at the end of the article example,

Journal*:*

Seyoum, E.T., Battese, G.E., &Flemming, E.M.(1998) Technical efficiency and productivity of maize producers in Eastern Ethiopia: A study of farmers within and outside the Sasakawa-Global 2000 project. *Agricultural Economics*. 19; 341-348.

Book:

Pallant J. (2010) SPSS Survival Manual. A step by step guide to data analysis using SPSS. England. The McGraw Hill Company

Whole e-book:

Author, A. (date). *Title of book*. Retrieved from http://xxxxxxxxx
Author, A. (date). *Title of book*.doi:xxxxxxxxxxxx

Chapter in an e-book:

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(pp. xx– xx). Retrieved from http://xxxxxxxxx

Author, A. (date).Title of chapter.In E. Editor (Ed.), *Title of book* (pp. xx– xx). doi:xxxxxxxxxx

The ***in-text citation*** includes the author and date, as with any other APA Style citation. In-text citations consist of the surname(s) of the author(s) and the year of publication.

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Contribution to a Book:

Etuk, U. R. & Adetoro, A. O. (2010) Indigenous Extension practices and for establishment in Nigeria. In H. M. Ijeomah & A. A. Aiyeloja (Eds), *Practical Issues in forestry and wildlife resources management.* Port Harcourt: 352 –361.

ABOUT APRNet

APRNet was established in 2009 at a meeting of Nigeria's agricultural research policy stakeholders in Abuja, Nigeria. The meeting was convened to examine the challenges of getting agricultural and rural development research into policy and practice. APRNet is conceptualized to connect research, policymaking and practice by rallying pool of researchers, policymakers and agricultural practitioners in a common platform. It was incorporated on June 14, 2011 in Nigeria as a nonprofit organization, Company Limited by Guarantee.

APRNet is a stakeholders' organization devoted to bridging the gap between research and policymaking for agricultural and rural development. It seeks to maximize the interface of research, policymaking and agricultural enterprise and thereby enhance the relevance, utilization and impact of research for solving agricultural and rural development challenges in Nigeria. The ultimate goal is to improve the livelihoods of agricultural and rural people, increase food security, reduce poverty and contribute to sustainable agricultural growth and economic prosperity in Nigeria.

APRNet Vision is to become an authoritative and independent forum for promoting research for evidence-based agricultural and rural development policies in Nigeria.

APRNet Mission is to facilitate the conduct of research as well as the communication and utilization of research results in the agricultural and rural development policy process in Nigeria.

HOW TO BECOME A MEMBER OF AGRICULTURAL POLICY RESEARCH NETWORK

Regular Membership: minimum of a Masters degree in Agriculture or related disciplines and active involvement in agricultural and rural development policy research.

Registration fee: ₦5, 000
Annual fee: ₦10, 000

Non- Regular Membership: individuals who are not researchers but interested in agricultural and rural development policy research.

Registration fee: ₦ 5, 000
Annual fee: ₦ 5, 000

Associate Membership: minimum of a Masters degree in Agriculture or related disciplines.

Registration fee: ₦5, 000
Annual fee: ₦1,000

Corporate Membership: organizations/institutions involved in agricultural research, training and education, production, marketing, financing, trade, service provision, advocacy, and allied activities.

Registration fee: ₦ 50, 000
Annual fee: ₦ 20, 000

Honorary Membership: This shall be awarded to deserving ndividuals/organizations who have contributed

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significantly to the development of agriculture in Nigeria as may be determined by the Executive Council from time to time. It shall be awarded to State governments as may be determined by the Executive Council.

Registration fee: Free
Annual fee: Free
Non-Nigerian Membership: minimum of Masters Degree in Agriculture or related disciplines and active involvement in Nigerian agricultural and rural development policy research.
Registration fee: 40 US dollars
Annual fee: 60 US dollars

DONATIONS

APRNet, as an NGO, welcomes donations in cash and kind from partners and interested funders worldwide. Any individual or organization who would like to contribute to the mission and vision of APRNet can forward such donation(s) to the following APRNet account details:

ACCOUNT DETAILS

All payments to APRNet in form of donations, subscriptions to NAPReJ and membership fees can be done using any of the following APRNet accounts:

Local Account: Account Name: AGRICULTURAL POLICY RESEARCH NETWORK. Account Number: 1015661697; Bank: UBA PLC

Domiciliary Account (for International transfers): Remitters of funds from abroad should inform their bankers as follows: Please pay: United Bank For Africa Plc, Nigeria.SWIFT CODE: UNAFNGL. Through: Standard Chartered Bank New York, SWIFT CODE:SCBLUS33; Account Number:3582-024992-001; Routing Number: 026002561, For further credit: **Beneficiary account number –3001574983**. **Name –** Agricultural Policy Research Network; Beneficiary address **-** #6 Ogbagi Street GarkiII FCT Abuja. **UBA Branch –**Imani Estate Business Office, 16 Mediterranean Street, Imani Estate, Maitama, Abuja.