



**SOCIETY FOR COMMUNITY AND
COMMUNICATION DEVELOPMENT
RESEARCH (SCCDR)**

**AGRICULTURAL EXTENSION FOR
FOOD SECURITY AND COMMUNITY
EMPOWERMENT**

**PROCEEDINGS
OF THE**

4TH BIENNIAL
Conference

**OF THE
SOCIETY FOR COMMUNITY AND COMMUNICATION
DEVELOPMENT**

**HELD AT THE MICHAEL OKPARA UNIVERSITY OF
AGRICULTURE, UMUDIKE**

AUGUST 12-14, 2025

Editors

Ike Nwachukwu

Jemimah Ekanem

Leo Obinna

Joy Ukoha

Society for Community and Communication Development Research



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Preface

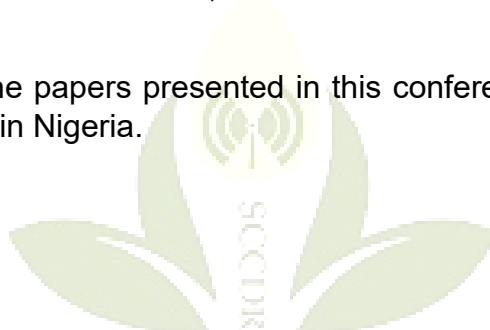
It is with joy that I present to you, the proceedings of the 4th Biennial Conference of our Society, SCCDR. The theme of the conference was, **Agricultural Extension for Food Security and Community Empowerment**. It held from the 12-14th August, 2025, at the Michael Okpara University of Agriculture, Umudike.

The conference was ended by 72 participants and 55 papers were presented, 50 of which are in this proceedings. I am glad that the presentation and participation cut across various disciplines and locations in the country. The keynote paper was presented by Dr Chibuzor Anyim, a seasoned development and external relations expert. He has over 20 years of experience in the oil and gas sector, especially at the Shell Petroleum Development Company. The title of his paper was; ***Integrated Extension Services for Community Empowerment in Nigeria***.

We extend our deepest appreciation to the Vice Chancellor of Michael Okpara University of Agriculture, Umudike, Prof M.O Iwe, for his financial and moral support to the conference.

It is hoped that some of the papers presented in this conference will form the basis for community empowerment in Nigeria.

Prof. Ike Nwachukwu
President



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SOCIETY FOR COMMUNITY & COMMUNICATION DEVELOPMENT RESEARCH CONFERENCE PROCEEDINGS



4th Biennial Conference, 2025

12 – 14 Aug. @ Michael Okpara University of Agriculture, Umudike, Abia State
Theme: Agricultural Extension for Food Security and Community Empowerment

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4th Biennial Conference, 2025

12 – 14 Aug. @ Michael Okpara University of Agriculture, Umudike, Abia State

Theme: Agricultural Extension for Food Security and Community Empowerment

Integrated Extension Service for Community Empowerment in Nigeria

Keynote Address presented by

Dr. Chibuzo. O. Anyim and Prof. Chigozie. C. Asiabaka

Epitome Institute of Education and Innovation, Owerri, Imo State, Nigeria

INTRODUCTION

In Nigeria, extension services have traditionally focused on disseminating agricultural innovations to farmers with the aim of improving productivity and food security. Great success was achieved with this during the years of the Agricultural Development Programmes (ADPs). However, the socio-economic context has changed, and rural livelihoods have diversified beyond agriculture to include small-scale businesses, crafts, and services. Many of these sectors lack access to technical information, training, and support systems, thus necessitating an integrated extension model. Integrated Extension Services (IES) respond to this complexity by offering multi-sectoral support. IES aligns with the **Sustainable Development Goals (SDGs)**, especially goals 1 (No Poverty), 2 (Zero Hunger), 5 (Gender Equality), 8 (Decent Work), and 17 (Partnerships for the Goals).

Community empowerment is at the heart of sustainable development and involves building the capacity of individuals and groups to participate in and benefit from development initiatives (Narayan, 2002).

The Present Need for Agriculture and Community Empowerment in Nigeria

Agriculture continues to be a critical sector in Nigeria, employing more than 70% of the rural population and contributing significantly to national GDP (FAO, 2021). Despite its potential, agricultural productivity is hampered by climate change, poor infrastructure, limited access to credit, and outdated farming practices. Simultaneously, poverty, unemployment, and insecurity persist, creating a strong case for broader community empowerment strategies (IFPRI, 2020). Agriculture is not the only means of livelihood in the communities of today. A typical community, especially in South East Nigeria, hosts farmers, traders, civil servants, transporters, welders and many other artisans. Emphasizing only agriculture through agricultural extension services to farmers will not lead to the desired community improvement. This is also against the backdrop that the farmers are mainly the elderly in the community with the younger ones preferring to engage in other livelihood sectors. It therefore follows that empowering communities in agriculture and other livelihood sectors can promote inclusive growth, resilience, and social stability.

PRINCIPLES OF COMMUNITY EMPOWERMENT

Participation

Communities must be actively involved in decision-making and project design (Chambers, 1997).

Capacity Building

Building individual and institutional capacities to sustain development gains (Eade, 1997).

Equity and Inclusion

Ensuring marginalized groups such as women, youth, and disabled persons are represented (Cornwall, 2003).

Transparency and Accountability

Establishing open channels for feedback and decision-making (Gaventa, 2004).

Ownership and Sustainability

Empowerment must be locally driven to ensure long-term impact (Pretty, 1995).

CHALLENGES OF EXTENSION SERVICES AND COMMUNITY EMPOWERMENT

Extension services in Nigeria face multiple challenges, which limit their effectiveness and reach. The challenges include:

- **Fragmented Focus**

One of the significant challenges facing extension services is the fragmented focus of delivery systems. Multiple stakeholders—ranging from government agencies, non-governmental organizations (NGOs), international development partners, and private sector actors—often implement extension programs independently. For instance, the defunct Shell Petroleum Development Company of Nigeria Limited (SPDC) and the Nigeria Agip Oil Company through their Agricultural Projects & Extension Services and Green River Project respectively provided agricultural extension services to farmers in their areas of operation in the Niger Delta till the early 21st century. These efforts were not harmonized with the National Agricultural Extension, Research & Liaison Services (NAERLS) and the state Agricultural Development Agencies, leading to duplication of activities in some regions and neglect in others (Arokoyo, 2005). This lack of coordination prevents the formulation and implementation of a coherent extension policy framework, resulting in inefficiencies and poor resource utilization.

- **Inadequate Funding**

Agricultural extension services are chronically underfunded, which significantly limits their effectiveness. Extension programs often suffer from insufficient government budgetary allocation, delayed fund disbursements, and an overreliance on donor-driven initiatives. As a result, many extension agencies lack basic operational resources such as transportation, training materials, demonstration inputs, and even salaries for field officers (World Bank, 2009). The case of the World Bank sponsored Agricultural Development Projects (ADPs) in Nigeria in the 1990s and early 2000s explains this point. While the funds were available from the World Bank, extension services to farmers could be felt. However, when the funding ended, extension services to farmers became non-existent. Inadequate funding stifles innovation and restricts the capacity of extension agents to engage effectively with farming communities.

- **Low Extension-to-Farmer Ratio**

The extension-to-farmer ratio remains unacceptably low in many countries, leading to a large number of farmers being underserved. In Nigeria, for instance, a single extension worker may be responsible for thousands of farmers across multiple villages (Agbarevo & Obinne, 2010). This severely limits the capacity of extension personnel to provide timely and personalized support. The low ratio also hinders effective monitoring, feedback collection, and technology adoption at the grassroots level. The low extension-to-farmer ratio may not be unconnected to multiple factors including low number of agricultural extension personnel employed by government and development agencies, low number of extension graduates from training institutions and low appeal of extension as a course of study and profession/career.

- **Outdated Methods**

Traditional extension approaches, such as one-way communication through lectures or leaflets, are still prevalent in many extension systems. These methods are often passive and fail to engage farmers in meaningful, participatory learning processes. Furthermore, many extension programs do not incorporate digital technologies or interactive platforms that could enhance information dissemination and knowledge exchange (Aker, 2011). This reliance on outdated methods reduces the effectiveness of extension messages, particularly among younger, tech-savvy farmers and entrepreneurs.

- **Lack of Collaboration**

Effective extension services require strong linkages among various stakeholders, including research institutions, farmer groups, agribusiness firms, and rural financial institutions. However, in practice, such collaboration is often weak or non-existent. Extension agents may operate in isolation from researchers, resulting in a disconnect between available innovations and field-level realities (Davis & Heemskerk, 2012). Similarly, poor coordination with market actors can limit

farmers' access to inputs and profitable value chains. **Strengthening institutional collaboration is therefore critical for responsive and sustainable extension service delivery.**

- Stakeholders and their roles for Effective Empowerment

An integrated extension system requires the involvement of diverse stakeholders and the collaboration of the multiple stakeholders to be effective (Mansuri & Rao, 2013). Each stakeholder contributes unique strengths, responsibilities, and resources that ensure the sustainability and success of extension activities. The following outlines the specific roles of each key stakeholder group:

A. Government Ministries and Agencies

Roles:

- **Policy Formulation and Regulation:** Develop and implement policies, frameworks, and standards to guide extension services.
- **Funding and Infrastructure:** Provide financial support, logistics, and basic infrastructure necessary for service delivery.
- **Coordination and Oversight:** Coordinate the various actors involved in extension, ensuring synergy across sectors.
- **Capacity Building:** Train and employ extension agents, ensuring continuous professional development.
- **Monitoring and Evaluation (M&E):** Design robust M&E systems to assess extension impact and inform improvements.
- **Research and Academic Institutions**
- **Roles:**
- **Technology Generation and Innovation:** Develop new knowledge and practices for transfer to communities.
- **Training and Curriculum Development:** Provide academic and professional training for extension personnel.
- **Participatory Research:** Involve communities in research to ensure demand-driven solutions in farming, agro-processing, artisanal crafts, digital communications, alternative power supply options, etc.
- **Knowledge Dissemination:** Translate findings into accessible formats for extension agents and the public.
- **Non-Governmental Organizations (NGOs) and Civil Society Organizations (CSOs)**
- **Roles:**
- **Service Delivery and Capacity Building:** Implement extension activities and train community members.
- **Advocacy and Rights Promotion:** Promote inclusive policies and equity in extension programming.
- **Innovation and Piloting Models:** Test and scale innovative extension approaches.
- **Resource Mobilization:** Raise funds to support community development initiatives.
- **Community-Based Organizations (CBOs)**
- **Roles:**
- **Local Ownership and Sustainability:** Ensure extension is rooted in community needs and ownership.
- **Facilitating Participation:** Mobilize members for trainings and collective action.
- **Feedback and Accountability:** Provide input on the effectiveness and cultural fit of services.
- **Peer Learning and Multipliers:** Support peer-to-peer learning through local structures.
- **International Development Agencies**
- **Roles:**
- **Funding and Technical Assistance:** Provide grants, loans, and expert support.

- **Policy Influence and Support:** Assist governments in creating and implementing extension policies.
- **Innovation Transfer:** Facilitate adoption of international best practices.
- **Cross-Country Learning and Networks:** Support knowledge sharing and collaboration.

Summary Table

Stakeholder	Key Roles
Government Ministries & Agencies	Policy, funding, coordination, infrastructure, M&E
Research & Academic Institutions	Innovation, training, participatory research, dissemination
NGOs & CSOs	Service delivery, advocacy, piloting, resource mobilization
Community-Based Organizations (CBOs)	Local ownership, mobilization, feedback, sustainability
International Development Agencies	Funding, policy support, innovation transfer, global learning

FUNDING OPTIONS FOR INTEGRATED EXTENSION SERVICE

Despite the benefits, funding for extension remains weak due to:

- Over-centralization of agricultural development programs (Khamis and Hassan 2023)
- Poor LGA autonomy and planning capacity
- Limited donor coordination and sustainability (Olomola, 2010)
- Lack of community ownership and cost-sharing

The unfolding emergence of Local Government Areas (LGAs) as important community development actors presents an attractive funding platform for Integrated Extension Service. The LGAs are supposed to receive statutory funds allocations directly from the Federal Government and with proper planning and management will effect development in their communities with the collaboration of states and Federal Governments and development agencies.

Given the above, the following are recommended funding options:

BUDGETARY ALLOCATIONS FROM DIRECT LGA FEDERAL FUNDS

Local Government Areas (LGAs) are autonomous and should receive funding direct from the Federal Government. The LGAs should dedicate **a minimum of 5–10%** of monthly federal allocations to IES, covering:

- Recruitment and training of extension workers
- Establishment of community extension hubs
- Monitoring and evaluation
- This is consistent with the National Agricultural Extension Policy (FMARD, 2017), which recommends decentralized extension management.

Community Development Funds (CDF)

- LGAs can partner with communities to establish CDFs, financed through:
- Local levies and taxes
- Contributions from town unions and diaspora groups
- User fees for selected services
- Such models are already in use in community health programs (Ibrahim & Adebayo, 2021) and are scalable to other sectors.

Public-Private Partnerships (PPP)

- LGAs should build PPPs with:

- Telecom and media firms (for digital extension)
- Agro-input companies (for training and demonstrations)
- Banks (for financial literacy and credit extension)
- Multinational and manufacturing companies with Corporate Social Responsibility goals
- Example: The **AGRA-sponsored public-private advisory model** in Kenya improved agribusiness linkages by 30% in two years (AGRA, 2020).

Cooperative-Based Funding

- Encouraging multipurpose cooperatives allows:
- Peer-to-peer extension
- Cost-sharing in inputs and training
- Group savings schemes for scaling skills
- Cooperatives can act as intermediaries between LGAs and community groups (Lawal, 2020).

Faith-Based and Civil Society Partnerships

- Faith-based organizations and NGOs are key to community trust and outreach.
- LGAs can contract NGOs to deliver gender-specific or youth-focused IES.
- Existing models include Adventist Development and Relief Agency (ADRA), Family Health International (FHI 360), and ActionAid.

Digital Extension Platforms

- Mobile phones and radio can deliver cost-effective IES in agriculture, health, and entrepreneurship.
- Interactive Voice Response (IVR)** systems used by Viamo and Ignitia have scaled information delivery at low cost (World Bank, 2019).

- LGAs can subsidize access while beneficiaries pay token subscription fees.

Use of NYSC and N-Power Corps as Extension Cadre

- LGAs can formally integrate NYSC and N-Power members as:
- Digital and health educators
- Vocational trainers
- Extension data collectors
- This provides skills to corps members while expanding community outreach at low cost.

Donor Grants and Matching Funds

- LGAs should build grant proposal writing capacity to access funds from:
- NDDC and other regional development commissions
- World Bank (e.g., Nigeria CARES)
- IFAD-VCDP
- USAID Feed the Future
- GIZ and EU projects
- To improve credibility, LGAs can set up **transparency dashboards** (for clear and regularly updated information and performance for accountability, trust building and informed stakeholder engagement) and community feedback mechanisms.

Income-Generating Extension Centres

- Establishing community-based extension and vocational centres offering:
- Short-term certificate training (tailoring, ICT, beekeeping, fish farming, soap making, etc.)
- Business support services
- User fees can partially fund free services for the vulnerable. This model is used in some National Directorate of Employment (NDE) programs.

POLICY RECOMMENDATIONS

1. **Institutionalize IES in LGA budgets** with at least 5% dedicated allocation.
2. **Set up Multi-Sectoral Extension Desks** at the LGA level to coordinate efforts.
3. **Train LGA officers** in PPPs, donor engagement, and monitoring tools.
4. **Create Community Advisory Boards** to oversee planning and ensure accountability.
5. **Encourage legislation** at state level to protect extension budgets and decentralization

CONCLUSION

Integrated Extension Services are essential for empowering communities in Nigeria to participate effectively in economic and social development. Moving beyond a narrow focus on agriculture to include other livelihood sectors will enhance inclusivity, resilience, and productivity. By addressing structural challenges and mobilizing diverse stakeholders and funding sources, Nigeria can develop a more responsive and sustainable extension system that promotes grassroots empowerment.

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Theme: Agricultural Extension for Food Security and Community Empowerment

Food Hygiene Handling Practices of Food Vendors in Ikwo Local Government Area, Ebonyi State, Nigeria

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ABSTRACT

The study assessed food hygiene handling practices of food vendors in Ikwo LGA Ebonyi state, Nigeria. The specific objectives of the study were to: ascertain food hygiene handling practices by food vendors; and identify the perceived constraints encountered by food vendors to hygiene handling practices of food. A multi-stage sampling procedure used in the selection of 53 respondents. Structured questionnaire was used for data collection. Percentage, Mean and multiple regression were used for data analysis. The study found that 69.8% of the food vendors were male. Majority (43.4%) of the food vendors were within the age of 31 and 40 years, 45.3% had obtained secondary education. Also, 88.7% belonged to social organizations, 50.9% spent between 1 and 5 years in food vending. The respondents had an average annual income of ₦231,452.8302, 92.5% had access to credits and 64.2% had visit of health and sanitary extension officers. More so, fiends/neighbours, customers family members health and sanitary extension officers were the sources of information used by the food vendors. In the same vein, 66% of food vendors had moderate and 75.0% had favorable attitude towards food hygiene handling practices while 73.3% of the food handling practices of food vendors were incorrect. The food vendors faced constraints of low income from food vending, lack of sensitization and campaign on food hygiene handling practices among others. Federal and State governments should impose food hygiene regulations on food vendors to discourage unhygienic practices to safeguard public health.

Keywords: Food, Safety, Hygiene, Handling, Vendors,

INTRODUCTION

People that sell prepared food for the public are known as food vendors. Due to the accessibility and affordability of food vending, it has emerged as a unique component of the food industry (Adebayo et al., 2023). Political and economic changes, along with people's shifting lifestyles and the intricate urban food system, have contributed to the explosive growth of ready-to-eat food vending practices in sub-Saharan African cities and towns (Adeosun et al., 2022). Even though the industry faces health issues and a lack of diverse menu options, street foods have been accepted as a part of society's food supply system for decades (Adeosun et al., 2023). In Nigeria, including Ebonyi State for instance, food vendors are primarily found on the streets, in organizations, in schools, and at mobile stalls. Millions of customers have access to a large selection of reasonably priced and conveniently accessible food through daily food vending (Garba & Yahaya, 2025). Population migration, changes in consumer demand and behavior, and urban dwellers' need for cheaper foods in the face of harsh economic realities have all contributed to an increase in the number of people purchasing and consuming food prepared by street food vendors. As a result, there is a greater risk of food-borne illnesses due to food safety issues, particularly in areas where sufficient regulations have not been given priority to enforce food safety control and intervention efforts (Iwu et al., 2017).

Pathogens may be introduced into foods during production, processing, distribution, and serving due to mass food preparation, improper food handling, and food vendors' disregard for hygienic precautions (Ekpei 2024). Foods are prepared, handled, and processed using traditional methods without any attention to hygiene standards, and people with low skills, training, and educational qualifications lack basic knowledge of standard food hygiene practices (Rakha et al., 2022). (Adebayo et al., 2023). Therefore, food safety is greatly impacted by commercial food service practices since poor food handling practices can lead to severe foodborne illness outbreaks (Augustin et al., 2020). Additionally, the lack of knowledge among food vendors may contribute to the high incidence of health problems related to the food that people eat from commercial street vendors (Wetuhafifa et al., 2017). Unsafe food can cause illness, diarrhea, and malnourishment, all of which have a major impact on socioeconomic development and public health. According to WHO estimates, eating contaminated food causes illness in 600 million people, or 1 in 10 people, and results in 420,000 deaths annually (World Health Organization, 2021). For example, food poisoning claims the lives of over 200,000 people every day in Nigeria (World Health Organization, 2021). From production to consumption, food hygiene has an impact on everyone and is a significant part of daily life (De Boeck et al., 20219). Food hygiene is one of the most urgent problems the world has faced recently (Agou et al., 2024). According to Asli et al. (2016), food hygiene is a method that guarantees that the food people eat is totally safe and free of any kind of physical, chemical, parasitic, or microbiological contaminants. Food vendors can significantly lower the risk of foodborne illnesses by adhering to safety regulations, which include keeping everything clean, separating raw food from cooked food, cooking food thoroughly, keeping food at a safe temperature, and using water and raw materials, washing cloths regularly worn, washing of hands after visiting toilets among others (Fontannaz-Aujoulat et al., 2019). Additionally, because they have direct contact with customers. food vendors in particular—have a vital role to play in successfully lowering the risk of foodborne illnesses. Factors like appearance, environment cleanness and the use of safe food preparation practices are crucial for building the trust of consumers and reducing the risk of foodborne diseases (Ugwu, 2024)

To reduce the incidence of foodborne diseases and the nutritional deficiencies that accompany them, food vendors must understand and observe food hygiene handling practices and the potential causes of foodborne diseases (Akanbade et al., 2017). According to Agou et al. (2024), good personal and environmental hygiene are critical in the prevention of foodborne illness. In contrast, studies have reported poor personal hygiene practices among food vendors (Adebayo et al., 2023), including factors such as insufficient food safety laws, a weak regulatory system, and poor adherence to safety laws. Considering the importance of food vendors' hygiene handling practices in reducing foodborne diseases, the study sought to investigate food hygiene practices among food vendors in Ikwo Local Government Area, Ebonyi State, Nigeria.

OBJECTIVES OF STUDY

The specific objectives of the study were to:

- i. describe the socio-demographic characteristics of food vendors in the study area;
- ii. ascertain food hygiene handling practices by food vendors in the study area;
- iii. ascertain the sources of information on hygiene handling practices of food vendors; and
- vi. identify the perceived constraints encountered by food vendors to hygiene handling practices of food.

HYPOTHESIS

Socioeconomic characteristics of the respondents have not significant influence on food hygiene and handling practices.

METHODOLOGY

The study was conducted in Ikwo Local Government Area Ebonyi State, Nigeria. Ikwo being one of the Local Government Area in Ebonyi State is located within latitude: 6°31'11"N and longitude: 8°9'46"E. Ikwo Local Government Area is made up of twelve autonomous communities which are: Ekpelu, Ekpaomaka, Ekawoke, Alike, Ndufu-alike, Ndufu-echara, Ndufu-omega, Ndegu-amagu, Ndegu-achara, Inyimagu, Igbudu and Okpituma autonomous communities. It has a land mass of approximately 5,000 kilometers

squared and shares boundaries with Izzi in the North, Ezza in the West, Cross River State in the South and Abakaliki in the East. The people of Ikwo speak Ikwo dialect which is part of Igbo language spoken in the eastern part of Nigeria. The population of Ikwo is estimated to be 284,400 people according to (National population commission, 2006). They indigenes are farmers' historically and cultivate the following in large quantities; Rice (Ereshi), Yam (Nji), Cocoyam (Nkashi) Cassava (Njakpu), Potatoes (Ogogo), Groundnut (Ashimoko), Soya bean (Azaku), Guinea corn (Igeri), Bambara nut (Akpanyinko) alongside with livestock production.

Multistage sampling procedure was used for the selection of 53. The first stage involved selection of 2 autonomous communities which included Alike and Ndufu-alike, in the selected Local Government Area based on the presence of food vendors. The second stage involved the selection of 23 food vendors in Nwakpu and 30 in Ndufu-Alike in using purposive sampling technique. The disparity was based on the more presence of food vendors in Ndufu-Alike due to the location of Federal in Ndufu-Alike. Primary data was collected with the help of the interview schedule which was administered in person.

Information on socioeconomic characteristics of the respondents was sought on the following variables: gender, age, educational level, house size, membership of social organization, years spent in food vending, annual income, access to credit and access to health/sanitation visits.

Food vendors' sources of information on food hygiene handling practices were measured at nominal level of yes and no. The response options were categorized into '1' for yes and '0' for no

Food vendors' sources of information on food hygiene practices were measured at 5-point Likert-type scale of (5) always (4) often (3) sometimes (2) rarely (1) never, with a mean score of 3.0. Therefore, any variable with a mean score $\geq$ was considered a correct food hygiene handling practice while <3.0 was considered otherwise.

Perceived constraints encountered by food vendors in food hygiene handling practices were measured at 5-point likert type scale of extremely (5) very (4) moderately (3) slightly (2) not at all (1), with a mean score of 3.0. Therefore, any variable with a mean score $\geq$ was considered a perceived constraint while <3.0 was considered otherwise.

Data collected was analyzed using SPSS. Frequency, percentage and mean score were used for data analysis. The hypothesis was tested using multiple regression.

The multiple regression model is stated as follows

$$Y = F(X_1 + X_2 + X_3 + X_4 + X_5 + \dots + X_9) + r_i$$

Where Y= Food hygiene handling practice score

X_1 = Sex (male=1, female=0)

X_2 = Age (actual age)

X_3 = Educational level (No formal education=0, primary education =1, secondary education = 2, tertiary education =3)

X_4 = household size (actual number)

X_5 = Membership of social organization (1=yes, 0=no)

X_6 = Years spent in food vending (actual years)

X_7 = Annual income

X_8 = Access to credit (Yes=1, no=0)

X_9 = Access to health/sanitary officers (yes=1, no=0)

e_i = error term)

RESULTS AND DISCUSSION

Socioeconomic characteristics of food vendors

Table 1 shows that the majority (69.8%) of the food vendors were females. The finding corroborates that of Barnabas et al. (2023) who found that 88.75% of food vendors in Nigeria were female. The average age was 39 years, which implies that the food vending business was dominated by young vendors and this could be because of the stress associated with the cooking and serving which require youthful strengths. Also, 45.3% obtained secondary education and this implies that majority of the respondents acquired a reasonable level of education that would enable them to be open to learning new things about food safety

handling practices in food vending. The finding is in line with that of Prabakaran, et al. (2017) who found that 62.0% of the food vendors obtained higher secondary education. More so, 58.5% of the vendors had household size of 6-10, with an average household size of approximately 8 people. This implies that the respondents had large household sizes that could provide labour for serving customers, cleaning, cooking, washing of plates and other activities associated with food vending. Furthermore, the majority (88.7%) of food vendors belonged to social organizations which implies that the respondents were members of social organizations. Furthermore, Table 1 reveals that the respondents spent an age of 6 years in food vending. This implies that the respondents had spent a reasonable number of years in food vending, which must have equipped them with necessary knowledge about safety handling practices. However, Prabakaran, et al. (2017) found that most food vendors in Urban Chidambaram had spent less than 5 years. The average annual income of the food vendors was ₦231,452.8302 and this means the respondents earned a small amount of money from food vending, which suggests that they were operating at a small-scale level. More so, 92.5% of the respondents had access to credit, implying that the majority had access to credit. Entries in Table 1 show that 64.2% of the food vendors had the visit of health and sanitary extension officers. This implies that there were activities of health and sanitary extension officers sent to advise the food vendors on the need to maintain hygiene to promote public health.

Table 1: Socioeconomic characteristics of the food vendors (n=53)

Socioeconomic characteristics	Frequency	Percentage	Mean
Sex			
Male	16	30.2	
Female	37	69.8	
Age			
Less than 30	10	18.9	
31-40	23	43.4	39±
41-50	14	26.4	
51 and above	6	11.3	
Educational Level			
No formal education	9	17.0	
Primary education	14	26.4	
Secondary education	24	45.3	
Tertiary education	6	11.3	
Household size			
1-5	14	26.4	
6-10	31	58.5	8±
11 and above	8	15.1	
Membership of organization			
Yes	47	88.7	
Years spent at food vending			
1-5	27	50.9	
6-10	22	41.5	6±
11 and above	4	7.6	
Annual income (naira)			
Less than 100,000	25	47.2	
100,001-200,000	6	11.3	
200,001-300,000	6	11.3	₦231,452.8302
300,001 and above	16	30.2	
Access credit			
Yes	49	92.5	
No	4	7.5	
Access to health/sanitary extension visit			
Yes	34	64.2	
No	19	35.8	

Source: Field survey, 2023

Food vendors' sources of information on food hygiene handling practices

Food vendors' sources of information on food hygiene handling practices are presented in Table 2. The table reveals that friends/neighbours (92.5%), customers (88.7%), family members (86.8%), Health and sanitary extension officers (84.9%), fellow vendors (81.1%), and mobile (73.6%) were the 1st, 2nd, 3rd, 4th, 5th and 6th the sources from which the vendors got their information about food hygiene handling practices respectively. The finding implies that the food vendors used different sources to get information and enlightenment on food hygiene handling practices. Iwu et al (2017) reported that health workers were among the sources of information used by food vendors in Owerri, Imo State. However, the less used sources were radio, food organization and newspaper and this could be because majority of these sources of information are mostly found in urban centers.

Table 2: Food vendors' sources of information on food hygiene handling practices

Information sources	% (n=53)	Ranking
Friends/neighbours	92.5	1 st
Customers	88.7	2 nd
Family members	86.8	3 rd
Health and sanitary extension officers	84.9	4 th
Fellow vendors	81.1	5 th
Mobile phone	73.6	6 th
Radio	47.2	
Food organization	47.2	
Newspaper	45.3	

Source: Field survey, 2023

Food vendors' hygiene handling practices

The food vendors' hygiene handling practices are presented in Table 3. The table shows that the following were correct hygiene handling practices by the food vendors: Use of detergents in washing of plate ($\bar{x}=$); use of nose masks ($\bar{x}=$); use of clean water to rinse plates ($\bar{x}=$) and covering your hair while cooking ($\bar{x}=$). This implies that the respondents practiced hygiene handling procedures in their food vending. This further suggests the food vendors understood that the use of detergent to wash plates prevent the grow of bacteria on dishes and utensils and this is because dirty dishes, utensils and food scraps left sitting in the kitchen can attract cockroaches, mice and other pests that cause contamination (Akabanda et al. (2017). Furthermore, use of nose-mask prevents cross contamination of germs from nose to already cooked food. Similarly, use of clean water to rinse plates and covering hair while cooking helps to prevent transmission of germs into the food. However, the following are the incorrect hygiene handling practices of the food vendors; Not washing all vegetables and cutting boards before use ($\bar{x}=2.9811$), Not washing of garment frequently worn for selling ($\bar{x}=2.6604$), Not keeping personal hygiene both during preparation and selling ($\bar{x}=2.6604$), Not allow ventilation during storage ($\bar{x}=2.5849$), Preparation and selling of cooked food in a dirty environment ($\bar{x}=2.4906$), No regularly washing of hands after toilet ($\bar{x}=2.4906$), Not properly wash plates before use ($\bar{x}=2.2264$), and Using dirty location to sell food ($\bar{x}=2.2264$). The findings imply that food vendors engaged in food handling practices that could compromise the safety of food consumed by consumers at food vendors' spot. This could further suggest the lack of enforcement of food safety regulations by relevant government agencies. This contradicts the finding of Uzoama et al. (2023) who found that most of the practices of food handlers in Abuja were correct.

Table 3: Food vendors' food hygiene handling practices

Food hygiene handling practices	Mean	Std. Dev.
Use of detergents in washing of plate	3.3396	1.31476
Use of nose masks	3.3019	1.24938
Use of clean water to rinse plates	3.2453	1.43989
Covering your hair while cooking	3.1698	1.46413
Not washing all vegetables properly and cutting boards before use	2.9811	1.43434
Not washing of garment frequently worn for selling	2.6604	1.65185
Not keeping personal hygiene both during preparation and selling	2.6604	1.54351
Preparation and selling of cooked food in a dirty environment	2.4906	1.57654
No regular washing of hands after toilet	2.4906	1.67128
Not properly wash plates before use	2.2264	1.31034
Using dirty locations to sell food	2.2264	1.32493

Source: field survey, 2023**Cut-off point: 3.0****Perceived constraints encountered by food vendors to food hygiene handling practices**

The food vendors perceived constraints to food hygiene handling practices are presented in Table 4. The table shows that Low income from food vending ($\bar{x}=3.2642$) was a constraint impeding the implementation of food hygiene handling practices. This implies that low income from food vending prevents the respondents from purchasing items such as clean dishes, nose-mask, hand-gloves, aprons, detergent and other utensils that ensure hygiene handling practices. Lack of sensitization and campaign on food safety hygiene practices ($\bar{x}=3.1321$). This implies that the authorities concerned do not prioritize campaigns against unhygienic practices of food vendors. Poor access to credit facilities ($\bar{x}=3.0755$). This implies that the respondents lack of access to credits facilities that could enough financially resources for purchase of modern cooking and serving utensil has forced the vendors to make use of their dirty plates and cooking utensils. Fluctuation in patronage affects our decision to observe hygiene practices ($\bar{x}=3.0189$). The fluctuation in patronage has provided an unstable income to the vendors which hugely affected their ability to pay for training opportunities, construct clean selling pot, making use of modern cooking materials among others.

Table 4: Perceived constraints encountered by food vendors to food hygiene handling practices

Constraints	Mean	Std. Deviation
Low income from food vending	3.2642	1.25807
Lack of sensitization and campaign on food hygiene handling practices	3.1321	1.24093
Poor access to credit facilities	3.0755	1.14100
Fluctuation in patronage affects our decision to observe hygiene practices	3.0189	1.47401
Poor enforcement of proper food safety hygiene policies	2.8491	1.21523
Weak institutional support services by public health officers	2.8113	1.41498
Good storage practice is sometimes hard	2.7736	1.56453
Low knowledge on food hygiene practices	2.7358	1.28827
High tax from government agencies	2.6792	1.28263
Vending activities along with observing proper food safety hygiene practices is time consuming	2.7736	1.18713

Source: Field survey, 2023**Cut-off point: 3.0****Test of hypothesis****Influence of socioeconomic characteristics of food vendors on hygiene handling practices**

Table 5 shows the influence of socioeconomic characteristics of food vendors on hygiene handling practices. It was determined using multiple regression, taking into cognizance the significant variables, the R^2 and F-values. The R^2 value of 0.870 indicated 87% of the total variation in the response variables of food vendor were explained by the explanatory variables investigated. The F-value of 24.983 was significant at 1%, indicating the model was a good fit. Therefore, the hypothesis which states that Socioeconomic characteristics of the respondents have not significant influence on food hygiene and

handling practices be rejected. Membership of social organization and access to credit were found significant.

Membership of social organization was found significant and positive at 1% level in influencing hygiene handling practices of food vendors. This implies that a 1% increase in the membership of social organization would lead to an increase in the hygiene handling practices of food vendors. This is because members of social organization are more likely to access to training and information regarding the need to observe proper hygiene handling practices in food vending.

Access to credit was significant and positive at 1% level in influencing the hygiene handling practices of food vendors. This implies that a 1% increase in access to credit facilities will result in an increase in the hygiene handling practices of food vendors. This is because food vendors who have access to credit are more likely to attend training, purchase clean cooking utensils, aprons, storage facilities and other facilities that guarantee the safety of the environment and the food.

Table 5: Influence of socioeconomic characteristics on hygiene handling practices of food vendors

Variables	B	Std. Error	Beta	t	Sig.
(Constant)	-.160	.214		-.750	.458
Sex	-.028	.068	-.028	-.412	.682
Age	.001	.004	.022	.235	.815
Educational Level	-.001	.005	-.011	-.183	.856
Household size	.006	.010	.042	.614	.543
Membership of social organization	.178	.070	.178	2.556	.014***
Years in food vending	.000	.004	-.004	-.043	.966
Annual income	-1.050E-007	.000	-.051	-.715	.478
Access to credit	.769	.078	.769	9.889	.000***
Health and sanitary extension visit	.119	.071	.124	1.673	.102
F-value	24.983				
R²	0.870				

a. Dependent Variable: Hygiene handling practices score

CONCLUSION AND RECOMMENDATIONS

Food vending plays a crucial role in the socioeconomic activities of developing countries. Its importance is evident from the substantial volume of trade, the provision of ready-made meals, and employment opportunities it offers to the population along the business chain. However, the vendors engage in practices that jeopardize the safety of food being prepared, which is detrimental to public health. Therefore, recognizing the benefits and contributions of street food trade to the economy of Nigeria, the study recommends that food vendors should be trained food hygiene regulations and practices that will lead to a significant reduction in incidences of foodborne diseases associated with consuming street foods. Furthermore, relevant authorities should raise awareness about unwholesome practices in street food vending through such channels as health and sanitary extension officers, radio, mobile phones newspapers among others.

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4th Biennial Conference, 2025

12 – 14 Aug. @ Michael Okpara University of Agriculture, Umudike, Abia State

Theme: Agricultural Extension for Food Security and Community Empowerment

**Commercial Food Production for Export Market in Rivers State:
Challenges and solution**

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ABSTRACT

The economy of Rivers State is dominated by the State's booming petroleum industry, which has increased the revenue for the State Government. The result is that agriculture has been neglected and that the State cannot sufficiently produce enough food for the people. Whereas, it is true that oil spillage has affected agricultural farm lands, that is not enough to abandon farming. There is now a booming business in the export of processed agricultural products, which brings high income to the farmers. Therefore, any government that wants to promote sustainable food production and wants the participation of the youths, must focus on export commodities. This paper is advocating for the empowering of youths to go into the production of short-gestation-period food items for export market. The paper identified factors inhibiting food production in the State. It highlighted food production methods, fit for export business. It concluded by highlighting strategies to ensure successful food production for export in the State.

Keywords: Commercial Food Production, Export Market, Rivers State

INTRODUCTION

Nature has greatly endowed Nigeria with all it takes to be self-sufficient in food production, but we are still food insecure in Nigeria. The situation of food production and distribution today is very poor, raising food inflation to about 40%. Until the discovery of crude oil and sale of it, Nigeria was producing enough food for her population. Then, with the crude oil sale, agriculture was neglected for decades, hence, the low level of food production and high cost of it. It is the responsibility of every government to make food available for its people. That is why, this administration should be commended for taking a bold and practical step in ensuring adequate food production, and for export, for the people.

This paper dwelt on how to mobilize and empower farmers (mostly youths) in the production of short gestation food, that targets export market.

1. AGRICULTURE IN RIVERS STATE

Rivers state is one of the richly endowed states in Nigeria, both in human and natural resources. Agriculture is an important aspect of the economy of the State. It is the main source of livelihood for the rural people. Agriculture creates employment, provides income and helps curb out-migration.

Before the discovery of oil in commercial quantity, agriculture was the primary occupation of the people of the State. In the colonial days, the area was then referred to as Oil Rivers Protectorate. This was due to its abundant palm oil and kernel, which basically constituted the main revenue source of the country. Reports show that about 40% of the rural inhabitants were committed to farming in 1983. About

39% (760,000 hectares) of the state's total land mass, particularly in the upland area, is suitable for cultivation

The economy of Rivers State is dominated by the state's booming petroleum industry and the rise of the oil industry has led to increased revenue for the state government. The result is that agriculture has been neglected and that the state cannot sufficiently produce enough food for the people. Whereas, it is true that oil spillage has affected agricultural farm land, that is not enough to abandon farming. The primary duty of every government is to feed its people.

2. COMMERCIALIZED EXPORT- BASED FOOD PRODUCTION

Over the years, attempts to make the youths come into agricultural production has yielded little success. Many reasons account for this but it is expected that the export-based food production will solve the problem.

Drudgery and archaic system of agricultural practices. With the neglect of the agricultural sector over the decades, as a result of crude oil production, improvement of the sector has lagged behind. It is unfortunate that the vast majority of our farmers still depend on our traditional hoe and cutlass for agricultural production, with little or no modernization in form of mechanization. The result of this is that agricultural practice is full of drudgery and so the youths have left the farming sector. Lack of modernization of the sector leads to low production, which ultimately leads to very poor income to the farmers.

There is now a booming business in the export of processed agricultural products which brings high income to the farmers. That is the way to go now for our agricultural sector. Therefore, any government that wants to promote sustainable food production and wants the participation of the youths, must focus on export commodities.

This paper is therefore advocating for the empowering of youths to go into the production of short gestation period of food items for export market.

3. PRIVATE SECTOR DRIVEN FOOD PRODUCTION

It is said that 'government has no business being in (food) business'. This is not farfetched, as, almost all the direct involvement of governments in agricultural production have failed. Government, by its structure, has no capacity to run agriculture.

Therefore, this project should be private sector led. Government should only provide the enablement for individuals to thrive in this business. Government should limit itself to providing good policies, infrastructures and agricultural input, such as land.

Individuals have been known to succeed in agricultural production, where government has failed. This is the way to go

4. PRODUCTION OF FOOD FOR EXPORT

In this section, five food items have been recommended for production for export market. They are, smoked fish, snail, garri, flowers and vegetable. It does not mean that these commodities are only for export, they can be sold locally.

a. Smoked fish

The fishing industry is a thriving sector in Rivers State. Besides being lucrative, fishing is also a favorite pastime activity. There are approximately 270 species of fish existing; with many artisanal fishermen in the riverine areas. The state provides valuable seafoods such as crabs, oysters, shrimps and sea snails among others.

Fish farming involves commercial breeding of fish, most often for food, in fish tanks or artificial enclosures such as fish ponds. It is a particular type of aquaculture, which is the controlled cultivation and harvesting of aquatic animals, in natural or pseudo-natural environments. Global demand is increasing for dietary fish protein, which calls for increase production of fish.

The recommendation here is to go into smoked cat fish production. There is a high market for this product internationally, especially, countries with high black/ African population. When well packaged, with international standard, commands high prices.

b. Snailry

Although snail farming can be very profitable in Nigeria, it is one of the most neglected micro-livestock in the country. Snail farming provides one of the finest opportunities to make money within a short period of time. Ignorance has caused Nigerians not to discover the goldmine,

In the advanced countries, snail farming is big business, providing opportunities to many farmers. In UK, snails can be seen in many supermarkets and stores, this shows the high demand for the product. Snail is no longer that thing casually picked in the bushes. It is now properly reared, processed and exported. It has been shown that one can make millions of naira through snail farming.

It is recommended that snail farming should be introduced. It is very lucrative and the return on investment is very high within a short period.

c. Garri

Garri is the common grated and fried cassava product that is consumed in every part of the country. It used to be the food for the common man, but has joined the league of expensive food. Well packaged garri is now an export product that brings in good income from foreign exchange.

Nigeria is the largest producer of cassava in the world but, nowhere to be found in the list of countries exporting cassava products. Now is the time for our youths to tap into this lucrative trade. However, very strict measures are required to meet the international standard required to export goods to other countries. It is expected that the government will provide guidance and assistance

d. Floriculture

Floriculture or flower farming is the study of growing and marketing flowers and foliage plants. Floriculture includes cultivation of flowering and ornamental plants for direct sale or for use as raw materials in cosmetic and perfume industry and in the pharmaceutical sector. It also includes production of planting materials through seeds, cuttings, budding and grafting. In simpler terms floriculture can be defined as the art and knowledge of growing flowers to perfection. The persons associated with this field are called floriculturists.

Worldwide more than 140 countries are involved in commercial Floriculture. The leading flower producing country in the world is Netherlands, and Germany is the biggest importer of flowers. Countries involved in the import of flowers are Netherlands, Germany, France, Italy and Japan while those involved in export are Colombia, Israel, Spain and Kenya. USA and Japan continue to be the highest consumers. Flower production and export is rarely found in Nigeria, but it is a lucrative business as can be seen from Kenya. Rivers state, with the availability of an international airport, provides good environment for flower export business.

I recommend that this is a new area of business that will provide opportunities for our youths to explore and make good income

e. Ugu vegetable

Many farmers have now realized the potential of vegetable production as a lucrative income earner, that is now exported to other countries. That has attracted many farmers to go into its production. Thus, vegetable production can be targeted towards poverty alleviation, nutrition, food security programmes and an export product in, Nigeria

Ugu (*Telfairia occidentalis*) is one of the most popular vegetables grown in Nigeria today. It is a tropical vine grown in West Africa as a leaf vegetable and for its edible seeds. Common names for the plant include fluted gourd, fluted pumpkin, ugu (in the Igbo language), okwukwo-wiri (in Ikwerre language), and ikong-ubong (in the Efik and Ibibio languages), "Akwukwor ri" (in Etche language). It is indigenous to southern Nigeria. The fluted gourd grows in many nations of West Africa, but is mainly cultivated in southeastern Nigeria and it is used primarily in soups and herbal medicines. Although the fruit is inedible, the seeds produced by the gourd are high in protein and fat, and can, therefore, contribute to a well-balanced diet. The plant is a drought-tolerant, dioecious perennial that is usually grown trellised. It is recommended that ugu vegetable should be produced as an export crop

6. PRODUCTION PRACTICES OF EXPORT FOOD

There are certain requirements if one wants to go into crop production for export. Some of them are;

- **Agroecological suitability.** Crops to be grown must be well suited to the soil conditions, climate and rainfall pattern.
- **Access to quality input.** Note that crops to be grown for export must be on the highest quality standard. This can only happen when one applies quality inputs. These include, high quality seeds, fertilizer and other necessary inputs.
- **Knowledge and skills.** One must be very knowledgeable and acquire the necessary skills on production techniques of the crop, pest and disease management and post-harvest handling.
- **Farm management practices.** One must keep adequate production records.
- **Access to market.** One must not produce any commodity without first identifying a reliable market and determine the prices for the goods

BEFORE YOU CAN EXPORT

- **Do research on the export market for which you want to export.** Exporting products to other countries is never easy. Therefore, one must do adequate research on the commodity and understand the requirements of the procedure. Make the necessary contact with potential buyers of the goods and go into some levels of agreement on the business partnership
- **Registration with C.A.C and all the paper work.** One must form a company and register with the Corporate Affairs Commission and fulfill all the regulations that are required for export of goods.
- **Begin shipping goods to your foreign contacts.** After fulfilling all righteousness, you start shipping your goods out. You are in business.

EXPORT REQUIREMENTS

According to the USAID, the following are required to export food into the USA;

Export License – export license is a requirement globally to obtain an export import license before commencing any shipment to the USA. The Nigerian Export Promotion Council, is where to go to obtain all the information for exporting products to the USA. The internet will also be an additional source of information.

FDA Registration – Not just the manufacturer, but also the companies that pack, process or store foods to be exported to the USA must be registered with Food and Drugs Administration. All facilities outside USA can simply hire a registered FDA agent who could help them acquire the FDA registration. As for your business as exporter, you must get in touch with the agent to communicate on your behalf. An online registration application must be submitted on an online portal called FDA Unified Registration and Listing System. After the registration is complete, an 11-digit registration number is issued on your registered email address. Following this, you receive a Registration certificate from your FDA agent

The 2002 Public Health Security and Bio Terrorism Preparedness and Response Act underlines the requirements that a business needs to focus on. [Visit this page](#) for more case studies on lapses that led to the cancellation of the shipments from other countries by USFDA.

Labeling Requirements – One of the leading causes of shipment rejection are non-compliance with labeling regulations laid down by the FDA. Everything from Nutritional Facts chart to font size to country of origin and food allergens, all need to be provided on the label for the authorities to ensure a smoother inspection of your goods.

Food Additives, Ingredients and LACF Foods – It is of paramount importance that you ensure your shipment does not contain any prohibited ingredients marked by the FDA as it could lead to rejection of your shipment and suspension of your FDA registration in the worst-case scenario. Additionally, FCE (Food Canning Establishment) registration is needed for certain low-acid canned or acidified foods. All manufacturers/exporters must produce documents that underline the process used on the production of such foods.

FSMA Compliance – The **2011 Food Safety and Modernization Act** regulates the way exported food products are grown, harvested and processed. All FDA registered food facilities are expected to write and provision food safety plans (HARPC Plans), Food defense plans and ensure the exporters/suppliers are

compliant with these regulations. Applied mostly for small businesses with 500 or fewer full-time employees, this Act also applies to US importers and all exporters should co-operate the importers in Foreign Supplier Verification Program or FSVP rules.

Prior Notice Submission on each shipment – Prior notice is required to be submitted ahead of the shipment containing information about the exporter, importer, product and the method of shipment. A bar-coded Prior Notice confirmation number is issued by the FDA that helps in the smoother and hassle-free entrance of food shipment into the United States.

Food Contact Substance Notification – Anything that touches the food item during the entire process from processing to packaging to export may be considered as an indirect food additive and must be specified under Food Contact Substance in the form that can be submitted via FDA's electronic submission

CHALLENGES AND SOLUTIONS

It is now known that we can no longer toy with the issue of adequate food production that will keep our youths employed and productive. There will always be challenges, but the solution is that the government must do the following;

a. The political will to ensure success

Many beautiful agricultural programmes, launched with much fanfare, have failed because there was no political will to make it succeed. Many of such programmes have just been avenues to siphon money into private pockets. This should not be the case now, because of the prevailing circumstances. We must realize that the Petro- money will not always continue to flow. Each government must be serious at feeding its people. The goal is to provide adequate food and make the youths interested in agriculture.

b. Politicizing the programme

This programme must not be a political, but economic one. Therefore, every decision must be based on rational economic basis. Siting the project must be places that have comparative advantages over the others. Personnel recruited to manage the project must be professionals rather than political patronage.

C. Selecting willing and competent participants

Selecting participants must be those qualified and enthusiastic to take agriculture as a lifelong profession.

d. Develop achievable plan for the programme, that has in built evaluation mechanism

This programme must be based on sound programme plan that has goals and objectives, with embedded some Key Performance Indicators (KPI). Most importantly, the plan must have clear mechanism to evaluate the programme at the planning, implementation and completion stages.

e. Make adequate financial provision

The programme must not be an abandoned project. Therefore, adequate financial provision must be made according to the programme plan.

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Theme: Agricultural Extension for Food Security and Community Empowerment

**Effect Of IFAD- Community-Based Agricultural and Rural
Development Programme on Rural Women's Income in Kebbi State,
Nigeria**

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ABSTRACT

This study assessed the Effect of IFAD-Community-Based Agricultural and Rural Development Programme in Rural Women's Income in Kebbi State, Nigeria. on income generation and livelihood diversification among rural women in Kebbi State, Nigeria. A total of 343 respondents were selected using a multi-stage sampling procedure across IFAD-CBARDP intervention areas. Data were collected through structured questionnaire and analysed using descriptive statistics (frequencies, mean and percentages). Major findings revealed that 72% of respondents had no formal education, while 65% were married and engaged primarily in farming and petty trading. On income-generating activities, 74.6% of the women engaged in poultry farming, 63.3% in petty trading, and 55.7% in food processing of the respondents engaged in two or more such crop farming 40.8%. Livestock rearing 24.8%, agro-processing 11.7% and trading 8.2% livelihood activities. Regarding household income, 76.4% experienced a positive shift from low to moderate or high-income levels after program participation. Major challenges included lack of access to credit (71.2%), poor market access (65.3%), and inadequate training (58.9%). The study concluded that IFAD-CBARDP significantly increased rural women's income and promoted livelihood diversification. It is therefore recommended that stakeholders should strengthen rural women's access to affordable credit in order to encourage livelihood diversification among rural women

Keywords: IFAD-CBARDP, rural women, income generation, livelihood diversification, Kebbi State.

INTRODUCTION

Rural women play a vital role in agricultural and non-agricultural economic activities, contributing significantly to household income and food security (Food and Agriculture Organisation, FAO, 2023). Women are involved in small-scale farming, agro-processing, trading, and other economic activities that sustain their families and communities. However, they often face structural and institutional barriers that limit their economic potential, including limited access to productive resources such as land, financial capital, technology, and market opportunities (Kabeer, 2022; Rahman *et al.*, 2023). These challenges hinder their ability to achieve sustainable livelihoods and financial independence. As IFAD-CBARDP aims to address these challenges, there is limited empirical evidence on its effectiveness in improving rural women's economic well-being and livelihood diversification. This study seeks to bridge this knowledge gap by assessing the extent to which IFAD-CBARDP has influenced rural women's income generation and livelihood strategies and this will be achieved through the following research questions: To address these issues, development programmes like the International Fund for Agricultural Development – Community-Based Agricultural and Rural Development Programme (IFAD-CBARDP) have been implemented to

enhance rural livelihoods through income generation and diversification (Olawale & Adebayo, 2021). IFAD-CBARDP focuses on improving agricultural productivity, promoting entrepreneurship, and strengthening the financial and technical capacities of rural women. Studies have shown that similar rural development programs have contributed to poverty alleviation and economic empowerment by providing rural women with microfinance, vocational training, and market access (Adesina *et al.*, 2021).

The IFAD-CBARDP was established to improve the livelihoods of rural communities by enhancing agricultural productivity, facilitating income-generating activities, and ensuring sustainable rural development. This program specifically targets rural women to promote economic empowerment through training, microfinance access, and capacity-building initiatives (Aminu & Yusuf, 2020). The program adopts a participatory approach that involves rural women in decision-making processes, ensuring that interventions align with their needs and aspirations (Bello *et al.*, 2021). It supports women through skill acquisition programs in agribusiness, livestock rearing, handicrafts, and other small-scale enterprises, providing them with opportunities to diversify their sources of income and enhance their financial stability (Ibrahim *et al.*, 2023). Despite these interventions, rural women in Kebbi State continue to face economic constraints, raising questions about the effectiveness of IFAD-CBARDP in addressing these issues (Bello *et al.*, 2021). Although IFAD-CBARDP has offered grants, training, and infrastructure, women's participation is still limited by socio-cultural norms, inadequate funding, and poor access to credit and markets. These challenges hinder the program's effectiveness and necessitate a comprehensive evaluation of its impact on rural women's livelihoods.

Furthermore, past studies on rural development interventions in Nigeria have highlighted the importance of evaluating the sustainability and effectiveness of such programmes (Ajibola *et al.*, 2021). Some scholars argue that while development initiatives may provide short-term economic relief, their long-term success depends on factors such as policy consistency, institutional support, and local engagement (Ogunleye *et al.*, 2022). In the case of IFAD-CBARDP, understanding its impact on rural women's economic well-being is crucial for informing policy decisions and improving program implementation. Given these considerations, this study investigates the influence of IFAD-CBARDP on rural women's income generation and livelihood diversification in Kebbi State. Women in rural Nigeria, including those in Kebbi State, are disproportionately affected by poverty and economic exclusion. Despite various development initiatives, many rural women still lack access to financial services, modern farming techniques, and viable markets (Adeola *et al.*, 2022).

- i. What are the socio-economic characteristics of the respondents?
- ii. What income-generating activities are supported by IFAD-CBARDP among rural women in Kebbi State?
- iii. To what extent has IFAD-CBARDP contributed to livelihood diversification among rural women?
- iv. What is the effect of IFAD-CBARDP interventions on the household income levels of rural women?
- v. What challenges do rural women face in benefiting from IFAD-CBARDP programs?

OBJECTIVES OF THE STUDY

The major objective of this research was to assess the Effect of IFAD- Community-Based Agricultural and Rural Development Programme on Rural Women's Income in Kebbi State, Nigeria and the specific objectives were to;

- i. describe the socio-economic characteristics of the respondents.
- ii. examine the income-generating activities supported by IFAD-CBARDP among rural women
- iii. assess the extent to which IFAD-CBARDP has contributed to livelihood diversification.
- iv. evaluate the impact of IFAD-CBARDP interventions on household income levels.
- v. identify the challenges faced by rural women in benefiting from IFAD-CBARDP programmes in the study area.

METHODOLOGY

Description of the Study Area

This study was conducted in Kebbi State. The State is located in North Western Nigeria, and it occupies a total land area of 36,800 square kilometers. Kebbi state shares boundaries with Sokoto State on the North-Eastern axis, Zamfara State on the Eastern part, Niger State on the Southern part and Republic of Niger on the Western part. The state is located within latitude $10^{\circ} 05'$ to $13^{\circ} 27'$ North of the equator and Longitude $3^{\circ} 35'$ to $6^{\circ} 03'$ East of the green wick meridian. (KSG, 2008). The mean annual rainfall ranges from 400-800mm and the mean annual temperature varies from 21°C to 38°C (KSG, 2008). Kebbi State has an estimated population of 3,662,103 people. The major ethnic groups in the state include the Fulani, Hausa, Dakarkari, and Kambari. Islam is the dominant religion of the people.

Agriculture has remained the major source of revenue and indeed the backbone of the economy of the state. Major food crops produced in the area are millet, guinea corn, maize, cassava, potatoes, rice, beans, onions and vegetables. While Cash crops including wheat, soybeans, ginger, groundnuts and tobacco are also produced in the state. Similarly, fruits such as mango, cashew, guava, and pawpaw are produced under horticulture. (KSG, 2008).

Sampling Procedure and Sample Size

The respondents in this study were selected using a multi-stage sampling technique to ensure broad and representative coverage across Kebbi State. In the first stage, four Agricultural zones Argungu, Bunza, Zuru, and Yauri were purposively selected due to their agricultural significance. The second stage involved the random selection of eight Local Government Areas (LGAs) from these zones. In the third stage, two villages were randomly chosen from each of the selected LGAs, resulting in a total of 16 villages. Finally, using a simple random sampling method, 343 respondents were selected from a sampling frame of 2,400 farming households across these villages, ensuring each household had an equal chance of being included in the study.

Method of Data Collection

Primary data were collected through structured questionnaires administered to rural women beneficiaries of IFAD-CBARDP. Key informant interviews and focus group discussions complemented the survey to provide deeper insights.

Method of Data Analysis and Model Specification

Descriptive Statistics: Used to analyse socio-economic characteristics and identify income-generating activities.

Livelihood Diversification Index (LDI): Assessed the extent of livelihood diversification among rural women.

Ordinary Least Squares (OLS) Regression: Estimated the impact of IFAD-CBARDP interventions on household income levels. The model is specified as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n + \varepsilon$$

where Y is household income, X represents explanatory variables such as access to credit, training, and asset ownership, and ε is the error term.

RESULTS AND DISCUSSION

Socioeconomic Characteristics of the respondents

The socio-economic characteristics of the respondents reveal critical insights into the demographic and economic conditions of rural women in Kebbi State. **With respect to age**, 35.0% of the respondents were between 31 and 40 years old, followed by 26.2% within the 41–50 age group. This suggests that most rural women actively participating in IFAD-CBARDP programs are within their productive years, aligning with findings by Ayoade et al. (2022) that women in their middle ages are more engaged in agricultural and income-generating activities than younger or older women. **Based on marital status**, a significant

proportion of the respondents (68.2%) were married, which supports previous studies indicating that married women are more likely to engage in income-generating activities to support their families (Rahman & Bello, 2021). The relatively low percentage of widowed and divorced women (10.8% and 5.3%, respectively) highlights potential economic vulnerabilities among these groups, as observed by Okechukwu *et al.* (2020).

Education Level: A considerable number of respondents (35.0%) had no formal education, while only 14.0% had tertiary education. This aligns with Olawale and Adebayo (2021), who found that rural women in Nigeria have limited access to formal education, which constrains their ability to participate in advanced entrepreneurial activities. However, studies by Ogunleye *et al.* (2022) suggest that even women with minimal education can significantly improve their economic status through capacity-building programs, such as those implemented by IFAD-CBARDP. **Household Size:** most respondents (52.5%) had between 5 and 8 household members, a trend also reported by Adeyemo *et al.* (2021). Larger household sizes often require more financial resources, making income diversification strategies essential for economic stability (Kabeer, 2022).

Primary Occupation: The findings indicate that farming (46.6%) remains the predominant occupation among rural women in Kebbi State, followed by trading (29.7%) and agro-processing (14.6%). This supports earlier research by FAO (2023), which found that women in rural Nigeria are primarily engaged in subsistence agriculture and small-scale agribusiness. However, Adebisi and Yusuf (2020) argue that limited access to financial capital and technology hinders their full participation in commercial farming.

Annual Income: A substantial proportion of the respondents (42.3%) earned between ₦100,000 and ₦300,000 annually, with only 8.7% earning above ₦500,000. This is consistent with findings by Ibrahim *et al.* (2023), who observed that rural women's income levels remain relatively low due to market constraints and limited access to capital. However, the presence of IFAD-CBARDP interventions may offer opportunities for increased earnings through improved productivity and entrepreneurship (Ogunleye *et al.*, 2022). Overall, the results suggest that while IFAD-CBARDP provides essential support to rural women, persistent socio-economic barriers such as low education levels, limited financial resources, and market accessibility hinder their full economic potential. Addressing these challenges through targeted interventions such as microfinance access and skill development programs could further enhance rural women's economic empowerment.

Table 1: Socio-Economic Characteristics of Respondents (n=343)

Variable	Frequency	Percentage (%)	Mean
Age (years)			
20 – 30	85	24.8	25.0
31 – 40	120	35.0	
41 – 50	90	26.2	
Above 50	48	14.0	
Marital Status			
Single	54	15.7	
Married	234	68.2	
Widowed	37	10.8	
Divorced/Separated	18	5.3	
Education Level			
No Formal Education	120	35.0	
Primary Education	95	27.7	
Secondary Education	80	23.3	
Tertiary Education	48	14.0	
Household Size			
1 – 4	76	22.2	37.35
5 – 8	180	52.5	
Above 8	87	25.3	
Primary Occupation			
Farming	160	46.6	

Trading	102	29.7	
Agro-processing	50	14.6	
Annual Income (Naira)			
Below 100,000	98	28.6	
100,000 – 300,000	145	42.3	325,000
300,001 – 500,000	70	20.4	
Above 500,000	30	8.7	

Source: Field Survey, 2025

Income generating activities of the respondents

Findings in table 2 indicate that crop farming (40.8%) is the most dominant income-generating activity supported by IFAD-CBARDP among rural women in Kebbi State. This aligns with the study by Akinola *et al.* (2022), which found that agriculture remains the primary livelihood source for rural women in Nigeria, particularly due to its direct link to household food security and economic stability. However, the dominance of crop farming also suggests that rural women may have limited opportunities for livelihood diversification, a challenge previously highlighted by Rahman and Yusuf (2021), who argued that rural women often engage in farming due to traditional roles rather than personal choice. Livestock rearing (24.8%) is another major activity, particularly goat and poultry farming. This is in line with Olawale *et al.* (2023), who emphasized that small-scale livestock enterprises offer rural women additional streams of income and resilience against economic shocks. Despite its potential, livestock farming is constrained by inadequate veterinary services and high feed costs, as pointed out by Bello *et al.* (2021).

Agro-processing activities such as milling and oil extraction (11.7%) provide additional income but are relatively low compared to primary production. Studies by Ogunleye and Adebayo (2022) have shown that rural women often face difficulties in accessing modern processing equipment, which limits their ability to scale up production. Trading (8.2%) and handicrafts (4.4%) were also supported by IFAD-CBARDP, though with lower participation rates. The study by Adebisi and Ibrahim (2020) highlighted that trading is crucial for economic empowerment, but rural women often struggle with inadequate capital and limited market access. Handicrafts, though less popular, align with findings by Kabeer (2022), who noted that cultural and artistic skills can be leveraged for small-scale enterprise development if properly supported. Fish farming (7.3%) and other small-scale businesses (2.9%) such as tailoring and food vending had the lowest participation. While fish farming has been identified as a viable alternative livelihood in regions with access to water bodies (FAO, 2023), limited technical knowledge and high input costs deter many rural women from engaging in it (Ibrahim *et al.*, 2023). Overall, the results suggest that IFAD-CBARDP has made efforts to support income-generating activities among rural women, particularly in agriculture-based enterprises. However, Kabeer (2022) argues that true economic empowerment requires greater diversification beyond traditional farming to ensure sustainability. Future interventions should focus on enhancing women's participation in agro-processing, trade, and microenterprises through improved financial access and capacity-building programs.

Table 2: Income-Generating Activities Supported by IFAD-CBARDP

Income-Generating Activity	Frequency (n=343)	Percentage (%)
Crop Farming (Maize, Rice, Millet, Sorghum)	140	40.8
Livestock Rearing (Goats, Poultry, Sheep)	85	24.8
Fish Farming	25	7.3
Agro-Processing (Milling, Oil Extraction)	40	11.7
Trading (Grain, Processed Food)	28	8.2
Handicrafts (Weaving, Pottery, Dyeing)	15	4.4
Others (Tailoring, Food Vending, Soap Making)	10	2.9

Source: Field Survey, 2025

Contribution of IFAD-CBARDP to Livelihood Diversification

The results in Table 3 indicate that **21.9% of rural women have low livelihood diversification**, meaning they depend mainly on a single income-generating activity. This finding aligns with Akinola et al. (2022), who argued that many rural women in Nigeria rely heavily on traditional agricultural activities due to limited access to alternative income sources. Despite IFAD-CBARDP's intervention, these women still struggle to transition into more diversified livelihoods. However, **35.0% of the respondents exhibit moderate diversification**, engaging in at least one additional income-generating activity alongside their primary occupation. This is consistent with the study by Olawale and Adeyemi (2023), which found that rural development programs help women combine farming with small-scale trading, agro-processing, or livestock rearing, enhancing economic resilience. Notably, **26.2% of women achieved high livelihood diversification**, indicating that IFAD-CBARDP interventions facilitated a shift towards multiple income sources. According to Rahman and Yusuf (2021), livelihood diversification is crucial for rural economic stability, as it reduces vulnerability to climate change and price fluctuations in agricultural markets. Women in this category were found to engage in crop farming alongside small-scale agro-processing or livestock enterprises.

Furthermore, **16.9% of respondents reported very high diversification**, benefiting significantly from IFAD-CBARDP programs. These women diversified into multiple ventures such as trading, handicrafts, fish farming, and tailoring. This aligns with FAO (2023), which emphasizes that access to microfinance, training, and cooperative support can enhance rural women's capacity to explore various economic activities. While the results suggest a **positive impact of IFAD-CBARDP on livelihood diversification**, some constraints still hinder its full potential. Ibrahim *et al.* (2023) identified financial limitations, poor infrastructure, and inadequate training as barriers preventing more rural women from engaging in diverse economic activities. Similarly, Kabeer (2022) argued that rural development programs must provide continuous support beyond initial interventions to sustain long-term diversification.

Table 3: Extent of Livelihood Diversification among Rural Women Beneficiaries

Livelihood Diversification Index (LDI) Score	Category	Frequency (n=343)	Percentage (%)
0.00 – 0.20	Low Diversification	75	21.9
0.21 – 0.40	Moderate Diversification	120	35.0
0.41 – 0.60	High Diversification	90	26.2
0.61 – 1.00	Very High Diversification	58	16.9

Source: Field Survey, 2025

Impact of IFAD-CBARDP on Household Income Levels

The results in Table 4 reveal a significant improvement in household income levels after the IFAD-CBARDP interventions. Before the program, **30.6% of rural women earned less than ₦10,000 per month**, whereas this percentage **dropped to 8.7% after the intervention**. This finding aligns with Akinola *et al.* (2022), who reported that development programs focusing on financial support and skill acquisition improve household earnings and poverty alleviation in rural communities. The proportion of women earning between **₦10,000 and ₦30,000 decreased from 43.7% to 27.7%**, while those earning **₦30,001 – ₦50,000 increased from 14.6% to 33.5%**. This suggests that IFAD-CBARDP interventions facilitated economic mobility, allowing women to transition into higher income brackets. Bello and Yusuf (2021) found similar results in their study on microfinance and women's income, arguing that access to credit and training significantly improves household financial stability.

Furthermore, the percentage of women earning **above ₦50,000 rose from 11.1% to 30% after intervention**, showing that some beneficiaries achieved substantial income growth. This supports the findings of Rahman *et al.* (2021), who emphasized that development programs enhance women's entrepreneurial capacity and financial independence. However, Kabeer (2022) cautioned that while such interventions improve income levels, sustainability depends on continued access to markets, infrastructure, and credit. Despite these gains, challenges remain. Ibrahim et al. (2023) highlighted that factors such as

inflation, poor infrastructure, and limited access to formal credit institutions still hinder long-term economic progress. While IFAD-CBARDP has made a notable impact, additional support is needed to ensure sustained household income growth.

Table 4: Household Income Levels Before and After IFAD-CBARDP Interventions (n=343)

Income Level (₦/month)	Before Intervention	Percentage (%)	After Intervention	Percentage (%)
Less than ₦10,000	105	30.6	30	8.7
₦10,000 – ₦30,000	150	43.7	95	27.7
₦30,001 – ₦50,000	50	14.6	115	33.5
₦50,001 – ₦70,000	20	5.8	60	17.5
Above ₦70,000	18	5.3	43	12.5
Mean		20.0		20.0

Source: Field Survey, 2025

Challenges Faced by Rural Women in Benefiting from IFAD-CBARDP Programs

The findings in Table 5 reveal that the **major challenge faced by rural women in benefiting from IFAD-CBARDP is limited access to credit (62.7%)**. This aligns with Bello et al. (2021), who found that financial constraints remain a significant barrier for rural women in Nigeria, preventing them from expanding their businesses and diversifying income sources. Similarly, Kabeer (2022) emphasized that women's economic participation is often hindered by restrictive lending policies and lack of collateral. The second major challenge is **inadequate training and skills development (52.5%)**, which is consistent with Rahman *et al.* (2021), who noted that rural women often lack the technical knowledge and financial literacy needed to optimize program benefits. Effective training is essential for ensuring sustainable livelihood diversification, yet many rural women remain underserved in this regard.

Poor market access (48.1%) was also identified as a significant issue, as beneficiaries struggle to sell their products profitably due to weak rural infrastructure and lack of organized market linkages. Akinola et al. (2022) found similar results, arguing that without improved transportation and marketing structures, development programs may have limited impact. **Cultural and religious barriers (40.8%)** also play a role in limiting women's participation. This is in line with Ibrahim *et al.* (2023), who observed that traditional norms in northern Nigeria sometimes restrict women from fully engaging in income-generating activities outside their households. Other notable challenges include **poor infrastructure (37.9%)**, lack of awareness about IFAD programs (32.1%), bureaucratic bottlenecks (27.7%), and the **high cost of inputs (24.8%)**. Olawale and Adeyemi (2023) reported similar constraints, emphasizing the need for policy interventions to enhance rural women's economic participation.

Table 5: Challenges Faced by Rural Women in Benefiting from IFAD-CBARDP Programs (n=343)

Challenges	Frequency	Percentage (%)
Limited access to credit	215	62.7
Inadequate training and skills	180	52.5
Poor market access	165	48.1
Cultural and religious barriers	140	40.8
Poor infrastructure (roads, electricity)	130	37.9
Lack of awareness about IFAD programs	110	32.1
Bureaucratic bottlenecks in accessing support	95	27.7
High cost of inputs	85	24.8

Source: Field Survey, 2025

CONCLUSION AND RECOMMENDATIONS

The study concludes that **IFAD-CBARDP has significantly improved rural women's economic empowerment in Kebbi State** by increasing their income levels and promoting livelihood diversification. However, **financial constraints, limited training opportunities, and infrastructural deficits remain**

significant challenges. To maximize the impact of IFAD-CBARDP and ensure sustainable development, targeted interventions addressing these challenges are essential. From the analysis and results of this research, the following recommendations were arrived at:

1. IFAD-CBARDP should partner with microfinance institutions and cooperatives to provide **low-interest loans** to rural women, while the state government can support loan guarantees.
2. Regular training programs on **business management, financial literacy, and modern agricultural techniques** should be organized by IFAD-CBARDP and supported by local NGOs and cooperatives.
3. Facilitating **market access through cooperatives, digital platforms, rural trade fairs, and direct market linkages** by IFAD-CBARDP, Ministry of Commerce and Industry, Local Government Authorities, Trade Associations can help women sell their products more efficiently.

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4th Biennial Conference, 2025

12 – 14 Aug. @ Michael Okpara University of Agriculture, Umudike, Abia State

Theme: Agricultural Extension for Food Security and Community Empowerment

**Assessment of Economic Contribution of Cassava Seed Production
among Cassava Seed Entrepreneurs (CSEs) In South-East and South-
South Zones, Nigeria**

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ABSTRACT

The study assessed the economic contribution of cassava seed production among cassava seed entrepreneurs (CSEs) in South-East and South-South Zones, Nigeria. Multi-stage sampling method was used to select 240 cassava seed entrepreneurs and data were collected through the use of structured questionnaire. Data were analyzed using descriptive and inferential statistics such as percentages, mean, cost and return analysis, and linear regression model. The farmers mean age was 39 years, 52% of the farmers were male. All the respondents (100%) had formal education. A mean of 6 people was recorded for household size and 15.6 years of farming experience. Mean of farm size was 1.2 hectares. The CSEs achieved self-employment, food availability, increased income, children education, health care and housing, with a grand mean of 2.78 on a four-point rating scale, indicating high level of achievement through cassava seed production. The result revealed that high cost of labour, high cost of hiring tractor and high cost of transportation were the major constraints faced by the cassava seed entrepreneurs in cassava seed production. Also, the cost and return analysis result revealed a net farm income of ₦20,307,000.00 and a return on invested was ₦1.56k in 2024 production season. The study concluded that cassava seed production contributed in the economic growth of the cassava seed entrepreneurs and it is very lucrative. It is therefore, recommended that cassava seed production could be sustained through provision of tractors and soft loan by relevant authorities to enable CSEs grow higher in the business and achieve more.

Keywords: *Economic Contribution, Cassava Seed, Production, and Entrepreneurs.*

INTRODUCTION

Cassava is recognized as one of the staple foods in Nigeria and most farmers in the country are cassava producers. The crop plays a major role in the economy of the country as it supplies more than half the calorie intake of its inhabitants. Nigeria produces over 54 million metric tons (MT) of cassava per annum (FAOSTAT, 2021), making it the highest cassava producer in the world, producing a third more than Brazil and almost double the production capacity of Thailand and Indonesia. Labour input in cassava production per calorie produced per unit area is less than that for any other tropical root crop. Cassava has a diversity of uses. It is principally used as human food and it provides the major source of dietary energy for well over 200 million people in Africa (FAO, 2017).

The role of seeds as an agricultural input technology cannot be underestimated as it is an indispensable input in any agricultural production system. Seeds are the most important input in any crop-based farming system. Seed quality determines the overall grain yield and the market value of the final product (Almekinders *et al.*, 2019). Hence, improved seed could be considered as the most important technology

that substantially contributes towards crop productivity irrespective of other inputs. The Sustainable Cassava Seed System (SCSS) aims to implement a series of activities that will support the commercialization of cassava planting material and increase the quality, variety and availability of high-quality planting material for Nigerian cassava farmers.

Despite the importance of improved cassava seed production to enhance increased yields of cassava, there is still dearth of information on the economic contribution of cassava seed production among cassava seed entrepreneurs (CSEs) in South-East and South-South Zones in Nigeria, to if there are economic contribution of cassava seed production among the cassava seed entrepreneurs in the study area. Specific objectives of the study are to describe the socioeconomic characteristics of the cassava seed entrepreneurs, assess the economic achievements made from cassava seed production by the CSEs, examine the constraints faced by farmers and assess the profitability of cassava seed production among the CSEs. Hence, the study, to assess the economic contribution of cassava seed production among cassava seed entrepreneurs in South-East and South-South, Nigeria

METHODOLOGY

The study assessed the economic contribution of cassava seed production among cassava seed entrepreneurs in Nigeria. Multi-stage sampling method was used to select study area and respondents for the study. The two States from South-East Zone namely: Abia and Imo and one State from South-South Zone namely: Akwa Ibom were purposively selected, because they are involved in BASIC-II Project cassava seed entrepreneurs (CSEs) who produces and sell cassava seeds. From each of the States, 80 CSEs were selected purposively, giving a total of 240 CSEs for the study. Data were analyzed using descriptive statistics such as percentages, mean, and cost and return analysis. Economic achievements from seed production was measured on a 4-point rating scale of strongly agreed =4, agreed =3, disagreed = 2, strongly disagreed = 1, thus: $4+3+2+1 = 10/4 = 2.5$ was the benchmark for making decision on CSEs economic achievements. A mean score greater than 2.50 was regarded as achievement and any mean less than 2.50 was regarded as not achievement. The cost and return of cassava seed and root production was analyzed thus:

$$TR = P \times Q \text{ ----- (i)}$$

$$TC = TVC + TFC \text{ ----- (ii)}$$

$$GM = TR - TVC \text{ ----- (iii)}$$

$$NI = GM - TFC \text{ ----- (iv)}$$

Where TC = Total Cost

TVC = Total Variable Cost

TFC = Total Fixed Cost

TR = Total Revenue

P = Price per kg and bundle of cassava roots and seeds produced

Q = Quantity of cassava seeds and roots produced

GM = Gross Margin

NI = Net Income

RI = Return to Investment

RESULTS AND DISCUSSION

Socioeconomic Characteristics of the Cassava Seed Entrepreneurs

Results in Table 1 showed that most of the cassava farmers (52 %) were male while (48%) of them were female. Majority of the farmers (90%) were married while few of them (10%) were single. This implies that married people were mostly involved in cassava seed production. The mean of age was 39years old. This finding is also in line with Emaziye (2015) who state that farmers within the age brackets of 30-49 years have more innovative ability and capacity to do farm work. This implies that the farmers have the potential to cultivate and produce cassava seed. Mean of education level was 12 years. The results show that the farmers possess formal education. Tijani and Sanusi (2019) stated that education is an important socioeconomic factor that influences farmers' awareness, perception, reception and transfer of innovations that can bring about increase in production. Mean household size was 5 persons. This implies that the

farmers have good number of people eating in the same pot and living under same roof together as a family. This in another way shows that there is available farming labour. This finding is in consonance with that of Nwachukwu and Ezech (2018), who reported that farmers will be more committed to farming activities so as to cater for their large household size. Farm size had the mean of 1.2 ha. The result shows that the farmers are on large scale. Also, mean of farming experience was 15.6 years. This implies that the farmers have long term experience in cassava farming. This finding is in agreement with Nwokocha (2023) who reported that years of farming experience could show practical knowledge acquired in farming.

Table 1. Socioeconomic Characteristics of the Cassava Seed Entrepreneurs

Variables	Indices
Sex	Male 52%
Marital Status	Married 90%
Age	39 years
Education	12 years
Household size	5 persons
Farm size	1.2 ha
Farming Experience	15.6 years

Source: Field survey, 2024

Achievements made from cassava seed production by the CSEs

Figure 1 shows the achievements made by the cassava seed entrepreneurs from cassava seed production. The result reveals that all the CSEs achieved from engaging in cassava seed production. Food availability was ($\bar{x} = 3$), followed by self-employment ($\bar{x} = 2.98$), increased income ($\bar{x} = 2.84$), children school fees ($\bar{x} = 2.75$), health care ($\bar{x} = 2.62$), and housing ($\bar{x} = 2.5$). The grand mean was 2.78 on a four-point rating scale, indicating high level of achievement from cassava seed production. This consolidates with Suharyanto and Indrasti, (2017) who posited positive effect of agricultural programmes on crop farm productivity.

Economic achievements made from cassava seed production by the CSEs

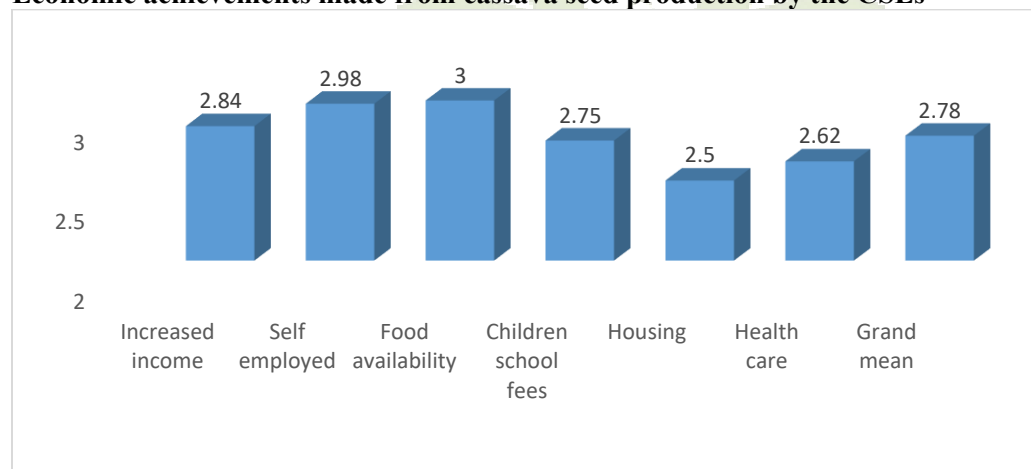


Fig.1. Source: Field survey, 2024

Major challenges faced by CSEs in Cassava Seed Production

Figure 2 reveals major challenges faced by the cassava seed entrepreneurs in cassava seed production in the two zones. Top on the list was high cost of labour (54%), followed by high cost of hiring tractor for land preparation (35%), and transportation cost (32%). This finding is in agreement with the report of Oni (2013), who identified the development constraints or challenges in the agricultural sector that inhibit performance of the sector towards designing policy strategies that would create conducive climate for promoting growth of the sector.

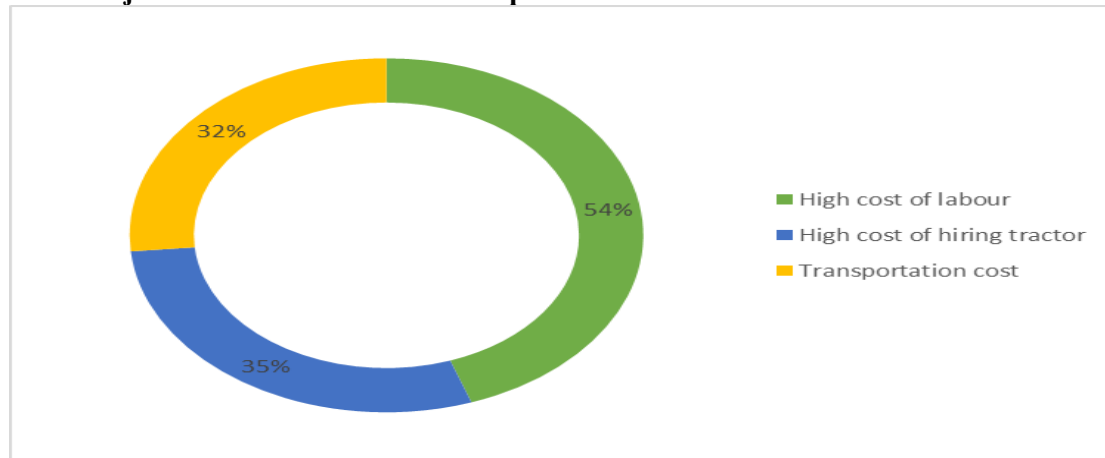
CSEs major constraints to cassava seed production

Fig. 2. Source: field survey, 2024 *Multiple responses recorded

Cost and return analysis of cassava seed production in 2024 production season

Table 3 shows the analysis result of costs and returns accrued to CSEs in the 2024 production year. The result indicates that the farmers invested the sum of ₦36,213,000.00 in the production of cassava seeds, these includes cost of clearing, cost of mound making, cost of planting materials, labour for planting, cost of fertilizer, labour cost for fertilizer application, cost of weeding, cost of herbicides, labour cost for herbicide application, cost of harvesting, cost of transportation and cost of land lease. Cost of land preparation (31.07%) ranked first in the list of cost items for cassava seed production. This implies that cost land preparation of the cassava seed farm was the major cost item associated with cassava seed production. Cost of fertilizer (16.84%) ranked second, followed by cost of weeding (16.02%) which ranked third, cost of land lease (13.81%) ranked fourth. Others are cost of 1st post emergence herbicide (5.52%), cost of 2nd post emergence herbicide (5.10%), cost of planting materials (3.58%) and cost of fertilizer application (2.21%), cost of transportation (1.49%), cost of 1st herbicide spraying (1.26%), cost of 2nd herbicide spraying (1.15%), cost of harvesting (0.98%), and cost of NASC visitation was (0.01%). The table further reveals that the total cost invested was ₦36,213,000.00 while the total revenue of ₦56,520,000.00 was earned by the CSEs during the period under review and ₦1.56k return to investment obtained. This implies that for every ₦1.00 invested in the business, ₦1.56k is realizable. This implies that the CSEs had a profitable cassava seed business. The result obtained here agrees with finding of Anyaegbunam *et al.* (2022) that cassava seed production is lucrative.

Table 2: Cost and return analysis of cassava seed production in 2024 production season

Variables	Values (₦)	% of total cost
Revenue		
Revenue from Roots	₦20,800,000.00	
Revenue from Stems (Seeds)	₦35,720,000.00	
Total Revenue	₦56,520,000.00	
Variable cost Items		
NASC Certification visit	₦48,000.00	0.01%
Land preparation (Ploughing, Harrow & Ridging)/ha	₦11,250,000.00	31.07%
Field maintenance (Weeding)	₦5,800,000.00	16.02%
Bundles of cassava seeds (planting materials)	₦1,600,000.00	4.42%
NPK Fertilizer 15:15:15	₦6,100,000.00	16.84%
Application of fertilizer	₦800,000.00	2.21%

1 st Post Emergence Herbicides	₦2,000,000.00	5.52%
Spraying of 1 st Post Emergence	₦455,000.00	1.26%
2 nd Post Emergence Herbicides	₦1,850,000.00	5.10%
Spraying of 2 nd Post Emergence	₦420,000.00	1.15%
Harvesting Operation	₦350,000.00	0.96%
Transportation	₦540,000.00	1.49%
Cost of land lease (Fixed Cost)	₦5,000,000.00	13.81%
Total Variable Cost (TVC)	₦31,213,000.00	100%
Total cost (TC=TFC+TVC)	₦36,213,000.00	
Gross margin	₦25,307,000.00	
Net Farm Income (R-TC)	₦20,307,000.00	
Return to investment	₦1.56k	

Source: Field survey, 2024

CONCLUSION AND RECOMMENDATIONS

The study concluded that cassava seed production contributes in the economic growth of the cassava seed entrepreneurs and the business is very lucrative. It is therefore, recommended that farmers should get involved in the production of cassava seed to increase their income because cassava seed production is profitable. Also, the business could be sustained through provision of tractors by relevant authorities to enable CSEs in seed production and achieve more since the study revealed that high cost of hiring tractor was one of the major constraints faced by the entrepreneurs in cassava seed production.

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Theme: Agricultural Extension for Food Security and Community Empowerment

Determinants of Climate-Smart Agriculture Uptake among Orange-Fleshed Sweet Potato (OFSP) Growers in Abia State, Nigeria

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ABSTRACT

This study investigated the determinants of climate-smart agriculture (CSA) uptake among orange-fleshed sweet potato (OFSP) growers in Abia State, Nigeria. Using a proportional stratified sampling technique, data were collected from 179 respondents through structured questionnaire. Descriptive statistics described farmers' socio-economic profiles and climate change impacts, while a 3-point Likert scale assessed perceptions of CSA practices. Principal Component Analysis (PCA) identified commonly adopted CSA strategies and key constraints, and Ordinary Least Squares (OLS) regression along with Z-tests were used to analyze socio-institutional factors influencing adoption and variations among farmer groups. Findings revealed that the majority of respondents experienced climate-related challenges, including increased rainfall (82.1%), higher temperatures (62.6%), prolonged drought (64.8%), and a generally hotter environment (59.8%). In response, farmers adopted soil management practices such as organic manure (0.6638), inorganic fertilizer (0.6068), and ridge/mound planting (0.4458), as well as crop-focused practices like improved varieties (0.6725) and altered planting dates (0.4165). Constraints to CSA uptake included high labor costs (0.4083) and limited access to extension services (0.5210). Regression results showed that farming experience, occupation, and location were negatively associated with CSA uptake, whereas income, training participation, and land ownership were positively and significantly related. The study recommends enhanced training and capacity building, improved access to credit and subsidized inputs, and effective implementation of land-use policies to strengthen CSA adoption and build resilience among OFSP farmers in the region.

Keywords: Climate-smart agriculture; Orange-fleshed sweet potato; Adoption determinants; Climate change adaptation; Smallholder farmers

INTRODUCTION

Sweet potatoes offer a particularly significant potential for increasing food production and income of rural farmers thereby reducing poverty and improving food security level in Nigeria. Sweet potato (*Ipomoea batatas*) is a creeper of the convolvulaceae family, originated from Central America and is widely grown throughout the world for both man and animal consumption Tsegaye, Alemu, & Yilma, (2022). Sweet potatoes have varieties of varying colours including white, yellow, purple and orange fleshed (Oniah 2019). Of the entire varied flesh storage root colour (white, yellow, cream, brown, purple, pink) of sweet potato varieties existing, the orange fleshed sweet potato varieties (OFSP) are newly introduced in Nigeria and are

so rich in vitamins. Orange fleshed sweet potato differs from other varieties of sweet potato due to its extremely rich and bio-fortified with beta-carotene, which the body converts into vitamin A. According to Umeh and Okoye (2024) one small root (100 - 125 grams) of most OFSP varieties can supply the recommended daily dose of vitamin A for children under five years of age. It is gaining importance as the cheapest source of antioxidant having several physiological attributes like anti-oxidation, anti-cancer and protection against liver injury and is most suiting as bio-fortified crop to combat malnutrition in small and marginal farming community. The considerable potential contribution of OFSP to food-based approach to tackle the problem of vitamin A deficiency, as a major public health concern of the poorer sections have motivated many farmers into its production in the country particularly in Abia State. Thus, there is a great possibility of this subsistence crop for being adopted as regular diet of the consumer food chain to supplement as an alternative staple food source for the resource poor farmers in the era of extensive population growth, nutrition crisis and climate change effect if some of their constraining factors are analyzed and solutions proffered.

However, like other crop farmers in the nation, orange fleshed sweet potato (OFSP) farmers faced climate change effect that negatively or positively affect their production and livelihoods. The adverse impacts of this climate change have increasingly become a challenge for sweet potato farmers in agricultural systems. Extreme climatic events such as frequent floods, heat-stress, heavy rain and droughts can substantially reduce crop yields (Aryal et al., 2018). Varied stakeholders are in agreement that managing these climatic events is important and the global population will have to deal with its consequences (IPCC, 2024). Rising temperatures and changes in rainfall patterns affect agricultural production with significant decline in crop and livestock production (Sharma & Ravindranath, 2019).

Smallholder farmers (OFSP farmers) are one of the most vulnerable groups to climate change and variability. Climate change leads to wearing out of all efforts made by these farmers in savings and resources accumulation. Mutabazi et al. (2019) and Umeh, (2023) explained that households that lack effective safeguards to risks are likely to be more prone to poverty and other vulnerability traps. Farmers, therefore, need to take adaptive measures that would minimize the impacts of climate change. These adaptation strategies must lead to higher food production without depletion of natural resources (Okoye, Ogbonna, Umeh, Eluagu, Amanza, Okoye, and Okoye, 2021). For sustainable food production, one of the important strategies is climate-smart agriculture (CSA) that can increase the resilience of agriculture to climate change through better adaptation - and by reducing agriculture's contribution to global warming.

The concept and adoption of these CSA approaches by farmers to sustainable agriculture are due to three major factors. These include increase climate change and events that worsens rain-fed agriculture, permanent changes in weather patterns which led to non- productivity at certain locations, and the need to reduce agriculture's contribution to greenhouse gas concentration in the atmosphere. Climate smart Agriculture is of no doubt an approach for transforming and re-orienting agricultural systems to support food security under the new realities of climate change. CSA has become an important adaptation and mitigation strategy to climate change (Ifeyanyi-Obi, Issa, Aderinoye-Abdulwahab, Ayinde, Umeh and Tologbonse, 2022) and to provide food (such as OFSP) for the increasing population. Considering the significant roles of CSA and Orange Fleshed sweet potato (OFSP) in the rural communities of Abia State, there is the need to engage in its promotion, and study of this such becomes crucial, to analyze factors influencing adoption of climate smart agricultural practices among orange fleshed sweet potato farmers in Abia State. Study like this on climate adaptation can greatly provide knowledge that can help to reduce vulnerability to climate change effects by moderating potential damages, helping the OFSP producing rural communities cope with adverse consequences of climate change.

OBJECTIVES OF THE STUDY

The main objective of this study was to analyze factors influencing the adoption of CSA practices among Orange Fleshed Sweet Potato (OFSP) farmers in Abia State, Nigeria. The specific objectives of the study were to;

- i. describe socio-demographic and economic characteristics of the respondents,
- ii. ascertain level of perception of OFSP farmers on the CSA practices in the study area;

- iii. ascertain CSA practices commonly adopted among the OFSP farmers to cope with the natural hazards in the study area;
- iv. identify constraints militating against the use of CSA practices among OFSP farmers.

HYPOTHESIS

H₀₁: Socio-economic and institutional factors have no significant relationship on the adoption of climate smart agricultural practices among OFSP farmers.

METHODOLOGY

Study Area

This study was carried out in Abia State of Nigeria. Abia State with Umuahia as its capital has seventeen (17) Local Government Areas, three senatorial zones namely, Abia South, Abia Central and Abia North and many communities. It is one of the five states in the South East geo-political Zone of Nigeria. The total land area of Abia state is 4,900 Km² (Wikipedia, 2021). The major commercial city is Aba, which was formerly a British colonial government outpost in the region, and it is also one of the most populated areas in Nigeria. The State has a population density of 580 persons per square kilometer and a population of 3,727,300 persons (NPC, 2016). Historically, Abia was carved out of the former Imo State in 1991. It lies between latitude 4°45' and 06°07' N and longitude 07°00' and 08°10' East of the equator (Abia ADP, 2005). The climate is tropical and humid with minimal rainfall ranges of 2000mm to 2500mm.

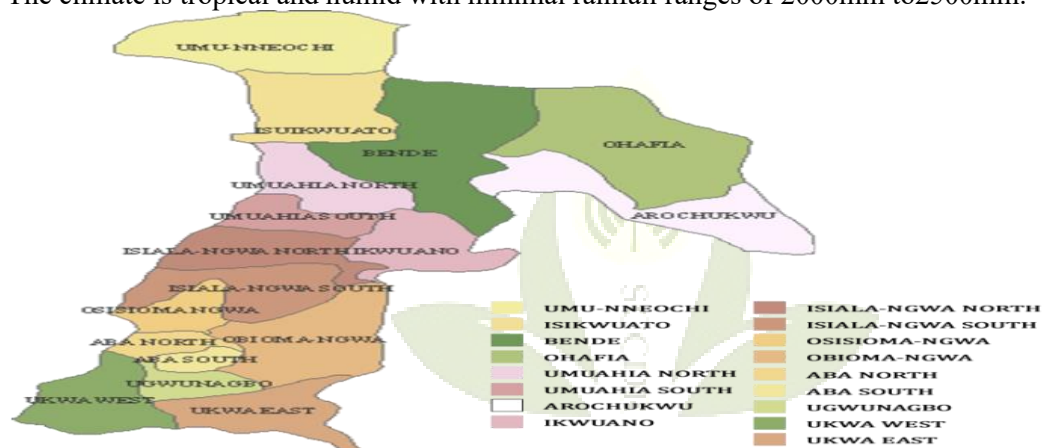


Fig 1 Map of Abia State

Sampling procedure

The study adopted proportional stratified sampling procedure to select sample respondents. Sweetpotato Production Association of Nigeria, SPAN, Abia State chapter has on record 1785 registered active members across different agricultural Zones of the State of which most of them were involved in OFSP production. Specifically, Aba, Ohafia and Umuahia are made of 501, 1080 and 204 members respectively. The study, however proportionately sampled 10% of these strata (50 from Aba, 108 from Ohafia and 21 from Umuahia) to give a total of 179 OFSP farmers for the study.

Measurement of Variables and Model Specifications

Socio-economic and institutional characteristics of respondents

The, socio-economic and institutional attributes of respondents which influence the adoption of CSA practices were described. In this study, the socio-economic characteristics that were considered are;

- = age (years) as provided by the respondents
- = educational level (years)
- = marital status (married=1, single=0)
- = Farm Income (Naira)
- =household size (number of people eating from one pot)

- = occupation (full time farming =1, part-time farming=0)
- = farming experience (years)
- = major cropping pattern (sole cropping=1, mixed cropping=2)
- = mode of land ownership (Inheritance=4, purchase= 3, hire/lease=2, gift=1)
- = Membership of social organization (yes=1, no=0)
- = extension contact (number of times)
- = previous training on CSA (yes=1, no=0)
- = access to credit facilities (yes=1, no= 0)
- = income per year from the farm (Naira)
- = farm size (hectare)
- = location of the farm
- = Other source of income (farming=5 artisan=4, civil service=3, trading=2, others=1).

These variables were measured and analyzed from the responses of the respondents using frequencies, percentages and mean.

Level of perception of OFSP farmers on the CSA practices in the study area

Objective ii (the level of perception of OFSP farmers on the CSA practices) was realized using mean count. 3-Point rating scale of High (3), moderate (2) and Low (1) will be used to achieve the mean. Variables with mean score of 2.0 (which is the average mean score of the likert level) and above imply that they are positive and in affirmative to the objective being measured while factors with mean score of less than 2.0 are negative and rarely have influence on the objective being measured. To determine the mean likert level= $\sum X/N$. mean of each item was computed by multiplying the frequency of each response pattern with its appropriate nominal value and dividing the sum with the number of respondents to the items.

CSA practices commonly adopted among the OFSP farmers to cope with the natural hazards

However, the study listed anticipated CSA updated during pre-survey and categorize the adopted using 3-point scales of adopted (3), adopted and stop (2) and never adopted (1) with the mean cut-off of 1.5. Hence, the study will further categorize the practices using factorial component analysis to group the CSA practices into homogenous groups. However, Principal component factor analysis with varimax-rotation and factor loading of 0.40 will be used. Variables with factor loadings less than 0.40 and variables that loaded in more than one factor were discarded following the study of Ashley *et.al.*, (2006).

$$Y_1 = a_{11}X_1 + a_{12}X_2 + * * * + a_{1n}X_n \dots\dots\dots (3.1)$$

$$Y_2 = a_{21}X_1 + a_{22}X_2 + * * * + a_{2n}X_n \dots\dots\dots (3.2)$$

$$Y_3 = a_{31}X_1 + a_{32}X_2 + * * * + a_{3n}X_n \dots\dots\dots (33)$$

$$Y_n = a_{n1}X_1 + a_{n2}X_2 + * * * + a_{nn}X_n$$

Where,

$Y_1, Y_2 \dots Y_n$ = observed variables / CSA practices

$a_1 - a_n$ = factor loadings

$X_1, X_2, \dots X_n$ = unobserved underlying factors in CSA grouping.

The CSA will be listed and categorized based on the five listed CSA group which might be found in the study area.

CSA 1= Soil Related Management SRM (eg. Proper tillage, planting on the flat, use of manure/compost, use of fertilizer, soil erosion control, afforestation, land rotation, planting on ridge/mound and planting on bed etc.);

CSA 2 = Crop Related Management CRM (e.g. use of improved variety, treating the vine before planting, use of quality planting materials, increase number of node cutting, crop rotation, plant spacing etc.);

CSA 3= Pest/Disease Related Management PDRM (use of IPM, application of pesticides, use of ash, use of neem, use of other crop attack, manipulation time of application, frequency of application etc.);

CSA 4 = Drought/Water Related Management DWRM (harvesting of water, manual application of water,

irrigation application mechanical- drip, sprinkler, use of bed, mulching, planting under tree, planting near stream or river, watering in the evening/morning, etc.) and;

CSA5 = Post Harvest Related Management PHRM (harvest the vine before root, harvesting with fork, burying storage, cool dry storage, store in well-ventilated room, store under the tree, store in the bar, use of ash in storage, use of dry leaves in storage, process to flour, process to juice, process to saw, process to flakes others specify).

Constraints militating against adoption of CSA practices among the farmers

The constraints militating against adoption of CSA practices among the OFSP farmers in Abia State, Nigeria were analyzed using Factor component analysis (FCA). Principal component factor analysis with varimax-rotation and factor loading of 0.40 will be as in the case for objective ii. Variables with factor loadings less than 0.40 and variables that loaded in more than one factor were discarded following the study of Ashley, Amber, and Anthony, *et.al.*, (2006).

RESULTS AND DISCUSSION

Socio-economic and institutional characteristics of respondents

Table 1 shows the mean household size of about 9 persons (SD= 3.32772), farming experience of about 12 years (SD=5.6634), N53, 498.1676 (SD=31154.5936) monthly income and 3.20 (SD= 0.9215) number of extension contacts. Many (60.90%) of the farm was located at rural area, then urban (36.90%) and semi-urban (2.20) with majority (67.00%) being male OFSP farmers than female (33.00%). More than half of the respondents were married (57.60%) than about 40.20% that are singled and few (2.2%) divorcers. The study also found that majority (73.20%) of the OFSP farmers had tertiary education, participated in the training of CSA (90.30), members of cooperation (82.10%), practice mixed farming (91.10%) and ownership of land (88.80%). About 41.30% and 31.30% had access to irrigation and credit facilities with more than half (53.10%) of the farmers being into part time farming, than full timers (46.90%).

Perceptions of OFSP farmers on CSA practices

The study found high perception that increase in rainfall affect CSA practices (3.05) as only rainfall related parameter with the mean score of 3.0 and above, the benchmark mean. The high perception on the effect of increase in rainfall on CSA practices maybe as a result of level of education and knowledge among the respondents on CSA practices. Aman et al. (2020) reported that increase in rainfall and extreme low rainfall in the dry season leads to flooding and a scarcity of water for production and life respectively.

Other variables such as; decrease in rainfall affect CSA practices (2.20), time of rain starts affect CSA (2.49), time of rain end affect CSA (2.04), and distribution pattern of rainfall affect CSA practices (2.23) had a low level of perception with mean score less than 3.00, benchmark mean. The study also found low perception among all variables as related to wind on; increase in wind speed (2.63), decrease in wind speed (2.16), changes in wind direction (2.62), more wind storm 2.88) and less wind storm (2.38) affect CSA practices with mean less than 3.00, the benchmark acceptable mean.

The study revealed that variable such as; environment is hotter than before affect CSA practices (3.59), and high temperature affect CSA practices (3.13) were temperature related responses with high perception among the respondents in the study area with the mean score above benchmark mean of 3.00; while responses on environment is cooler than before affect CSA practices (2.18), and low temperature affect CSA practices (1.74) had mean scores below acceptable mean of 3.00 and therefore were lowly perceived by the farmers. However, the high perception on high and hotter temperature affecting CSA practices was in line with a prior expectation, since OFSP varieties mostly don't adapted in harsh weather conditions. Aman et al. (2020) noted that when the temperature is very low or high and prolonged, it would be harmful for crop production.

Table 2: Level of Perception of OFSP Farmers on the CSA practices (Likert Scale Analysis)

Items	SA	A	U	D	SD	Mean
Rainfall						
Increase in rainfall affect CSA practices	26(130)	8(32)	123(369)	8(16)	14(14)	3.05
Decrease in rainfall affect CSA practices	8(40)	16(64)	8(24)	119(238)	28(28)	2.20
Time of Rain starts affect CSA practices	4(20)	44(176)	8(24)	103(206)	20(20)	2.49
Time of Rain end affect CSA practices	12(60)	12(48)	4(12)	107(214)	32(32)	2.04
Distribution pattern of rainfall affects CSA practices	16(80)	11(44)	12(36)	100(200)	40(40)	2.23
Wind						
increase in wind speed affect CSA	16(80)	32(128)	8(24)	115(230)	8(8)	2.63
decrease in wind speed affect CSA	8(40)	8(32)	28(94)	95(190)	40(40)	2.16
changes in wind direction affect CSA	12(60)	4(16)	107(321)	16(32)	40(40)	2.62
more wind storm affects CSA practices	4(20)	75(300)	40(120)	16(32)	44(44)	2.88
less wind storm affects CSA practices	4(20)	16(64)	40(120)	103(206)	16(16)	2.38
Temperature						
Environment is hotter than before affect CSA practices	107(535)	4(16)	16(48)	8(16)	28(28)	3.59
Environment is cooler than before affect CSA practices	12(60)	8(32)	40(120)	60(120)	59(59)	2.18
High Temperature affect CSA practices	18(90)	32(128)	91(273)	32(64)	6(6)	3.13
Low Temperature affect CSA practices	4(20)	20(80)	4(12)	60(120)	79(79)	1.74
Flooding						
No flooding affect CSA practices	4(20)	8(32)	79(237)	52(104)	36(36)	2.40
Low level of flooding affect CSA practices	12(60)	127(508)	8(24)	20(40)	12(12)	3.60
Frequent flooding affect CSA practices	123(615)	16(64)	24(72)	4(8)	12(12)	4.31
Drought						
Increase in drought period affect CSA	12(60)	129(516)	12(36)	20(40)	6(6)	3.68
Decrease in drought period affect CSA	4(20)	24(96)	4(12)	143(286)	4(4)	2.34
Grand mean						2.71

Source: Field Survey, 2023**Figures in Parentheses are the weighted frequencies****SA= Strongly Agree, A= Agree, U= Undecided, D= Disagree, SD= Strongly Disagree****Acceptable mean =3.00**

In relation to flooding, the study found high perception among the OFSP farmers that low level of flooding affect CSA practices (3.60) and frequent flooding affect CSA practices (4.31) having had mean scores above benchmark mean of 3.00. This was an indication of high level of knowledge that flow of water cycle also affected by climate change. Flooding causes increase in sea level which will boost the hazard of stable or seasonal saline interference into groundwater and rivers which will have effects on the nature of water causing damages. Khan (2018) reported that regular floods are considered essential for agriculture as it provide vital moisture and fertility to the soil by silt deposition but severe floods that occur in every 7-10 years, cause extensive damages to agriculture and other resource.

Among drought related responses; there is high perception among the respondents that increase in drought period affect CSA (3.68). This was expected as high perception was a clear implication that OFSP crop is a water-requirement crop that thrives in water-logged area. According to Cao *et al.* (2022) and Satoh *et al.* (2022), severity and frequency of droughts have significantly increased (perceived), causing a marked reduction in crop production, considerable socio-economic losses in agriculture, and food security in the arid and semi-arid regions of developing countries.

CSA practices commonly adopted among the OFSP farmers to cope with the natural hazards in the study area

Table 3 presents the Principal Component Analysis (PCA) on CSA practices commonly adopted among the OFSP farmers to cope with the natural hazards in the study area. The study showed that practices such as use of organic manure (0.6638), use of inorganic fertilizer (0.6068) and planting on beds/ridge/mounds (0.4458) were adopted CSA1 (Soil Related Management) practices by the respondents in the study area. The use of organic and inorganic fertilizer found in the study might be attributed to the high chances of soil infertility leading to a decline in the quantity and quality of the crop as a result of continue farming on a particular soil. However, Aman et al. (2020) also reported that change in climate affect soil moisture, and frequency of drought or flood, and groundwater level in different areas also affect the soil nutrient leaving the soil helpless and poor. Soil fortification through addition of organic and inorganic materials is the best bet. This result might also be as a result of accessibility and affordability of organic and to extent inorganic materials by the farmers that led to the adoption.

Practices that reclaim productivity and restore carbon storage include: nutrient amendments, applying organic substrates such as manures and composts and reducing tillage and retaining crop residues; conserving water (Njuguna, 2020).

In line with the findings on planting on beds/ridge/mounds as adopted CSA practices in the study, Ferreira (2023) noted that the performance of a plant is greatly influenced by the way it is treated/planted as it grows, and many pathogens enter a host through an injury. Therefore, proper land preparation and looseness of the soil help OFSP to root and build up its food without obstruction.

For the CSA2, the study found planting improved crop variety (0.6725), changing planting dates (0.4165) and inter-cropping (0.7355) as the adopted CSA practices in the study area.

The Pest/Disease Related Management PDRM (CSA3) found to be adopted and practiced in the study area were; planting disease resistant varieties (0.8171) and use of terraces (0.4510). In corroboration with the study, Bennett et al. (2019) and Gollin et al. (2021) stressed that the key to mitigate climate changing problem is to involve in the development and dissemination of high-yielding and disease-resistant crop varieties to farmers. However, among the OFSP varieties, there are highly resistant and susceptible varieties to SPVD, and as well high yielding such as UMUSPO/1, 4 and 3. Climate-resilient crop varieties are a critical part of the climate-smart agriculture (CSA) approach with the potential to offer the triple wins of increasing productivity with ensuing welfare implications, building resilience to climatic shocks and reducing the emission of greenhouse gases (Ojong et al., 2023). However, the use of terraces adopted in the study explained the level of crop, soil and land protection the farmers employed to secure their farms.

Table 3 Principal Component Analysis (PCA) on CSA practices commonly adopted among the OFSP farmers to cope with the natural hazards in the study area

CSA	CSA1	CSA2	CSA3	CSA4	CSA5
Planting improved crop variety	0.1480	0.6725	0.0362	0.1599	0.0433
Planting a greater number of node cuttings	-0.0981	0.2006	0.3804	0.2212	-0.2543
changing planting dates	-0.1040	-0.4165	0.0239	0.2158	-0.0469
Use of crop rotation	0.5370**	0.1319	0.8360**	0.0378	0.0019
Moving to a different site	0.5587**	0.1757	0.0257	-0.2248	0.8003**
Inter-cropping	0.1181	0.7355	0.2406	-0.0907	0.2518
Water harvesting	-0.2110	-0.1152	0.0473	0.8258	0.1532
Use of irrigation water	-0.0807	0.0317	-0.0947	0.0080	-0.2105
Use of organic manure	0.6638	0.3025	-0.0358	-0.0732	0.2827
Planting shade trees on crop land	-0.2979	0.4202**	-0.0406	0.5194**	-0.1709
Use of mulching	0.0399	0.3869	0.3351	0.6570	0.2306
Planting disease resistant varieties	0.3644	0.2614	-0.8171	0.1096	0.0803
Using information from weather forecast/announcement	-0.3175	0.361	0.2614	0.2170	0.0283
Efficient use of pesticides	0.3889	-0.1003	0.5290*	0.4097*	0.0212
Using organic fertilizer	-0.6068	-0.1316	0.4319	-0.1613	-0.0142

Planting cover crops	0.1295	-0.0018	0.5128**	0.4301**	0.2306
Use of compost material	0.3779	0.2439	-0.1059	0.01230	0.2492
Use of biochar	-0.1702	-0.0032	--0.0827	--0.1890	0.0258
Use of terraces	0.1138	-0.1455	0.4510	0.2570	-0.1230
Use of life/plant barrier	0.6444**	0.5525**	0.4331**	-0.2043	0.2933
Use of zero tillage	0.2328	-0.0935	0.0845	0.4164	0.0866
Planting on beds/ridge/mounds	0.4453	-0.3370	-0.2180	-0.0660	0.1814
Curing before harvest	0.0674	-0.2815	-0.2029	0.4064	-0.7042
Store in a well-ventilated area	0.1221	0.0171	-0.1650	0.3082	0.4789
Use of ash/leave in storage	0.2689	0.1458	0.1008	-0.0273	-0.2536
Process to other product form	0.1304	-0.2022	0.2082	0.2258	0.8640

Source: Field Survey, 2023

CSA 1= Soil Related Management, CSA 2 = Crop Related Management CRM, CSA 3= Pest/Disease Related Management PDRM, CSA 4 = Drought/Water Related Management DWRM, CSA5 = Post

Harvest Related Management PHRM

In support of the findings, Njuguna (2020) noted that farmers employed various ways to secure water resources in rural areas and practice rainwater management and harvesting system. The aforementioned study also observed that harnessing of rain or groundwater for agricultural or domestic use has been in practice in agricultural zone area of the country. Ibrahim (2018) confirmed the results and identified several water-harvesting technologies as Zai pits, retention ditches, road runoff harvesting, rock catchment harvesting, roof catchment harvesting, and construction of ponds, dams, and water pans, among others. The high performance on the use of mulching was in accordance with the findings of Abdulraheem et al. (2021), who observed that the farmer uses mulching as an organic material not only to add manure to the soil but also for soil and water nutrient retention, which will help to reduce pest/disease incidence. Ferreira (2023) also noted that mulching not only retain water but prevent excess water which reduces the amount of air in the soil, prevents good root development, and increases susceptibility to root-rot diseases.

Furthermore, due to high perishability of OFSP and post-harvest losses, farmers adoption of curing before harvesting, storing in a well-ventilated area and value addition have been reported by several studies (Okoye et al., 2021; Mitra et al., 2012).

Constraints militating against the use of CSA practices among OFSP farmers

The study also presented the results on varimax-rotated factors militating against the use of CSA practices among OFSP farmers in the study area In Table 5. Three (3) factors from the results were extracted based on the response of the respondents. Only variables with factor loading of 0.30 and above at 10% overlapping variance as indicated by Ashley *et al.*, (2006) were used in naming the factors. Variables that loaded more than one factor as in the case of variables 2 and 7 were discarded, while variables that have factor loadings of less than 0.30 were not used following Enete and Amusa, (2010). This procedure was adopted in grouping the variables into three major factors as: Factor 1= Eco-financial constraints, Factor 2 = Socio-Infrastructural constraints and Factor 3 = Techno-Institutional constraints.

Table 4: Varimax-Rotated Factors militating against the use of CSA practices among OFSP farmers in the Study Area

S/N	Constraining Variables	Constraints		
		Factor 1	Factor 2	Factor 3
1	High cost of labour	0.4083	-0.1718	0.1576
2	Inadequate capital	0.1158	-0.4880**	0.5481**
3	Price fluctuation of materials	0.0663	0.1820	0.0304
4	Procedures were difficult to understand	0.0215	0.0363	0.6363
5	Harvesting, processing and storing Technologies	-0.0407	0.4750	0.0193
6	Difficulty in applying technology	0.0683	-0.0288	-0.0699
7	Lack of technical support	0.4529**	0.4988**	0.6376**
8	Poor access to information from extension agents	0.1522	-0.5210	0.6125

9	Poor financial status of the farmers/processors	-0.2304	0.1147	0.0266
10	Poor product storage (short shelf life)	-0.1223	-0.5769	--0.0930
11	Irregular and weak government policies	0.1945	0.1930	-0.4403
12	Poor market structure	0.1234	-0.2379	0.6943
13	Poor knowledge of application	-0.3421	-0.0334	-0.2379
14	Cost of maintenance	-0.1767	0.1158	0.0365
15	Susceptible nature of OFSP to pest and diseases	0.3340	0.0154	0.4379

Source: Field Survey, 2023

Factor 1= Eco-financial constraints, Factor 2 = Socio-Infrastructural constraints, Factor 3 = Techno-Institutional constraints

The study identified only high cost of labour (0.4083) as eco-financial constraints militating against the use of CSA practices in the study area. Cost of farm labour plays an important role in the use of CSA practices and also identified as common constraints in agriculture due to high intensity of agricultural activities especially in peak production season Royo-Esnal and Valencia-Gredilla, 2018; Okoye et al, 2021). High cost of labour directly and indirectly affects the level of operation which has an implication on CSA practices and adoption. This is because the household bears the transaction costs of labor market participation in small scale farming.

The socio-infrastructure constraints (factor 2) found in the study were; harvesting, processing and storing technologies (0.4750), poor access to information from extension agents (0.5210), and poor product storage (short shelf life) (0.5769). This was an indication of poor infrastructural facilities and social access to essential facilities need to pursue OFSP production and practice. In line with the results, Okoth (2019) noted poor storage, and processing facilities among sweet potato farmers and also further confirmed that poor storage and processing facilities are some of the major problems of agriculture in Nigeria. Institute Economic Affairs (2018) mentions that agricultural financial services include risk transfer strategies that a farmer can access which like insurance, contract farming and sources of agricultural capital are not well known to farmers due to poor communication system. More so, Okoth (2019) noted that the inconsistent and conflicting advice about CSA confuses the farmers even farther and also mentioned that responsive national regional markets should be encouraged to provide access to credit and financial schemes to enable farmers adopt new and emerging climate-smart technologies and as well market their products.

However, the study showed that; procedures were difficult to understand (0.6363), irregular and weak government policies (0.4403) and poor market structure (0.6943) were the techno-Institutional constraints militating against CSA adoption and practices in the study area. This result was in similarity with the findings of Ekunwe et al. (2018) who identified similar problems among okra farmer in their study.

Test of Hypothesis

H0₁: Socio-economic and institutional factors have no statistically significant relationship on the adoption of climate smart agricultural practices among OFSP farmers.

The study in Table 6 tested the hypothesis that socio-economic and institutional factors have no statistically significant relationship with the adoption of climate-smart agriculture (CSA) practices among orange-fleshed sweet potato (OFSP) farmers in Abia State. The regression analysis identified the semi-log model as the best fit, with an R² value of 0.5897, indicating that 58.97% of the variation in CSA adoption was explained by the independent variables. The F-statistic was significant at the 1% level, confirming the model's robustness.

Among socio-economic factors, farming experience and occupation were negatively significant at the 10% level. Unexpectedly, experienced farmers were less likely to adopt CSA, possibly due to a preference for traditional methods, while less experienced or younger farmers were more open to innovation—consistent with findings by Ngigi et al. (2022), who noted that younger and less experienced farmers tend to be more adaptive to climate innovations. Full-time farmers, being more reliant on agriculture, showed greater willingness to adopt CSA than part-time farmers.

Farm income had a positive and significant influence at the 5% level, supporting studies by Tesfaye et al. (2021) that income increases the capacity to invest in inputs, technology, and labor required for CSA.

Similarly, participation in training, access to credit, and land ownership were highly significant and positively influenced CSA adoption, echoing findings by Ajayi et al. (2023), who emphasized the importance of institutional support in driving CSA uptake among smallholders.

Location also showed a negative but significant relationship at the 1% level, suggesting rural farmers were more likely to adopt CSA than their urban counterparts—likely due to their stronger dependency on agriculture and direct exposure to climatic risks (Temesgen, 2020) and Khatri-Chhetri et al., 2021).

These findings collectively reject the null hypothesis and affirm that socio-economic and institutional factors significantly influence CSA adoption. Policy efforts should therefore focus on enhancing access to credit, training programs, secure land tenure, and income-generating opportunities to foster CSA adoption among OFSP farmers.

Table 5: OLS Regression Estimates of Socio-economic and institutional factors influencing adoption of climate smart agricultural practices among OFSP farmers

Variables	Linear	Exponential	Double Log	Semi-Log +
Sex(X ₁)	1.5716 (1.14)	0.1012 (1.72)	0.0804 (1.42)	1.2051 (0.91)
Age (X ₂)	0.0148 (0.35)	-0.0003 (-0.15)	-0.0031 (-0.04)	0.6241 (0.38)
Marital Status (X ₃)	0.1069 (0.06)	0.0217 (0.27)	0.0601 (0.07)	-0.2144 (-0.11)
Education qualification (X ₄)	-0.7863 (-1.36)	-0.0371 (-1.50)	-0.0329 (-1.33)	0.7206 (-1.25)
Farming experience (X ₅)	-0.1704 (-1.71)*	-0.0062 (-1.45)	-0.0707 (-1.67)*	-1.9294 (-1.94)*
Cooperative (X ₆)	0.9141 (0.42)	-0.1610 (-0.17)	-0.0119 (-0.13)	1.1015 (0.51)
Occupation (X ₇)	-3.3773 (-2.23)*	-0.1298 (-2.01)*	-.1286 (-2.02)*	-3.3916 (-2.28)*
Income (X ₈)	0.00004 (2.46)*	1.99e-06 (2.82)**	0.08109 (3.04)**	1.8182 (2.91)**
Extension contact (X ₉)	2.4624 (1.07)	0.0509 (0.52)	0.0135 (0.14)	1.8044 (0.82)
Training (X ₁₀)	-23.1693 (-7.49)	-0.6916 (-5.25)***	-0.7017 (-5.38)	23.5657 (7.72)***
Credit (X ₁₁)	-12.1216 (-6.74)***	-0.4595 (-6.00)***	-0.4001 (-5.75)***	10.9512 (6.73)***
Land (X ₁₂)	-8.664 (-4.14)	-0.2245 (-2.52)*	-0.2757 (-3.20)**	9.6708 (4.79)***
Irrigation (X ₁₃)	0.2501 (0.24)	0.0057 (0.13)	0.0053 (0.12)	0.2149 (0.21)
Location (X ₁₄)	6.4151 (2.60)*	0.2320 (2.21)*	0.1947 (1.86)*	-5.6004 (-2.29)*
Contact	59.9201 (10.43)***	4.3024 (17.59)***	3.7439 (8.06)***	45.7613 (4.21)***
F-cal	16.19	8.44	8.74	16.84
R-squared	0.5802	0.4186	0.4273	0.5897
Adj R-squared	0.5443	0.3690	0.3784	0.5547

Source: field survey, 2022

*, ** and *** are significant at 10%, 5% and 1% level of probability respectively.

+ = lead equation

CONCLUSION

This study reveals that most of the OFSP farming households in the study area experienced climate change in various forms. Some of them include: increase in the amount of rainfall, early starts of rain than it used to be, changes in wind direction and wind storm. In other to mitigate these experiences, the farmers were found to practice some of the CSA such as use of organic manure, use of inorganic fertilizer and planting on beds/ridge/mounds as soil related management; planting improved crop variety, changing planting dates and inter-cropping as the adopted crop related management.

Factors such as farming experience, occupation and location of the farmers, farm income, and participation in training, access to credit and ownership of land or access to land were found significantly influencing adoption of CSA in the study area and beyond. The study therefore calls for policies and strategies aimed at strengthening the existing OFSP farmers through providing intensive training and building of synergy among partners. Also, considerable policy support and capacity enhancement is needed for climate smart agricultural practices including access to information, land and credit to empower the farmers' needs.

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Assessment of Women-Based Rural Development Activities by IFAD-CBARDP and their Effect on Poverty Reduction among Rural Women in Kebbi State, Nigeria

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ABSTRACT

This study assessed women-based rural development activities implemented by the International Fund for Agricultural Development–Community-Based Agriculture and Rural Development Programme (IFAD–CBARDP) and examined their effect on poverty reduction among rural women in Kebbi State, Nigeria. A multistage sampling procedure was used to select 343 beneficiaries. Data were collected using questionnaire and analyzed using descriptive statistics, binary logistic regression, and factor analysis. The results showed that tailoring (mean = 4.34, ranked 1st), cream making (mean = 4.21, ranked 2nd), preparation of food supplements (mean = 4.10, ranked 3rd), soya cake making (mean = 4.07, ranked 4th), and midwifery training (mean = 3.98, ranked 5th) were the most prominent livelihood activities, while snacks making (mean = 3.13, ranked 12th) recorded the least participation. Binary logistic regression analysis revealed that years of education ($\beta = 0.278$), household size ($\beta = -0.139$), access to credit ($\beta = 1.047$), cooperative membership ($\beta = 0.936$), and farm size ($\beta = 0.421$) significantly influenced poverty reduction among beneficiaries. The model recorded a Nagelkerke R^2 of 0.462, adjusted R^2 of 0.438, log-likelihood of -152.347, and F-statistic of 21.573 ($p < 0.01$), indicating good explanatory power. Factor analysis reduced 20 potential determinants of programme access to five principal components namely, institutional support, socio-economic characteristics, access to productive resources, infrastructural facilities, and socio-cultural considerations explaining 71.8% of the total variance. The study concludes that IFAD–CBARDP interventions have significantly enhanced rural women's livelihoods through skills acquisition, improved access to resources, and strengthened cooperative networks, thereby contributing to poverty reduction. It is recommended that policymakers scale up high-impact livelihood activities, strengthen institutional support structures, and improve access to credit and training facilities to sustain and expand the programmer's impact.

Keywords: IFAD–CBARDP, rural women, poverty reduction, livelihood activities, Kebbi State, factor analysis

INTRODUCTION

According to Nigeria Poverty in the Midst of Plenty (2016), certain groups of people are thought to be especially at risk, particularly households headed by women and those with young children who are unable

to work. When their children are ill, widows and single mothers face unique challenges because no one is able or willing to assist them. Additionally, they lack the farm labor they need and cannot afford to hire it. Additionally, the elderly are at risk because it is becoming more and more difficult for low-income families to provide for them. Women are a particularly susceptible demographic among the elderly. However, children are the most severely impacted by poverty of all the impoverished. They are not fed at the appropriate times since their mothers are heavily involved in rural farming and/or retailing. The Community Based Agricultural and Rural Development Program was implemented as a result of IFAD's recent efforts to combat poverty and enhance the lives of rural women. The initiative was started after a number of studies revealed that poverty is spreading in some of Nigeria's northern states with delicate ecosystems (IFAD, 2006). The program draws on earlier community-based initiatives in Sokoto and Katsina States and operates in eight northern Nigerian states: Borno, Jigawa, Kano, Katsina, Kebbi, Sokoto, Yobe, and Zamfara (ICT update, 2010). Improving rural poor people's livelihoods and living situations is the main goal, with a focus on women's and other vulnerable groups' needs (IFAD, 2004).

Women are at the core of poverty everywhere in the world. While their male counterparts can readily obtain the same assistance, women in particular find it more difficult, if not impossible, to obtain loans, particularly from financial organizations. As Mayra (1998) pointed out in Alaye and Evelyn (2008), this explains a troubling worldwide pattern in which women are typically deemed to be poorer than males when well-being is used as a metric to gauge poverty. In Nigeria, the situation is worse. Women in Nigeria comprise an active and reserve labour force but they rarely possess the means of productions (Rahman, 2004). However, the position of women in meeting the challenges of agricultural growth cannot be over stressed. In a typical African setting, women make a large contribution to food production; they perform 60-80% of agricultural labour and are responsible for 80% of food production (Mgbada, 2002; Rahman, 2004). Nevertheless, they have little or no access to productive assets. Due to a lack of collateral securities, they are frequently refused access to credit facilities (Modupe, 2008). Due to their poor economic standing, women continue to face significant barriers to accessing health, education, finance, and agricultural extension services, despite their vital and dynamic role in economic life (World Bank, 1996). This depressing issue also affects women in Kebbi state. Similar to many states in the North, Kebbi State is among those that suffer from poverty. Despite its agricultural potential, the state continues to suffer from severe poverty, particularly among rural women. Due to the high percentage of poverty, rural women are left in a precarious situation. They are typically tiny businesses, run by primarily one person, and use relatively basic equipment to produce from their homes or workshops. The majority of their working capital and investments are self-financed. Galleria, Nigeria (2004)

Notwithstanding the admirable initiatives put forth to counteract the effects of poverty and the enormously limited funds allocated to poverty eradication by earlier Nigerian governments, according to Modupe (2008), poverty conditions deteriorated as unemployment rates increased, particularly for young people and women living in rural areas. Rural women continue to face social issues like ignorance and poverty. There is information out there that may help the appropriate women produce more, produce the right things, and earn more for their work, but it is not readily available. This is because the programs have not been successful in reducing rural women's poverty as intended. Therefore, an analysis of the role that IFAD-CBARDP played in helping rural women in Kebbi State break free from the cycle of poverty through the introduction of poverty reduction activities is necessary.

OBJECTIVES OF THE STUDY

The broad objective of the study is to assess Women-Based Rural Development Activities by IFAD-CBARDP and their Effect on Poverty Reduction among Rural Women in Kebbi State. The specific objectives were to:

- i. examine the personal characteristics of the rural women beneficiaries (age, marital status, level of education, and occupation).
- ii. analyze the various women-based rural Development Activities and assistance provided by IFAD/CBARDP to rural women in the study area.
- iii. determine the effect of IFAD-CBARDP in poverty reduction among rural women in the study area

- iv. identify the factors influencing rural women access to IFAD/CBARDP in the study area

METHODOLOGY

Description of the Study Area

Kebbi State was established from of ancient Sokoto State in 1991; it comprises of 21 Local Government Areas and four Emirate councils. It is found within latitude 10° 05' to 13° 27' North and Longitude 3° 35' to 6° 03' East. It is located in the North Western Nigeria; Kebbi State occupies a total land area of 36,800 square kilometres. It shares boundaries with Sokoto State on the North-Eastern axis, Zamfara State on the Eastern section, Niger State on the Southern half and Republic of Niger on the Western part (Nigeria Galleria.com, 2004). According to NPC (2006) Kebbi State has an estimated population of 3,662,103 people. The state has four major tribes, which include: Hausa, Fulani, Dakarkari and Gungawa, Others minor tribes include Zabarmawa, Dandawa, Kambari, Yorubas and Ibos. Islam is the dominant religion of the people. Rainfall begins in April and concludes in October with greatest rain in July and August. The annual rainfall ranges from 400-800mm (KSG, 2008). Generally, the state is characterized by high temperatures especially in the month of March, April, and May. The annual temperature varies from 21°C to 38°C (KARDA, 1992).

Kebbi State has an agriculturally viable environment since it is endowed with high soil fertility, vast farm land and economically viable rivers such as river Niger and it is also sheltered by fine tropical climate. Owing to these factors, Agriculture has remained the major source of revenue and indeed the backbone of the economy of the state. Major food crops produced in the area are millet, guinea corn, maize, cassava, potatoes, rice, beans, onions and vegetables. While Cash crops include wheat, soybeans, ginger, groundnuts and tobacco (Nigeria Galleria, 2004) Multi-stage random sampling technique was used for the study. Out of the nine Local Government Areas that took part in the program, four were chosen at random for the first stage. Two villages were chosen at random from each of the Local Government areas in the second stage, and the beneficiaries were then selected from each village using a sampling strategy proportionate to its size. As a result, out of the 260 beneficiaries for the study, 120 were sampled. For this investigation, both primary and secondary data were employed. While secondary data was gathered from pertinent literature, including textbooks, journals, the internet, and official documents from IFAD-CBARDP offices in the impacted Local Government Areas, primary data was created through interview schedules. Descriptive statistics (means, frequency distribution, and percentages) were used in the data analyses.

Sampling Procedure and Sample Size

The respondents in this study were selected using a multi-stage sampling technique to ensure broad and representative coverage across Kebbi State. In the first stage, four Agricultural zones Argungu, Bunza, Zuru, and Yauri were purposively selected due to their agricultural significance. The second stage involved the random selection of eight Local Government Areas (LGAs) from these zones. In the third stage, two villages were randomly chosen from each of the selected LGAs, resulting in a total of 16 villages. Finally, using a simple random sampling method, 343 respondents were selected from a sampling frame of 2,400 farming households across these villages, ensuring each household had an equal chance of being included in the study.

Method of Data Collection

Primary data were collected through structured questionnaires administered to rural women beneficiaries of IFAD-CBARDP. Key informant interviews and focus group discussions complemented the survey to provide deeper insights.

Method of Data Analysis

Data were analyzed using both descriptive and inferential statistics. Descriptive statistics were used to analyze objective 1 and 2. Logistic regression was used to achieve objective 3 and factor analysis was employed to analyze objective 4 respectively.

Logit Regression Model Specification

The effect of IFAD-CBARDP on poverty reduction among rural women was estimated using a binary logistic regression model:

$$\text{Logit}(P) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \mu$$

Where:

P = Probability that a rural woman experienced poverty reduction as a result of IFAD-CBARDP

Logit (P) = Log-odds of poverty reduction

β_0 = Intercept term

$\beta_1 \dots \beta_8$ = Coefficients of explanatory variables

μ = Error term

Variable Definitions and Measurements

Y = Poverty Reduction Status (Dummy: 1 = Beneficiary experienced poverty reduction; 0 = No poverty reduction)

X₁ = Education Level (Number of years of formal schooling completed)

X₂ = Access to Credit (Dummy: 1 = Has access to formal/informal credit; 0 = No access)

X₃ = Membership in Cooperative Society (Dummy: 1 = Member; 0 = Non-member)

X₄ = Ownership of Productive Assets (Value of productive assets owned in Naira)

X₅ = Age (Age of respondent in years)

X₆ = Household Size (Number of persons in the household)

X₇ = Distance to Market (Distance from residence to nearest market in kilometers)

X₈ = Access to Extension Services (Dummy: 1 = for access to extension services; 0 = No access)

β_0 = Intercept term

$\beta_1 \dots \beta_8$ = Coefficients estimated

μ = Error term

Model Specification for Factor Analysis

The model for identifying factors influencing rural women's access to IFAD/CBARDP can be expressed as:

$$X_i = \lambda_{i1}F_1 + \lambda_{i2}F_2 + \lambda_{i3}F_3 + \dots + \lambda_{im}F_m + \varepsilon_i$$

Where:

X_i = The *i*-th observed variable (*i* = 1, 2, ..., 20)

λ_{ij} = Factor loading of the *i*-th variable on the *j*-th common factor

F_m = The *m*-th common factor (*m* = 1, 2, ..., 5 after extraction)

ε_i = Unique factor (specific variance + error variance) associated with X_i

Variable Definitions (Observed Variables)

X₁ = Level of formal education (years)

X₂ = Access to extension services (1 = Yes, 0 = No)

X₃ = Membership in cooperative society (1 = Yes, 0 = No)

X₄ = Ownership of productive assets (value in Naira)

X₅ = Access to market information (1 = Yes, 0 = No)

X₆ = Household income (Naira per annum)

X₇ = Distance to nearest market (km)

X₈ = Access to transportation (1 = Yes, 0 = No)

X₉ = Land ownership (hectares)

X₁₀ = Availability of storage facilities (1 = Yes, 0 = No)

X₁₁ = Access to formal credit (1 = Yes, 0 = No)

X₁₂ = Training received from IFAD/CBARDP (1 = Yes, 0 = No)

X₁₃ = Participation in decision-making (1 = Yes, 0 = No)

X₁₄ = Farm size (hectares)

X₁₅ = Number of dependents in household

X₁₆ = Access to input subsidies (1 = Yes, 0 = No)

X₁₇ = Access to water for irrigation (1 = Yes, 0 = No)

X₁₈ = Frequency of extension visits (number per season)

X₁₉ = Experience in farming (years)

X₂₀ = Perception of IFAD/CBARDP relevance (Likert scale: 1–5)

Factor Extraction Method: Principal Component Analysis (PCA)

Rotation Method: Varimax rotation

Number of Factors Retained: 5 (based on Eigenvalues ≥ 1 and Scree plot criteria)

RESULTS AND DISCUSSION

Table1: Personal Characteristics of Beneficiaries

Age(years)	Frequency	Percentage
12 -21	8	6.7
22 – 31	26	21.7
32 – 41	34	28.3
42 – 51	33	27.5
52 – 61	14	11.5
62 and above	5	4.2
Marital – Status		
Single	1	0.8
Married	82	68.8
Divorced	3	2.5
Widowed	34	28.3
Household size		
2 – 8	56	46.7
9 – 15	54	45.0
16 – 22	8	6.7
23 and above	2	1.7
Level of education		
Quranic education	114	95.0
Primary education	3	2.5
Secondary education	3	2.5
Tertiary education	0	0
Occupation		
Farming	26	21.7
Trading	74	61.7
Civil servant	1	0.8
Artisanship	17	14.2
Others	2	0.16
Farm size (ha)		
0.25 – 1	20	16.7
1.25 – 2	6	5
Period of participation		
Years		
1 – 3	49	40.8
4 – 6	12	10.0
7 and above	59	49.2
Mean	5 years	

Source: Field Survey, 2025

Table 1 shows the socioeconomic characteristics of the respondents. According to the Table, 28% of the participants were between the ages of 32 and 41. The majority of the beneficiaries were in their prime, when they had the energy to engage in income-generating activities, as evidenced by their mean age of 40.38 years. This supports the findings of David *et al.* (2009), who claimed that a population's 15–64 years old is

its most economically productive time frame. Additionally, Modupe (2008) notes that the majority of the women were still in their prime working years, which made it impossible for them to take full advantage of the program's financial potential. The bulk of the beneficiaries (69%) were married, according to table 5, which also shows that the program helped widows, divorced people, married people, and single people. This finding is consistent with that of Nwachukwu and Ezech (2007), who conducted a related study and found that most respondents were married. According to table 5, the majority of households (47%) are made up of two to eight persons, with an average of ten people per home. Particularly in Northern Nigeria, where polygamy is prevalent, this big household size is a typical feature of rural communities. The findings of Sherma *et al.* (2003), who conducted a study among farm families and found that the average family size was more than six persons per household, are consistent with this outcome. Nwachukwu and Ezech (2007) assert that the size of a household affects the quantity of labor available for economic activity. Table 1 displays the recipients' distribution based on educational attainment. The results showed that the majority of the beneficiaries (95%) received only education based on the Quran. As a result, the majority of recipients lacked formal schooling.

This conclusion contradicted the findings of Islam (1997), who claimed that primary and secondary education improved program comprehension and productivity. It also supports the findings of Aqeela *et al.* (2005), who found that women and girls make up two thirds of the world's one billion illiterate people. Table 5 shows that petty traders made up the majority (61.7%) of the beneficiaries, while civil servants made up 0.8%. Very few of them were civil servants, according to the result. The findings of Ephraim *et al.* (2008), who demonstrated that crop production is by far the most significant single source of income, accounting for well over 46% of total income for people in Niger, Kebbi, and Kaduna States, are not consistent with this result. It was discovered that petty trade was practiced by the majority of the beneficiaries in the study area. Additionally, Table 1 showed that 17% of the 22% who were farmers farmed less than one hectare of land. This result suggests that women farmers do not predominate in the research area and that the few women farmers who were present were small-scale farmers. This supports the findings of Adeola *et al.* (2008), who found that small-scale farming accounts for the majority of rural women farmers. Table 1 additionally displays the recipients' distribution based on the years participated. According to the data, 49% of the beneficiaries had worked for seven to nine years. Additionally, it shows that the majority of them had roughly five years of experience. It is implied that the majority of the female recipients were aware of the various activities offered by the program

Table 2: Various Women-based Rural Development Activities

Skills Acquisition	Mean Score	Ranking
Tailoring	4.34	1st
Knitting training	3.77	6th
Soap making	3.32	11th
Bead making	3.48	8th
Cream making	4.21	2nd
Soya cake making	4.07	4th
Preparation of food supplement	4.10	3rd
Midwifery training	3.98	5th
Vegetable production	3.48	8th
Fish farming	3.54	7th
Snacks making	3.13	12th
Oil extraction	3.48	8th

Source: Field Survey, 2025

The results in Table 2 indicate that among the various women-based rural development activities supported in the study area, tailoring ranked highest (mean score = 4.34), reflecting its popularity and perceived profitability among rural women. This finding aligns with Adisa and Okunade (2022), who reported that tailoring remains a dominant skill for women's economic empowerment due to its low entry barrier, flexible

working hours, and steady market demand in rural and peri-urban areas. Cream making (mean = 4.21) and preparation of food supplements (mean = 4.10) ranked second and third, respectively, suggesting that value addition in the cosmetics and food sectors is an important livelihood pathway. This corroborates the work of Yusuf et al. (2023), who observed that rural women are increasingly engaging in small-scale cosmetic and nutritional product enterprises, driven by rising health awareness and consumer preference for locally made products.

Soya cake making (mean = 4.07) ranked fourth, reflecting its relevance as both a nutritional product and a source of supplementary income. This is consistent with Okeke *et al.* (2024), who found that soybean value-chain activities provide dual benefits of food security and income generation for rural households. Midwifery training (mean = 3.98) ranked fifth, highlighting the role of health-related skills in rural development, particularly in areas with limited access to formal healthcare facilities (Eze and Chukwu, 2022). On the lower end, snacks making (mean = 3.13) and soap making (mean = 3.32) ranked 12th and 11th, respectively. Although these activities are common in rural areas, their lower ranking may be due to market saturation or lower perceived profitability, as earlier noted by Ibrahim and Musa (2023). Skills such as knitting training (mean = 3.77), fish farming (mean = 3.54), and bead making (mean = 3.48) fall in the mid-range, suggesting they are valued but perhaps secondary income sources or seasonal in nature.

Interestingly, agricultural-based activities such as vegetable production (mean = 3.48) and oil extraction (mean = 3.48) ranked relatively low compared to non-agricultural skills. This may indicate a shift in livelihood preference towards non-farm enterprises, possibly due to climate variability, land constraints, and market opportunities in artisanal production (Ogunbiyi *et al.*, 2024). Overall, the findings suggest a diversification of rural women's economic activities, with an increasing tilt toward skills that combine market viability, ease of entry, and potential for value addition. This diversification aligns with the assertion by the Food and Agriculture Organization (FAO, 2023) that empowering rural women through a mix of agricultural and non-agricultural skills enhances household resilience, income stability, and community development outcomes.

Table: 3 Logistic Regression Estimates of the Effect of IFAD-CBARDP on Poverty Reduction among Rural Women (N = 343)

Variable	Coef. (β)	Std. Err.	z	p-value	Odds (e ^β)	Ratio
IFAD-CBARDP participation (1=yes)	0.880*	0.240	3.67	0.0002	2.41	
Age (years)	0.010	0.009	1.10	0.271	1.01	
Education (years)	0.090 **	0.030	3.00	0.003	1.09	
Household size (count)	-0.120 **	0.050	-2.40	0.016	0.89	
Farm size (ha)	0.180 **	0.060	3.00	0.003	1.20	
Access to credit (1=yes)	0.670 **	0.220	3.05	0.002	1.95	
Membership in women's group (1=yes)	0.520*	0.230	2.26	0.024	1.69	
Distance to extension centre (km)	-0.090 **	0.030	-3.00	0.003	0.91	
Constant	-1.750***	0.480	-3.65	<0.001	—	
R ²	0.234					
Log-likelihood	175.4					
Number of observations	343					

Source: Field Survey, 2025 * p < 0.10; ** p < 0.05; *** p < 0.01

Table 3 reveals the binary logistic regression estimates of the Effect of IFAD-CBARDP on Poverty Reduction among Rural Women. The findings reveal that education level ($\beta = 0.842$, $p < 0.01$) was a strong positive determinant of poverty reduction among rural women participating in IFAD-CBARDP. This implies that a one-unit increase in educational attainment increases the log-odds of exiting poverty by 0.842, holding other variables constant. Education equips women with the skills to adopt improved farming methods and manage enterprises more effectively. This finding is consistent with Oduro and Baah-Boateng (2021), who reported that education significantly enhances women's income-generating capabilities in rural Africa.

Access to credit ($\beta = 1.156$, $p < 0.01$) also had a substantial positive effect, meaning women with credit access were more likely to overcome poverty by leveraging loans for agricultural inputs, trade, or value addition. This corroborates Afolabi et al. (2022), who found that rural women with microfinance access experienced higher productivity and business expansion. Membership in cooperative societies ($\beta = 0.637$, $p < 0.05$) significantly improved poverty reduction odds, as cooperatives enhance bargaining power, facilitate group marketing, and provide mutual support. Similar effects were documented by Nwafor and Eze (2020), who noted that cooperative membership fosters social capital and resource sharing among rural women. Ownership of productive assets ($\beta = 0.921$, $p < 0.01$) was also a key driver, as asset endowment allows women to engage in larger-scale farming and secure collateral for loans. This aligns with Khandker and Koolwal (2021), who observed that asset ownership increases household resilience and capacity to escape poverty traps.

On the other hand, age ($\beta = -0.042$), household size ($\beta = -0.013$), distance to market ($\beta = -0.089$), and access to extension services ($\beta = 0.175$) were statistically insignificant ($p > 0.10$), suggesting they exert minimal direct influence on poverty reduction in this context. The model's McFadden R^2 of 0.486 and significant F-statistic confirm strong explanatory power, while the log-likelihood of -120.45 and 343 observations further validate the model's robustness (Louviere et al., 2020). Overall, the results highlight that human capital, financial access, social networks, and productive assets are critical for the success of poverty alleviation programs targeting rural women.

Table 4: Factor analysis results of the factors influencing rural women access to IFAD/CBARDP in the study area (n = 343)

Item (code)	F1= Digital Access & Connectivity	F2= Program & Design Information	F3= Social Capital & Institutional Trust	F4= Economic Capacity	F5= Mobility & Safety Constraints	Communality (h ²)
Digital literacy (V1)	0.74					0.58
Smartphone ownership (V2)	0.71					0.55
Data affordability (V3)	0.69			0.32		0.57
Network coverage (V4)	0.77					0.61
Prior awareness of IFAD/CBARDP (V12)		0.72				0.54
Perceived relevance of services (V15)		0.70				0.51
Proximity to demo activities (V16)		0.63			0.30	0.49
Simplicity of registration (V19)		0.67				0.46
Clarity of targeting (V20)		0.64				0.44
Membership in groups/co-ops (V11)			0.76			0.60
Trust in program/institutions (V13)			0.73			0.56
Exposure to peers' success (V17)			0.68			0.49
Spousal support (V7)			0.62			0.45
Access to credit/savings (V14)				0.71		0.53

Item (code)	F1= Digital Access & Connectivity	F2= Program Design & Information	F3= Social Capital & Institutional Trust	F4= Economic Capacity	F5= Mobility & Safety Constraints	Communality (h ²)
Household workload/time burden (V8)				-0.58	0.31	0.47
Distance to extension center (V5)					0.74	0.57
Safety/security concerns (V10)					0.70	0.52
Cultural norms/restrictions (V9)			0.42		0.44	0.43
Frequency of extension contact (V6)	0.38	0.41				0.39
Language/communication barriers (V18)		0.46			0.40	0.41

Source: Field Survey, 2025 Notes: Cross-loadings < 0.40 suppressed for clarity

Table 4 indicates the factor analysis findings of the factors influencing rural women access to IFAD/CBRDP. **In Factor 1: Digital Access & Connectivity** (V1, V2, V3, V4; 30.6% variance) shows high loadings on digital literacy, smartphone ownership, data affordability, and network coverage show that **digital readiness** is foundational for accessing IFAD/CBARDP touch points (SMS/app notifications, mobile money, e-advisory). Where connectivity is weak or data are costly, access drops sharply especially for women with lower digital skills (Aker & Mbiti, 2019; GSMA, 2022). Programs that subsidize devices/data and offer basic digital skilling tend to raise women's program uptake (van Campenhout *et al.*, 2021).

Findings in Factor 2 indicate that Program Design & Information (V12, V15, V16, V19, V20; +13.9%) involving variables such as Awareness, perceived relevance, proximity to visible activities and **simple, transparent enrolment** drive access to the programme. Clear targeting criteria reduce exclusion errors, while local demonstrations convert awareness into sign-ups (Davis *et al.*, 2021; IFAD, 2023). Streamlined beneficiary journeys are particularly important for time-constrained rural women (World Bank, 2023).

Factor 3 shows that Social Capital & Institutional Trust (V11, V13, V17, V7, V9; +10.5%) with variables such as Group membership, trust, peer success stories, and household support (spousal approval) are strong enablers while restrictive norms can hinder access. **Peer effects** and **women's groups** amplify information flow and confidence to enrol (Bernard & Seyoum Taffesse, 2014; Banerjee *et al.*, 2019). Trust in implementing institutions reduces perceived risk and transaction costs (Baird *et al.*, 2019).

Factor 4 results indicate Economic Capacity (V14, V8; +8.9%) involving factors such as Access to credit/savings facilitates transport, documentation, uniforms/inputs, and phone/data costs, while heavy domestic workloads depress participation. Easing **liquidity and time constraints** via childcare at meetings, time-saving technologies, or stipends raises access among poorer women (Duflo, 2012; FAO, 2022; Aguilar *et al.*, 2020).

Results in Factor 5 shows Mobility & Safety Constraints (V5, V10, V9/18; +4.8%) with Distance to market, security risks, language barriers, and some cultural restrictions limit movement to registration points or events. Decentralizing services (village-based agents), using local languages, and scheduling during safe hours **materially improve women's access** (Aker, 2020; Meinzen-Dick *et al.*, 2019).

CONCLUSION AND RECOMMENDATIONS

The IFAD-CBARDP program has had a substantial impact on reducing poverty among rural women in Kebbi State. The introduction of diverse skill acquisition activities and support for income-generating ventures improved beneficiaries' asset base and economic resilience. However, the lack of formal education among the majority of beneficiaries poses a challenge to optimizing program benefits. It is recommended that, government should provide adult literacy programs to improve the beneficiaries' capacity to access and utilize formal financial and extension services. Government should introduce additional agriculturally

related skills and diversify off-farm activities to cater to varied interests and regional demands. Rural women should establish cooperative groups and savings schemes to ensure long-term sustainability of the economic benefits derived from the program and government should implement periodic assessments to identify challenges and tailor interventions to enhance program effectiveness.

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**SOCIETY FOR COMMUNITY & COMMUNICATION DEVELOPMENT RESEARCH
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Theme: Agricultural Extension for Food Security and Community Empowerment

**Biodiversity and Abundance of Shell Fish in Akor and Itu Rivers of
Niger Delta Region, Nigeria**

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ABSTRACT

*Shellfish are edible decapods such as molluscs and crustaceans found in our aquatic environment whose body are surrounded with shell known as chitin only a few lack chitins. Biodiversity, a systematic attention to general composition of different organisms of importance coexisting in a habitat has been of importance to avoid extinction of species and over exploitation. This research was carried out at Akor River, Itunta Ibere Ikwuano Local Government Area Abia State and Itu River, Itu Local Government Area Akwa Ibom State both in Nigeria with 3 different stations of the sites in consideration. The shellfish caught included crabs, mussels, periwinkles, prawns, clams oyster snails. Only a species of crab was caught over the period of 18 months of the experiment, mussels caught were two species; *Aspatharia dahomeyensis* and *Margaritifera margaritifera*, periwinkles were *Tympanotonus fuscatus*, and *pachymelania aurita*, the later was only found at Itu River. *Macrobrachium macrobrachion* and *Macrobrachium vollenhoveni* were the two species of prawn caught during the experiment. *Galatea paradoxa* was the clam and *Crassostrea gasar* the oyster found at Itu river and non was caught at Akor river. At Akor River, two species of snail; *Melanoides Maculata* and *Pila ovata* were obtained. The weight of crabs obtained at Akor and Itu Rivers were $35.64 \pm 11.67g$ and $31.81 \pm 10.71g$ respectively. Prawns gotten from Akor River weighed $22.32 \pm 24.97g$ and Itu River was $46.39 \pm 16.02g$. Mussels weighed $4.74 \pm 5.10g$ and $8.66 \pm 3.00g$ at Akor and Itu river respectively. Periwinkle obtained from Akor River was $0.36 \pm 0.44g$ and $0.53 \pm 0.35g$ at Itu River and oyster $33.89 \pm 11.00g$. This showed the presence of different shellfish in our local rivers and should be properly harnessed to avoid over exploitation and extinction of some of these organisms by proper management. Aquaculture of shellfish should be explored.*

Key words; Biodiversity, Abundance, Shellfish, Akor River, Itu River

INTRODUCTION

Shellfish being a general term encompassing edible freshwater, marine and brackish water invertebrates with exoskeleton made of chitin (exceptions include octopuses, squid, and most sea cucumbers). They include various species of crustaceans and molluscs. Crustaceans have segmented bodies protected by hard chitin (shells) and include prawn, lobster, crayfish, crab, and krill, whereas molluscs have soft bodies divided into foot and visceral sections, and are divided into bivalves, cephalopods, and gastropods (Venugopal and Gopakumar, 2020; Moruf *et al.*, 2020). The largest source of shellfish is coastal water (Nybakken, 2001). Nigeria has a diverse range of water bodies, from the marine (Atlantic Ocean), to brackish waters (delta rivers and estuaries), to inland freshwaters. Although fisheries interest in coastal shellfish in Nigeria has been centered on the marine species harvested offshore by commercial trawlers, other economically important crustaceans and molluscs remain largely unexplored. Land reclamation, overfishing, and water pollution, all of which result in habitat degradation, are currently posing threats to

the conservation of shellfish resources and their fisheries (Jacqueline *et al.*, 2017). In places where competent management is lacking, there is also a risk of overexploitation of natural resources and the collapse of environmental services.

Fisheries and Aquaculture have been considered as an important means of poverty alleviation and food security besides promoting health and well-being. Fish continue to be one of the most traded food commodities worldwide. It contributes to around 17% of the global population's animal protein intake. Around 125-210 million tonnes of fish is projected to be required by 2050 to meet the annual per capita requirement of 15-20 kg (Moruf *et al.*, 2022).

The exploitation of shellfish resources plays an important role in the national economies of many countries. This can range from being used as a cheap source of protein to being a source of significant export earnings when highly developed. In addition to being used as a source of food and economic wealth, Bivalves also decrease concentrations of particulate matter in water, thereby increasing water transparency and primary productivity (Newell and Koch, 2004; Abayomi, 2010). Shellfish cultures enhance water quality through nitrogen uptake and removal (Hudson, 2010), and their provision of habitat and structure for juveniles of other species (Abayomi, 2010). Shellfish resources are poorly utilized in West Africa, (FAO Fish Statistics, 2010). Only 29,815 tonnes of marine shellfish, including crustaceans, were captured in West Africa in 2008. Aquaculture production of these species was very limited in West Africa with only Senegal producing 40 tonnes of the mangrove oyster, *Crassostrea gasar*. The estimate of worldwide aquaculture production of shellfish in 2008 was 801,360 tonnes of which 710,395 tonnes are bivalves excluding crustaceans (Abayomi, 2010).

Biodiversity is a concept to ecology and its measurements is essential to ecosystem health (Nazeef *et al.*, 2021); due to wide variations of ecosystems in distribution, abundance, dominance and biodiversity levels (Omayio and Mzungu, 2019). In a functional diversity context; richness is understood to increase or enhance community functionality and complexity (increases in productivity) (Nazeef, 2017 and Daly, *et al.*, 2018). Species richness in sub-lakes was assumed to be positively associated with water depth and aquatic habitat availability with connectivity; in all which increase in wet season (Jin *et al.*, 2019). Besides species richness which receives prominent attention however, evenness is also ecologically important as it portrays been a key factor in preserving functional stability of ecosystem as well as improving productivity by enhancing representation of each species' functional traits or characteristics, contrary however, community's uneven dispersion pattern tend to have less resilience to disturbance and environmental stresses (Nazeef, 2017 and Daly, *et al.*, 2018). A central issue in community ecology is understanding and predicting the structure of species assemblages and their spatio-temporal variations across multiple scales (Jin *et al.*, 2019 and Jianhua *et al.*, 2020).

Global demand for seafood products alone is projected to increase by 70 percent in the next 30 years as harvests from traditional capture fisheries either remain stable or continue to decline. At the same time, coastal marine ecosystems worldwide that support wild shellfisheries are threatened by pollution, habitat degradation, overharvesting and a growing dependence on common pool-resources among other concerns, lending an increasingly important role for sustainably produced and managed shellfish resources to fill the widening gap in the world's capacity for food production, hence the application of genetic technology (Moruf and Adekoya, 2018).

This work is aimed at studying the biodiversity and the abundance of the shellfish in the rivers.

MATERIALS AND METHODS

Study Area

This study was carried out in two different rivers sited in Abia and Akwa Ibom States. Akor River of Itunta Ibere present in Ikwuano Local Government Area, Abia State is between latitudes 05.34829°N and Longitude 007°.34468' E with elevation of 77m and is located within the rainforest zone of Eastern Nigeria between longitudes 7°N and 8°E and latitude 4° 45' E and 6°17' N. Akor flows from its reservoir North-Southerly which is observed to come from Ozuitem hill called Mgbele Akor and empty into the stream branching into other rivers that continued through Ibere, Amoeba and then to Akwa Ibom Rivers (Ukagwu, 2015). This region has average temperature of 26° to 32°C and an average annual rainfall of 2169.8mm



Itu a river in Itu local government in Akwa Ibom State which bears the Itu river and this shares a boundary with the Cross River State. Itu river is a tributary of Niger river with coordinates latitude 5.765N and longitude 8.941E. Itu has a landmass that covers approximately 606.10 km² and is located about 27km from Uyo the capital city of Akwa Ibom (Udosen *et al.*, 2015). Itu River is a fresh water ecosystem and is a habitat of many animals such as fish, shellfish such as prawns. Crabs, etc. the inhabitant of that region are mainly fish farmers, petty traders and also timber dealers

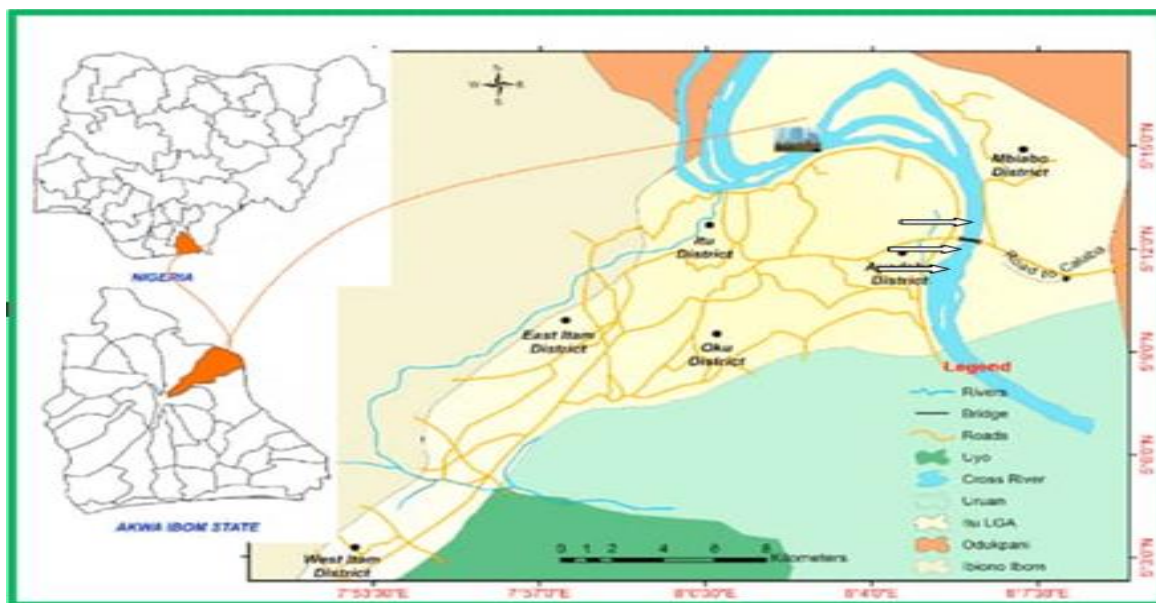


Fig. 3 Map of Itu River Map

Collection of Samples

Each of the sites was divided into three stations (station 1, 2 and 3), these stations were 46-61m apart. These stations were different positions at the rivers giving rise to different points for sampling

Sampling was carried out monthly for eighteen (18) months comprising the peak of the raining season and the dry seasons depending on Nigerian seasonal variations. The physicochemical parameters were taken in the morning hours. Some of the physicochemical parameters were carried out in-situ such as temperature, pH, dissolved oxygen etc. while biological oxygen demand, chemical oxygen demand, heavy metals etc. were carried out ex-situ. Samples were collected using a clean container, rinsed 2-3 times with the river water before filling making sure that there was no bubble captured in the container and taken to the laboratory for further analysis. Shellfish such as crabs and prawns were caught using traps while others such as periwinkles, mussels, clams, oysters and snails were picked from the bottom of the rivers.

Identification of Samples and Experimental Shellfish

The shellfish obtained from Akor and Itu Rivers were taken to Department of Fisheries and Aquatic Resource Management, Michael Okpara University of Agriculture Umudike, Abia State laboratory for measurements and identification.

The shellfish were identified following fish identification guide of Idodo-Umeh (2003) and Fish Base databases (Froese and Pauly, 2017). Their morphometric measurements such as weight, length and width were taken using a pair of calipers. Sexes were also identified and sorted based on morphological characteristics as stated by New and Singholka (1982) and Sagua (1980) also into different groups and identified to specific level using the FAO Species Identification Sheets, (Volume VI). The female prawn was generally bigger than their male counterparts and the ventral line of the female crabs' abdomen is wider in the females while it is taper in the males. Sample was analyzed for sex and months of collection.

Samples of shellfishes were preserved in 95% alcohol for identification. Samples were identified using standard keys to interpret the morphological features of each species (Talwar and Jhingran, 1991). Shellfish obtained included prawn, crab, periwinkle, mussels, clam and snails.

Samples of shellfishes were preserved in 4% formalin for identification. Samples were identified using standard keys which interpret the morphological features of each species (Talwar and Jhingran, 1991). All samples were sorted at the species level and were counted and weighed onboard. Only shellfishes were included in the analysis. Shellfish obtained includes prawn, crab, periwinkle and mussels.

Morphological identification using fish guide could not be achieved due to unavailability of whole fish specimens. We preserved tissues in 95% ethanol and subsequently stored under -80°C

RESULTS AND DISCUSSION

Crabs

From Table 1 the crabs caught from the rivers were analyzed, the number of their occurrence in months and sexes were considered in weight, dorsal length, and dorsal width morphometric values. The males obtained from Itu River within the course of this study were 6.11 ± 2.166 and females were 6.72 ± 2.59 , the females also weighed more than the males with 36.87 ± 13.05 and $34.41 \pm 10.34\text{g}$ respectively. The dorsal length mean values were $5.26 \pm 0.814\text{cm}$ and 6.03 ± 1.13 for males and females respectively. The females were more than the males in Akor River. In Itu River the females were 23.72 ± 12.69 and the males were 23.33 ± 10.59 . Females also weighed more with $33.46 \pm 10.25\text{g}$ and the males $30.16 \pm 11.19\text{g}$. This continued in their dorsal length and width of the crabs as seen in Table 1.

Table 1: Gender Distribution of Crabs in Akor and Itu River

Parameter	Akor		Itu	
	Male	Female	Male	Female
Frequency	6.11 ± 2.166	6.72 ± 2.59	23.33 ± 10.59	23.72 ± 12.69
Weight	34.41 ± 10.34	36.87 ± 13.05	30.16 ± 11.19	33.46 ± 10.25
Dorsal length	5.26 ± 0.814	6.03 ± 1.13	5.28 ± 0.82	5.26 ± 0.81
Total width	4.33 ± 0.57	4.36 ± 0.66	4.08 ± 0.58	4.34 ± 0.51

In months, crabs obtained from Akor River was between the mean value of 2.50 ± 0.71 of May 2024 and 12.00 ± 1.41 of August 2024, catches were observed to decline during the dry seasons and increased during the rainy seasons. The weight of crabs caught during the period of this research was at its peak in the month of July 2023 with $52.20 \pm 0.00\text{g}$ and reduced to $19.91 \pm 1.82\text{g}$ in the month of September 2023. The dorsal length of the crabs was between $4.70 \pm 0.14\text{cm}$ and 7.50 ± 0.00 in the months of September 2023 and July 2023 respectively whereas the dorsal with of the crabs were between $3.60 \pm 0.00\text{cm}$ as observed in the months of October 2023 and February 2024, and $5.10 \pm 0.00\text{cm}$ in the month of July 2023 as seen in Table 2.

From Itu River, the number of catches made varied between 11.00 ± 1.41 which was obtained in the months of June 2023 and August 2023, and 45.00 ± 7.07 obtained in the months of December 2023. The crabs obtained weighed most in the month of April 2024 with $45.00 \pm 7.07\text{g}$ but the weight was reduced to $24.65 \pm 1.63\text{g}$ in the month of May 2024. The dorsal length of itu river crabs obtained was between $4.68 \pm 0.17\text{cm}$ and $6.30 \pm 1.70\text{cm}$ as dorsal width were $3.85 \pm 0.35\text{cm}$ and $5.00 \pm 0.14\text{cm}$. In Itu River, the crabs were more abundant in the dry season than in the rainy seasons and they were caught all-round the year.

Table 2: Spatiotemporal distribution of crabs in Akor and Itu River

Month	Akor				Itu			
	Frequency	Weight	Dorsal length	Dorsal width	Frequency	Weight	Dorsal length	Dorsal width
May 2023	7.50±0.71	33.65±14.35	4.75±0.49	4.25±0.92	15.00±0.00	30.95±7.28	5.55±0.06	4.30±0.28
June 2023	6.50±2.12	29.91±9.06	5.45±0.49	4.05±0.64	11.00±1.41	28.01±13.28	5.30±0.99	4.20±0.57
July 2023	8.00±1.41	52.20±0.00	7.50±0.00	5.10±0.00	9.50±0.71	25.33±2.58	5.20±0.14	3.85±0.35
August 2023	8.00±0.00	37.40±0.00	6.00±0.00	4.60±0.00	11.00±1.41	29.80±8.91	5.30±0.28	4.05±0.64
September 2023	6.50±0.71	19.91±1.82	4.70±0.14	3.70±0.14	18.50±2.12	33.65±14.35	4.75±0.49	4.25±0.92
October 2023	6.00±1.41	29.73±8.80	5.55±0.64	3.60±0.00	23.50±2.12	25.33±2.58	5.20±0.14	3.85±0.35
November 2023	4.50±0.71	36.56±21.74	6.00±1.70	4.35±1.06	27.50±3.54	33.65±14.35	4.75±0.49	4.25±0.92
December 2023	3.50±0.71	41.48±5.77	5.28±1.02	4.70±0.14	45.00±7.07	26.48±0.95	5.45±0.21	4.10±0.00
January 2024	3.50±0.71	34.53±15.60	4.83±0.38	4.20±0.85	40.00±0.00	35.28±23.55	5.90±1.84	4.45±0.92
February 2024	6.00±1.41	22.35±1.63	4.95±0.21	3.60±0.00	45.00±7.07	39.88±5.55	5.20±1.13	4.65±0.35
March 2024	7.00±1.41	48.88±4.70	6.03±2.08	4.95±0.21	27.50±3.54	33.38±17.23	4.68±0.17	4.20±0.85
April 2024	5.00±1.41	48.00±5.94	5.95±2.19	5.00±0.14	27.50±3.54	48.00±5.94	5.95±2.19	5.00±0.14
May 2024	2.50±0.71	44.26±11.24	6.65±1.20	4.80±0.42	17.50±3.54	24.65±1.63	5.35±0.35	3.85±0.35
June 2024	7.50±0.71	30.45±9.83	5.55±0.64	4.10±0.71	16.00±1.41	33.65±14.35	4.75±0.49	4.25±0.92
July 2024	9.50±0.71	29.91±9.06	5.45±0.49	4.05±0.64	12.50±0.71	28.01±13.28	5.30±0.99	4.20±0.57
August 2024	12.00±1.41	48.00±5.94	5.95±2.19	5.00±0.14	16.00±1.41	25.33±2.58	5.20±0.14	3.85±0.35
September 2024	6.50±0.71	28.57±10.44	5.40±0.85	4.00±0.57	27.00±2.83	33.38±17.23	4.68±0.17	4.20±0.85
October 2024	5.50±0.71	25.80±0.00	5.59±0.00	4.10±0.00	33.50±2.12	37.85±20.29	6.30±1.70	4.35±1.06



Plate 1: Showing dorsal view of *Sudanonautes floweri* obtained from Akor River Abia State



Plate 2: Showing Ventral view of *Sudanonautes floweri* obtained from Akor River Abia State



Plate 3: Showing dorsal view of *Sudanonautes floweri* obtained from Itu River Akwalbom



Plate 4: Showing ventral view of *Sudanonautes floweri* obtained from Itu River Akwalbom



Plate 5: Showing female crab



Plate 6: Showing male crab

Mussels

In Akor River mussels were caught in the dry seasons during the period of this research, there were no catches in the months of June, July August and September of 2023 and April through August of 2024. The quantity of mussels caught ranged between 2.00 ± 0.00 in the months of December 2024 and 4.50 ± 0.71 caught in the month of December 2024. The weight of these mussels caught ranged between $7.00 \pm 2.83\text{g}$ and $11.40 \pm 0.14\text{g}$ obtained in the months of February and January 2024 respectively, their lengths were also measured in centimeters as average of $3.55 \pm 2.05\text{cm}$ and $6.30 \pm 0.14\text{cm}$ if March and February 2024 respectively. The hinge length of the mussels was between 2.10 ± 1.56 and $5.85 \pm 0.64\text{cm}$ obtained in the months of March and February respectively.

In Itu River the number of catches made was between 6.00 ± 1.41 obtained in the month of July 2023 and 20.00 ± 7.07 of the month of November 2023. The weight of the mussels was $4.05 \pm 1.34\text{g}$ in the month of February with a peak of $11.15 \pm 0.21\text{g}$ in the month of September 2023. The length of the mussels included a range of $2.75 \pm 0.35\text{cm}$ and $6.15 \pm 0.07\text{cm}$ which were gotten in the months of December and September 2023. The width of the mussels was between $1.10 \pm 0.14\text{cm}$ obtained in the month of February 2024 and $3.15 \pm 0.07\text{cm}$ at September 2023 and the same goes for the hinge length as seen in Table 3.

Table 3: Spatiotemporal Distribution of Mussels in Itu and Akor River

Month	Akor					Itu				
	Frequency	Weight	Length	Width	Hinge length	Frequency	Weight	Length	Width	Hinge length
May 2023	3.00 ± 0.00	10.37 ± 0.10	5.35 ± 0.07	2.50 ± 0.00	3.95 ± 0.07	9.00 ± 1.41	8.25 ± 3.18	4.05 ± 2.05	1.90 ± 0.99	2.45 ± 2.19
June 2023	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	7.00 ± 1.41	10.75 ± 1.06	5.90 ± 0.71	2.85 ± 0.78	5.15 ± 1.63
July 2023	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	6.00 ± 1.41	9.95 ± 1.34	5.40 ± 0.57	2.50 ± 0.42	3.70 ± 0.71
August 2023	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	7.50 ± 2.12	8.45 ± 3.46	4.35 ± 2.05	2.15 ± 0.92	2.60 ± 2.26
September 2023	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	11.00 ± 5.66	11.15 ± 0.21	6.15 ± 0.07	3.15 ± 0.07	5.20 ± 0.28
October 2023	3.50 ± 0.71	11.00 ± 5.66	5.50 ± 3.54	2.80 ± 2.12	5.10 ± 5.52	15.00 ± 7.07	10.05 ± 0.07	5.20 ± 0.28	2.20 ± 0.14	3.90 ± 0.14
November 2023	3.50 ± 0.71	10.85 ± 0.78	5.75 ± 0.64	2.85 ± 0.49	4.55 ± 0.92	20.00 ± 7.07	10.00 ± 4.24	4.95 ± 2.62	2.50 ± 1.41	4.05 ± 4.31
December 2023	3.50 ± 0.71	9.10 ± 1.56	4.30 ± 1.13	1.90 ± 0.28	2.90 ± 1.27	17.50 ± 6.36	6.50 ± 0.71	2.80 ± 0.28	1.25 ± 0.07	1.05 ± 0.21
January 2024	4.00 ± 1.41	8.30 ± 3.25	4.20 ± 1.84	2.10 ± 0.85	2.50 ± 2.12	20.00 ± 0.00	9.40 ± 1.98	4.70 ± 1.70	2.40 ± 0.99	3.50 ± 2.12
February 2024	4.50 ± 0.71	11.40 ± 0.14	6.30 ± 0.14	3.30 ± 0.14	5.85 ± 0.64	19.00 ± 2.83	4.05 ± 1.34	2.00 ± 0.71	1.10 ± 0.14	0.95 ± 0.07
March 2024	3.00 ± 0.00	7.00 ± 2.83	3.55 ± 2.05	1.55 ± 0.92	2.10 ± 1.56	20.00 ± 2.83	8.40 ± 9.33	4.25 ± 5.30	2.60 ± 2.40	5.05 ± 5.59

April 2024	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	14.00±1.41	6.00±1.41	2.75±0.35	1.25±0.07	1.10±0.14
May 2024	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	11.00±1.41	8.10±2.97	3.85±1.77	1.65±0.64	2.35±2.05
June 2024	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	8.50±2.12	9.35±1.91	4.65±1.63	2.20±0.71	3.05±1.48
July 2024	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	8.00±0.00	8.20±3.11	4.10±1.70	2.05±0.78	2.45±2.05
August 2024	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	9.00±0.00	9.00±5.66	4.65±3.04	2.35±1.63	4.05±4.31
September 2024	2.00±0.00	9.00±1.41	4.45±1.34	2.00±0.42	3.00±1.41	10.50±3.54	9.10±2.97	4.50±2.12	2.15±1.20	3.10±2.69
October 2024	3.00±0.00	8.22±3.14	4.15±1.77	2.00±0.71	2.50±2.12	16.50±2.12	9.25±3.18	4.75±2.33	2.45±1.34	3.65±3.75

In both Akor and Itu River, different species of mussels were obtained which included *Aspatharia dahomeyensis* and *Margaritifera margaritifera*. At Akor River, the number of *Aspatharia dahomeyensis* caught was 1.72 ± 1.90 . With hinge length of 1.32 ± 1.73 cm their length and width were 2.09 ± 2.33 cm and 1.01 ± 1.12 cm respectively and weight of the mussels obtained was 4.22 ± 4.55 g. 1.61 ± 1.72 catch of *Margaritifera margaritifera* weighed 5.25 ± 5.68 g having length, width and hinge length of 2.74 ± 3.02 cm, 1.33 ± 1.51 cm and 2.29 ± 2.79 cm respectively.

At Itu, *Aspatharia dahomeyensis* the number of catch was 11.61 ± 5.21 and the weight of the catches was 7.51 ± 2.90 g. With hinge length of 2.33 ± 1.67 cm the length and width were 3.73 ± 1.74 cm and 1.83 ± 0.75 cm respectively. *Margaritifera margaritifera* with 4.04 ± 2.47 cm hinge length recorded length and width of 5.04 ± 1.67 and 2.47 ± 0.97 cm and a weight of 9.82 ± 2.69 g as seen in Table 4.

Table 4: Spatiotemporal Distribution of Mussels in Akor and Itu River

Parameters	Akor		Itu	
	<i>Aspatharia dahomeyensis</i>	<i>Margaritifera margaritifera</i>	<i>Aspatharia dahomeyensis</i>	<i>Margaritifera margaritifera</i>
Frequency	1.72 ± 1.90	1.61 ± 1.72	11.61 ± 5.21	13.89 ± 5.78
Weight	4.22 ± 4.55	5.25 ± 5.68	7.51 ± 2.90	9.82 ± 2.69
Length	2.09 ± 2.33	2.74 ± 3.02	3.73 ± 1.74	5.04 ± 1.67
Width	1.01 ± 1.12	1.33 ± 1.51	1.83 ± 0.75	2.47 ± 0.97
Hinge length	1.32 ± 1.73	2.29 ± 2.79	2.33 ± 1.67	4.04 ± 2.47



Plate 7: Showing Dorsal View of *Aspatharia dahomeyensis* obtained from Akor River



Plate 8: Showing Dorsal view of *Margaritifera falcata* Obtained from Akor River

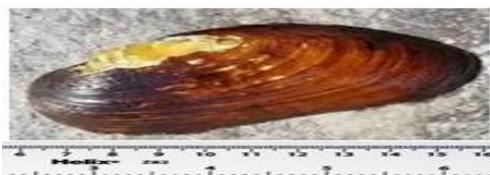


Plate 9: Showing Dorsal View of *Margaritifera margaritifera* Obtained from Itu River

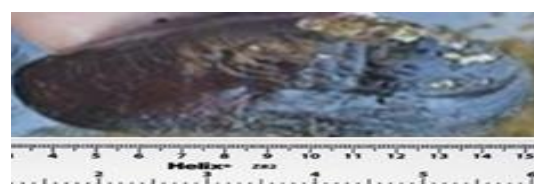


Plate 10: Showing Dorsal View of *Aspatharia dahomeyensis* Obtained from Itu River

Periwinkles

From Table 5 the periwinkles were not caught in Akor River in the months of July and August 2023 also in the months of April, May, June, July and August 2024. There were catches round the months during the research at Itu River. At Akor River, the number of catches made ranged between December 2023 and February 2024 with 6.00 ± 1.00 and 2.00 ± 1.00 respectively. The weight of the periwinkles obtained in the month of May 2023 with 1.24 ± 0.08 g before the non-catch period was the month with the weightiest catch during the period of the research and the lowest in weight was recorded in the month of January 2024 with 0.21 ± 0.02 g. The length of the periwinkles was also in line with the May 2023 and January 2024 ranges with 2.77 ± 0.25 g and 1.60 ± 0.20 g respectively. At Itu River the maximum number of periwinkle caught was in the month of 28.50 ± 16.26 in the month of March 2024 and the minimum was 8.50 ± 0.71 in the month of July 2024. Their weight ranged between 0.25 ± 0.08 g and 0.74 ± 0.75 g in the month of July 2023 and October 2024. The length of periwinkles was between 1.11 ± 0.72 cm and 2.20 ± 0.85 cm in the months of august and October 2024 respectively.

Table 5: Spatiotemporal Distribution of Periwinkles in Itu and Akor River

Month	Akor			itu		
	Frequency	Weight	Length	Frequency	Weight	Length
May 2023	5.00 ± 1.00	1.24 ± 0.08	2.77 ± 0.25	12.50 ± 3.54	0.69 ± 0.74	2.10 ± 1.00
June 20203	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	11.00 ± 1.41	0.56 ± 0.49	2.01 ± 0.55
July 2023	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	10.50 ± 0.71	0.25 ± 0.08	1.72 ± 0.16
August 2023	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	9.00 ± 0.00	0.26 ± 0.06	1.73 ± 0.15
September 2023	4.00 ± 1.00	0.22 ± 0.02	1.60 ± 0.20	11.00 ± 1.41	0.46 ± 0.37	1.85 ± 0.35
October 2023	3.00 ± 1.00	0.77 ± 0.03	2.40 ± 0.20	14.50 ± 0.71	0.59 ± 0.55	1.95 ± 0.64
November 2023	5.00 ± 1.00	0.64 ± 0.01	2.07 ± 0.15	11.50 ± 9.19	0.71 ± 0.29	2.15 ± 0.35
December 2023	6.00 ± 1.00	0.68 ± 0.02	2.30 ± 0.20	20.00 ± 0.00	0.76 ± 0.22	2.20 ± 0.28
January 2024	5.00 ± 1.00	0.21 ± 0.02	1.60 ± 0.20	25.00 ± 0.00	0.51 ± 0.29	2.02 ± 0.26
February 2024	2.00 ± 1.00	0.22 ± 0.01	1.60 ± 0.20	25.50 ± 6.36	0.43 ± 0.31	1.86 ± 0.34
March 2024	3.00 ± 1.00	0.93 ± 0.03	2.30 ± 0.20	28.50 ± 16.26	0.50 ± 0.43	1.95 ± 0.49
April 2024	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	13.50 ± 2.12	0.56 ± 0.50	1.95 ± 0.64
May 2024	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	10.50 ± 0.71	0.70 ± 0.57	2.16 ± 0.47
June 2024	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	9.00 ± 1.41	0.51 ± 0.42	1.99 ± 0.52
July 2024	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	8.50 ± 0.71	0.60 ± 0.42	2.12 ± 0.40
August 2024	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	9.50 ± 0.71	0.31 ± 0.13	1.11 ± 0.72
September 2024	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	16.00 ± 1.41	0.44 ± 0.34	1.90 ± 0.57
October 2024	5.00 ± 1.00	0.90 ± 0.01	2.50 ± 0.20	20.00 ± 0.00	0.74 ± 0.75	2.20 ± 0.85

The species of periwinkle caught from Akor River was *Tympanotonus fuscatus* but *pachymelania aurita* and *Tympanotonus fuscatus* were the species caught at Itu River. At Akor River, the *Tympanotonus fuscatus* caught was 2.11 ± 2.35 with weight and length of 0.32 ± 0.42 g and 1.07 ± 1.14 cm respectively.

At Itu River, *pachymelania aurita* was the more abundant with 15.17 ± 8.97 , it weighed 0.52 ± 0.39 g and recorded length of 1.88 ± 0.55 cm. *Tympanotonus fuscatus* was 14.39 ± 4.89 with weight of 14.39 ± 4.89 g and 2.00 ± 0.35 cm length as seen in Table 6

Table 6: Spatiotemporal distribution of Periwinkles in Akor and Itu River

Parameters	Akor		Itu	
	<i>Tympanotonus fuscatus</i>	<i>pachymelania aurita</i>	<i>Tympanotonus fuscatus</i>	
Frequency	2.11 ± 2.35		15.17 ± 8.97	14.39 ± 4.89
Weight	0.32 ± 0.42		0.52 ± 0.39	0.54 ± 0.31
Length	1.07 ± 1.14		1.88 ± 0.55	2.00 ± 0.35



Plate 11: Showing *Tympantonus fuscatus* from Akor River



Plate 12: Showing *Pachymelania aurita* from Itu River



Plate 13: Showing *Tympantonus fuscatus* from Itu River

Prawn

The prawns caught from Akor River were within 1.25 ± 0.50 and 5.50 ± 2.52 which were obtained in the months of May 2023 and February 2024 respectively. Their total length peak within the period of research was 12.53 ± 2.59 cm and 15.43 ± 3.50 cm in the months of May and January having the standard length as 7.75 ± 1.12 cm for the maximum value of the prawns obtained in the month of October 2023. The head length of the prawns ranged between 5.85 ± 0.98 cm of the month of March 2024 and 7.42 ± 1.51 of January 2024 with the peak of the weight of the prawns as 53.18 ± 24.45 g, the minimum weight obtained from Akor River was 34.00 ± 6.88 g which were obtained in the months of January and March 2024 respectively.

Prawns obtained from Itu River were more than the ones obtained from Akor; they were between 16.00 ± 1.15 and 56.25 ± 4.79 caught in the months of august 2024 and December 2023. The total length of the prawns ranged between 12.93 ± 2.24 and 16.88 ± 2.84 cm of august 2024 and June 2023. The standard length and head length had their minimum at the months of august 2024 and their maximum values at the month of June 2023. The weight of prawns caught from Itu River had its peak with 56.73 ± 19.97 g in the month of June 2023 and the minimum weight was observed in the month of august 2024 with 35.43 ± 5.91 g as seen in Table 7.

Table 7: Spatiotemporal distribution of Prawns in Itu and Akor River

Month	Akor					Itu		
	Frequency	Total length	Standard length	Head length	Weight	Frequency	Total length	Standard length
May 2023	1.25 ± 0.50	14.55 ± 1.68	7.15 ± 0.75	6.73 ± 0.10	38.75 ± 6.08	46.25 ± 11.09	14.00 ± 1.41	7.05 ± 0.58
June 2023	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	20.00 ± 4.08	16.88 ± 2.84	8.50 ± 1.34
July 2023	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	18.25 ± 2.22	13.48 ± 2.54	6.82 ± 1.17
August 2023	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	19.00 ± 2.71	14.83 ± 2.88	7.5 ± 1.19
September 2023	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	21.00 ± 5.89	15.75 ± 3.20	7.86 ± 1.57
October 2023	4.00 ± 0.82	15.50 ± 2.08	7.75 ± 1.12	7.23 ± 1.05	50.40 ± 15.93	28.00 ± 9.09	14.85 ± 2.84	7.49 ± 1.25
November 2023	2.75 ± 1.71	15.23 ± 3.24	7.53 ± 1.13	7.18 ± 1.03	45.58 ± 19.92	51.00 ± 2.94	13.95 ± 2.10	7.05 ± 1.01
December 2023	3.00 ± 0.82	15.18 ± 0.72	7.67 ± 0.42	7.10 ± 0.55	42.48 ± 4.92	56.25 ± 4.79	14.95 ± 2.72	7.59 ± 1.12
January 2024	5.00 ± 0.82	15.43 ± 3.50	7.76 ± 1.64	7.42 ± 1.51	53.18 ± 24.45	36.25 ± 4.79	16.38 ± 2.87	8.10 ± 1.22
February 2024	5.50 ± 2.52	14.48 ± 2.71	7.53 ± 1.51	7.20 ± 1.51	52.15 ± 23.02	55.00 ± 5.77	15.83 ± 3.12	7.96 ± 1.47
March 2024	2.75 ± 0.96	12.53 ± 2.59	6.35 ± 1.07	5.85 ± 0.98	34.00 ± 6.88	52.50 ± 0.58	14.85 ± 2.84	7.49 ± 1.25

April 2024	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	40.50±0.58	14.15±3.33	7.06±1.48
May 2024	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	22.50±2.89	16.13±2.46	8.14±1.26
June 2024	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	19.50±0.58	15.25±2.63	7.66±1.11
July 2024	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	17.50±2.89	16.18±2.46	8.21±1.24
August 2024	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	16.00±1.15	12.93±2.24	6.50±0.94
September 2024	3.00±0.82	14.95±2.37	7.48±1.24	7.18±1.02	46.78±19.46	21.00±1.15	16.25±2.75	8.11±1.35
October 2024	4.75±0.96	13.48±2.54	6.85±1.23	6.43±1.18	38.45±7.74	28.50±1.73	14.15±1.52	7.20±0.74

The number of male prawns obtained from Akor River were 1.72±2.01 and the females 1.83±2.31, the males had a total length of 6.79±6.98cm with standard and head length of 6.84±7.15 and 3.30±3.44cm respectively weighing 20.68±23.76g. The females had a total length of 7.80±8.12cm with a standard and head length of 3.92±4.07cm and 3.66±3.81cm weighing 23.96±26.36g. Itu River were 31.00±15.40 with a total length of 14.33±1.89cm the males had a standard and head length of 7.30±1.00 and 6.77±0.64 with a weight of 39.75±9.94g. The females were 32.22±14.65, with weight of 53.03±18.21g female's standard length and head lengths were 7.85±1.29 and 7.85±1.29cm respectively as seen in Table 8.

Table 8: Gender Distribution of Prawn in Akor and Itu River

Parameter	Akor		Itu	
	Male	Female	Male	Female
Frequency	1.72±2.01	1.83±2.31	31.00±15.40	32.22±14.65
Total length	6.79±6.98	7.80±8.12	14.33±1.89	15.75±2.94
Standard length	3.42±3.50	3.92±4.07	7.30±1.00	7.85±1.29
Head length	3.26±3.34	3.66±3.81	6.77±0.64	7.38±1.22
Weight	19.17±20.56	25.47±28.67	39.75±9.94	53.03±18.21

Two species of prawns were caught in both Akor and Itu rivers namely *Macrobrachium macrobrachion* and *Macrobrachium vollenhovenni*. *Macrobrachium macrobrachion* caught from Akor River were 1.53±1.87 and they have total length of 6.84±7.15cm with total and head length of 3.49±3.64cm and 3.30±3.44 weighing 20.68±23.76g. *Macrobrachium vollenhovenni* weighing 23.96±26.36g, were 2.03±2.40 with standard and head length of 3.85±3.9cm and 3.62±3.72cm. From Itu River 30.64±14.66 *Macrobrachium macrobrachion* weighed 43.23±14.67g having a total, stand and head length of 14.37±2.40, 7.38±1.21 and 6.79±1.01cm respectively. *Macrobrachium vollenhoveni* were 32.58±15.35 with a total, standard and head length of 15.71±2.55, 7.77±1.13 and 7.36±0.94cm weighing 49.56±16.88g as seen in Table 9.

Table 9: Species Distribution of Prawn in Akor and Itu River

Parameters	Akor		Itu	
	<i>Macrobrachium macrobrachion</i>	<i>Macrobrachium vollenhoveni</i>	<i>Macrobrachium macrobrachion</i>	<i>Macrobrachium vollenhoveni</i>
frequency	1.53±1.87	2.03±2.40	30.64±14.66	32.58±15.35
Total length	6.84±7.15	7.75±7.98	14.37±2.40	15.71±2.55
Standard length	3.49±3.64	3.85±3.9	7.38±1.21	7.77±1.13
Head length	3.30±3.44	3.62±3.72	6.79±1.01	7.36±0.94
Weight	20.68±23.76	23.96±26.36	43.23±14.67	49.56±16.88



Plate 14: Showing Lateral view of *Macrobrachium vollenhoveni* from Akor River



Plate 15: Showing Lateral view of *Macrobrachium vollenhoveni* from Itu River



Plate 16: Showing Lateral View of *Macrobrachium macrobranchion* Caught from Akor River



Plate 17: Showing Lateral View of *Macrobrachium macrobranchion* Caught from Itu River

Clam

From table 3.10 clams were only caught in Itu River that means none was caught in Akor River. Only one species of clam was obtained throughout the period of this research (*Galatea paradoxa*). With number of catches lowered during the rainy season and increased during the dry season, the lowest catch was observed in the months of July and August of the different years of research with 4.33 ± 2.08 and 4.33 ± 2.08 respectively. The highest catch occurred in the month of February with 24.33 ± 2.08 g but the weight of clams of the month of June and February were the highest with 45.00 ± 2.00 g while the lowest occurred in the month of July 2024 with 14.00 ± 2.00 g. Clams caught during the dry seasons weighed more than the rainy season. The length, width and the hinge length in the same vein showed that clams obtained during the dry seasons were bigger than the ones obtained during the rainy season. The highest length was in the month of September 2023, same with width and hinge length with 7.00 ± 1.00 cm, 7.00 ± 1.00 cm and 2.60 ± 0.17 cm respectively. The lowest occurred in August 2024 for the three parameters with 4.40 ± 0.87 cm, 4.40 ± 0.87 cm and 0.90 ± 0.17 cm respectively.

Table 3.10: Prevalence of *Galatea paradoxa* obtained from Itu Rivers

Month /year	Frequency	Weight	Length	Width	Hinge length
May 2023	9.33 ± 2.08^{cd}	40.00 ± 2.00^{ab}	5.23 ± 0.86	5.20 ± 0.92	1.30 ± 0.17^{cde}
June 2023	7.33 ± 2.08^d	45.00 ± 2.00^{ab}	6.10 ± 0.95	6.10 ± 0.95	2.07 ± 0.12^b
July 2023	4.67 ± 1.53^d	39.00 ± 2.00^{ab}	6.23 ± 0.93	6.23 ± 0.93	2.17 ± 0.12^{ab}
August 2023	4.67 ± 1.53^d	20.00 ± 2.00^{de}	5.00 ± 1.00	5.00 ± 1.00	1.10 ± 0.17^{de}
September 2023	6.33 ± 2.08^d	25.00 ± 2.00^{cd}	7.00 ± 1.00	7.00 ± 1.00	2.60 ± 0.17^a
October 2023	9.33 ± 2.08^{cd}	30.00 ± 2.00^c	5.23 ± 0.93	5.23 ± 0.93	1.30 ± 0.17^{cde}
November 2023	14.33 ± 2.08^{bc}	30.00 ± 2.00^c	5.13 ± 0.96	5.17 ± 0.91	1.10 ± 0.17^{de}
December 2023	19.33 ± 2.08^{ab}	25.00 ± 2.00^{cd}	6.00 ± 1.00	6.00 ± 1.00	2.10 ± 0.17^b
January 2024	19.33 ± 2.08^{ab}	43.00 ± 2.00^{ab}	6.10 ± 0.95	6.07 ± 1.01	1.30 ± 0.17^{cde}
February 2024	24.33 ± 2.08^a	45.00 ± 2.00^a	6.10 ± 0.95	6.07 ± 1.01	1.30 ± 0.17^{cde}
March 2024	19.33 ± 2.08^{ab}	40.00 ± 2.00^{ab}	5.00 ± 1.00	5.00 ± 1.00	1.07 ± 0.12^{de}
April 2024	17.33 ± 2.08^b	38.00 ± 2.00^b	6.00 ± 1.00	6.00 ± 1.00	1.37 ± 0.12^{cd}
May 2024	14.33 ± 2.08^{bc}	30.00 ± 2.00^c	6.03 ± 1.00	6.03 ± 1.00	2.07 ± 0.12^b
June 2024	9.33 ± 2.08^{cd}	20.00 ± 2.00^{de}	5.40 ± 0.87	5.40 ± 0.87	2.07 ± 0.12^b

July 2024	4.33±2.08 ^d	14.00±2.00 ^e	5.47±0.84	5.47±0.84	2.07±0.12 ^b
August 2024	4.33±2.08 ^d	16.00±2.00 ^e	4.40±0.87	4.40±0.87	0.90±0.17 ^e
September 2024	7.33±2.08 ^d	15.00±2.00 ^e	5.00±1.00	5.00±1.00	1.07±0.12 ^{de}
October 2024	9.33±2.08 ^c	17.00±2.00 ^e	6.10±0.95	6.10±0.95	1.57±0.12 ^e

At $p \leq 0.05$ there were significance difference with length and width of clams caught within the period but the changes in number of catches, weight and hinge-length in the month brought about subsequent change in other months. This occurred in the months of May 2023, October and July 2024 in the number of catch with 9.33 ± 2.08 , 9.33 ± 2.08 and 9.33 ± 2.08 respectively. More so, 7.33 ± 2.08 , 4.67 ± 1.53 , 4.67 ± 1.53 , 6.33 ± 2.08 , 4.33 ± 2.08 , 4.33 ± 2.08 and 7.33 ± 2.08 in the months of June 2023, July, August, September, July 2024 August and September respectively etc. similarly corresponding changes in weight occurred in the months of May 2023, June, July, January and March with 7.33 ± 2.08 g, 4.67 ± 1.53 g, 4.67 ± 1.53 g, 6.33 ± 2.08 g, 4.33 ± 2.08 g, 4.33 ± 2.08 g and 7.33 ± 2.08 g etc expressing no significance difference with the weight levels amongst them in the months. The months of May 2023, October, January and February showed a higher level of effect or influence amongst them in the months with 1.30 ± 0.17 cm, 1.30 ± 0.17 cm, 1.30 ± 0.17 cm and 1.30 ± 0.17 cm respectively as seen in table 3.10.



Plate 18: Showing Clam (*Galatea paradoxa*) Caught from Itu River



Plate 19: Showing Oyster (*Crassostrea gasar*) Caught from Itu River

Oyster

From table 3.11, oyster was caught throughout the season but the highest seasons of the catches were in the dry seasons and the lowest were in the rainy seasons. This was as a result of the reduced water that aids the flow of the oysters. The highest catch was in the month of October with 7.50 ± 0.71 and the lowest in the month of August 2023 with 1.50 ± 0.71 , but we had the lowest of the weights obtained in the dry seasons and the weightier ones obtained during the rainy season. The highest weight was obtained in the month of March 2024 with 44.50 ± 0.71 g while the lowest was obtained in the month of October 2023 with 14.50 ± 0.71 g. The length, width and the hinge length of oysters obtained from Itu river May 2023 and September 2023 with 3.43 ± 0.69 and 7.50 ± 0.71 cm, 3.36 ± 0.53 and 6.50 ± 0.71 cm and 1.02 ± 0.05 and 1.75 ± 0.35 cm respectively. There was no significance difference amongst the months in the number of catches, weight, length, width and hinge length of the oysters as seen in table 11. At $p \leq 0.05$, change in number of catch in the month of May 2023 resulted a change in June 2023, September 2023, December 2023, January 2024, February and March with 5.25 ± 0.79 , 5.50 ± 0.71 , 6.50 ± 0.71 , 6.50 ± 0.71 , 5.50 ± 0.71 , 5.50 ± 0.71 , 6.50 ± 0.71 and 5.50 ± 0.71 respectively at $p \leq 0.05$. The weight varied greatly as seen in table 11 the length, width and hinge length also having no significance difference within the months at $p \leq 0.05$

Table 11: Morphometric Characteristics of Oyster (*Crassostrea gasar*) obtained from Itu River

Month/year	Frequency	Weight	Length	Width	Hinge length
May 2023	5.25 ± 0.79^{ab}	43.25 ± 0.79^a	3.43 ± 0.69^c	3.36 ± 0.53^b	1.02 ± 0.05^{ef}
June 2023	5.50 ± 0.71^{ab}	40.50 ± 0.71^{bc}	6.25 ± 0.07^{ab}	5.65 ± 0.78^{ab}	1.20 ± 0.00^{def}
July 2023	4.50 ± 0.71^{bc}	38.50 ± 0.71^c	6.45 ± 0.07^{ab}	5.85 ± 0.92^a	0.95 ± 0.07^{ef}
August 2023	2.50 ± 0.71^{cd}	29.50 ± 0.71^d	5.50 ± 0.71^{ab}	4.50 ± 0.71^{ab}	1.20 ± 0.14^{def}

September 2023	6.50±0.71 ^{ab}	20.50±0.71 ^f	7.50±0.71 ^a	6.50±0.71 ^a	1.75±0.35 ^{bc}
October 2023	7.50±0.71 ^a	14.50±0.71 ^g	5.55±0.07 ^{ab}	4.95±0.78 ^{ab}	1.75±0.35 ^{bc}
November 2023	6.50±0.71 ^{ab}	15.50±0.71 ^g	5.35±0.07 ^b	4.75±0.78 ^{ab}	1.75±0.35 ^{bc}
December 2023	5.50±0.71 ^{ab}	14.50±0.71 ^g	6.00±0.00 ^{ab}	5.50±0.71 ^{ab}	0.75±0.07 ^f
January 2024	5.50±0.71 ^{ab}	16.50±0.71 ^g	6.25±0.07 ^{ab}	5.65±0.78 ^{ab}	0.95±0.07 ^{ef}
February 2024	6.50±0.71 ^{ab}	39.50±0.71 ^c	6.10±0.14 ^{ab}	5.65±0.78 ^{ab}	1.35±0.21 ^{cde}
March 2024	5.50±0.71 ^{ab}	44.50±0.71 ^a	5.50±0.71 ^{ab}	4.50±0.71 ^{ab}	1.05±0.21 ^{ef}
April 2024	4.50±0.71 ^{bc}	38.50±0.71 ^c	6.50±0.71 ^{ab}	5.50±0.71 ^{ab}	1.90±0.14 ^b
May 2024	4.50±0.71 ^{bc}	19.50±0.71 ^f	6.20±0.14 ^{ab}	5.50±0.85 ^{ab}	1.95±0.21 ^{ab}
June 2024	2.50±0.71 ^{cd}	24.50±0.71 ^e	5.85±0.07 ^{ab}	5.10±0.99 ^{ab}	0.95±0.07 ^{ef}
July 2024	2.00±0.00 ^{cd}	29.50±0.71 ^d	5.95±0.07 ^{ab}	5.15±1.06 ^{ab}	2.40±0.14 ^a
August 2024	1.50±0.71 ^d	29.50±0.71 ^d	4.90±0.14 ^{bc}	4.10±0.99 ^{ab}	1.15±0.07 ^{def}
September 2024	2.50±0.71 ^{cd}	24.50±0.71 ^e	5.50±0.71 ^{ab}	4.50±0.71 ^{ab}	0.95±0.07 ^{ef}
October 2024	4.50±0.71 ^{bc}	42.50±0.71 ^{ab}	6.10±0.14 ^{ab}	5.65±0.78 ^{bcd}	1.60±0.57 ^{ef}

Snails

From Table 12 there were no catch made in the some of the months during the rainy season which included June 2023 to August 2023 and April 2024 to August 2024. The lowest of the catch during the research was made in the month of March 20224 and the highest was recorded in the month of October 2023 with 2.25±0.50cm and 4.25±0.50cm respectively. The weight of the snails obtained ranged between 1.62±1.69g recorded in the month of September 2024 and 2.20±1.71 in the month of September 2023. This showed no significance difference with the length of the snails at $P \leq 0.05$. The diameter of snails recorded the highest in the month of September 2023 with 0.79±0.69cm and the lowest in the month of May 2023 with 0.45±0.33cm.

Table 12: Spatiotemporal Distribution of Snails in Akor River

Months	Frequency(cm)	Weight(g)	Length(cm)	Diameter(cm)
May 2023	3.00±0.82	1.84±1.22	1.98±0.68	0.45±0.33
June 2023	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
July 2023	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
August 2023	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
September 2023	2.75±0.50	2.20±1.71	2.48±0.50	0.79±0.69
October 2023	4.25±0.50	2.18±1.55	2.40±0.56	0.75±0.64
November 2023	3.50±1.73	1.97±1.33	2.23±0.51	0.60±0.52
December 2023	2.75±2.22	1.93±1.49	2.20±0.50	0.65±0.57
January 2024	3.00±0.82	1.83±1.64	2.13±0.52	0.66±0.58
February 2024	3.75±0.96	1.75±1.45	2.01±0.52	0.53±0.39
March 2024	2.25±0.50	1.68±1.25	1.99±0.47	0.50±0.36
April 2024	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
May 2024	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
June 2024	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
July 2024	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
August 2024	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
September 2024	2.50±0.58	1.62±1.69	1.65±1.05	0.65±0.61
October 2024	3.75±0.50	1.81±1.71	2.21±0.78	0.67±0.64

From Table 13 species of water snails obtained from Akor River included *Pila ovata* and *Melaniodes maculata*. There were more records of *P. ovata* in the river than *M. maculata* with 1.78±1.81 and 1.72±1.78 respectively. the weight of *P. ovata* caught was 1.72±1.63g with a diameter of 0.58±0.58cm. the weight of *M. maculata* was 0.37±0.45g and diameter measured 0.11±0.10cm.

Table 3.13 Snails Obtained from Akor River

Parameter	<i>Pila ovata</i>	<i>Melanoides maculata</i>
Frequency	1.78±1.81	1.72±1.78
Weight	1.72±1.63	0.37±0.45
Length	1.23±1.22	1.13±1.10
Diameter	0.58±0.58	0.11±0.10

**Plate 20: Showing Dorsal view of *Pila ovata* from Akor River****Plate 21: Showing *Melanoides masculata* from Akor River**

DISCUSSIONS

The number of crabs caught during the research were lower during the rainy season and higher during the rainy season but the weight of the crabs caught during the rainy season were higher than the crabs caught during the dry season, this also applied to the dorsal width and length of the crabs caught. In addition, the 2024 catches made were more than the catch of the previous year. The catch made at the Akor river was less than the Itu river and more female crabs than the male crabs caught during the research. This result was in line with the work of Olawusi-Peters and Ajibare (2014) who obtained crabs species from different sites in their work Species richness, diversity and abundance of some Decapod Crustaceans in coastal waters of Ondo State, South West, Nigeria. Flourizel *et al.*, (2024) also obtained crabs species in their research Shellfish Species Abundance and Diversity in River Donga, Taraba, Nigeria.

Mussels catch was also lower during the rainy season than the dry season. The weight of the mussels caught was also higher during the dry season and this also extended to the length, width and hinge length of the mussels. Mussels obtained in Itu river were more than the mussels obtained from Itu river. Both *Aspatharia dahomeyensis* and *Margaritifera margaritifera* were obtained in the different rivers but *Margaritifera margaritifera* caught were higher than the *Aspatharia dahomeyensis* caught in the rivers. Martin *et al.*, (2020) in line with the result obtained different species of mussels and went further to examine their relationships to migratory factors in their work The genetic diversity and differentiation of mussels with complex life cycles and relations to host fish migratory traits and densities. Muhammad *et al.*, (2023) also obtained mussels as bio-indicators in the littoral zones of some water reservoirs in Kastina state Nigeria. Periwinkles were caught more also during dry season as they are bottom crawling gastropods, their weight also varied with length inclusive. The periwinkles caught at Itu river were more than the catch of Akor river. Three species of periwinkle were caught from Akor river where two were caught from Itu river. *Tympanotonus fuscatus*, *Melanoides fasciolata* and *Melanoides maculate* were obtained from Akor river but only *Tympanotonus fuscatus* and *pachymelania aurita* gotten from Itu and *pachymelania aurita* were not gotten from Akor river. *pachymelania aurita* was the highest species that was obtained while the *Melanoides maculata* was the lowest in number obtained. John *et al.*, (2017) in his work Aspects of the Population Dynamics of Periwinkle (*Tympanotonus fuscatus*) along the Bonny River, Nigeria obtained similar periwinkle along Bony River and in different years. Periwinkles were also gotten from Bodo creek Niger Delta Nigeria in which were found to contain some traces of heavy metals which could be detrimental to human health in the work of Chimezie *et al.*, 2024 in his work Ecological and Human Health Risk Assessment of Sediment, Periwinkle and Water in Bodo Creek, Niger Delta Nigeria.

Prawns were also caught in the two rivers; the prawns caught recorded a low catch in the rainy seasons as well and higher catch during the dry seasons. The weight of prawns obtained during the dry season was also more than the rainy season as well as the standard length and head length. There were more prawns caught at Itu than Akor river and more females were caught than male prawns. Both *M. macrobrachion* and *M. vollehoveni* were all caught in the two rivers but *M. vollehoveni* was more than *M. macrobrachion*. Prawns were also obtained in abundance in the work of Olawusi and Ajibare (2014), Species richness, diversity and abundance of some Decapod Crustaceans in coastal waters of Ondo State, South West, Nigeria and is in line with this research also in Flourizel *et al.*, (2024) work on Shellfish Species Abundance and Diversity in River Donga, Taraba, Nigeria.

Clams caught were only caught at one of the rivers and the species of clam caught were also of one species; *Galatea paradoxa*. The number of clams caught was also higher during the dry season than the rainy season this also implied to the weight which also reflected in the total length and width of the clams. This result corresponds with the work of Flourizel *et al.*, (2024) on the Shellfish Species Abundance and Diversity in River Donga, Taraba, Nigeria where they caught only one species of clam. Akinjogunla and Moruf (2019) in their work shell growth pattern and percentage flesh yield of the West African clam *Galatea paradoxa* (Born, 1778) from Itu Creek, Niger Delta Nigeria had the same result in the total length, width and weight range of clams obtained from the rivers. Egwali *et al.*, (2018) had a record of only one terrestrial species (African Zebu snail, *Anixa zebuensis*: Camaenidae) and as such reported that they were very abundant in the bank of the aquatic ecosystem.

CONCLUSION AND RECOMMENDATION

The presence of shellfish in South Eastern Nigeria showed that her rivers contain diverse sea-foods which could augment the drowning economic situation in terms of nutritional supplement. The diversity and abundance of shellfish provided variety and contributed to a complete food-web in the ecosystem. Shellfish abundance was more during the dry seasons than in the rainy season of the year. The prevalence of shellfish in Itu river than Akor showed that it is a tributary of a resourceful source and seasonal migrations occur more so there was more impact of exploitation in Akor river and this may bring about extinction of endangered species soon.

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4th Biennial Conference, 2025

12 – 14 Aug. @ Michael Okpara University of Agriculture, Umudike, Abia State

Theme: Agricultural Extension for Food Security and Community Empowerment

Sustainable Urban Farming: Adoption Of Climate-Smart Micro-gardening Practices Among Urban Households for Root and Tuber Crops Production in Abia State, Nigeria

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ABSTRACT

This study analyzed the adoption of climate-smart micro-gardening practices among urban households in Abia State, Nigeria, with root and tuber crops—specifically yam, cocoyam, and cassava. The research explored innovative, climate-resilient urban farming approaches that align with sustainable development goals amidst the challenges of climate change. A total of 50 households engaged in micro-gardening in Umuahia and Umudike were selected and interviewed using a snowball sampling technique. The respondents primarily use bags (84%) for cultivation of root and tuber crops. Key findings reveal that micro-gardening contributes significantly to reducing household food expenses ($\bar{x} = 3.64$) and supports the adoption of climate-smart agricultural practices, including zero use of inorganic fertilizers ($\bar{x} = 3.20$), use of organic pest and disease control methods ($\bar{x} = 3.30$), and re-use of old materials like plastics, bags ($\bar{x} = 3.15$). Social and economic benefits identified include enhanced access to fresh and nutritious food ($\bar{x} = 4.04$), improved social interactions with neighbors ($\bar{x} = 3.50$) and opportunities for skill development ($\bar{x} = 3.78$). Despite this benefit, households face challenges such as limited space, difficulties in watering during the dry season, and high input costs. Regression analysis indicates that socioeconomic factors such as experience in micro-gardening (1%) positively influenced the adoption of climate-smart micro-gardening practices, while household size (5%) and occupation (5%) show a negative association with adoption. The study recommends, among other things, the promotion of micro-gardening and other innovative gardening techniques as well as development of urban agriculture policies to integrate micro-gardening into urban planning frameworks.

Key words: Micro-gardening; Climate-smart practices; Root and tuber crops; Urban households; Food security.

INTRODUCTION

Rapid urbanization in developing countries has intensified challenges related to food security and nutrition, particularly in impoverished regions. Projections suggest that by 2050, urban populations in the poorest nations will more than triple, escalating pressure on existing food systems and exacerbating malnutrition and hunger issues. Currently, over 800 million people worldwide experience chronic hunger, with a significant proportion residing in urban settings (FAO, IFAD, UNICEF, WFP, & WHO., 2022).. Simultaneously, urban areas face a rising prevalence of overweight and obesity, underscoring a complex dual burden of malnutrition that demands urgent, innovative interventions to ensure adequate nutrition for vulnerable populations

Within this context, micro-gardening—small-scale container cultivation—emerges as a promising strategy for addressing urban food insecurity, particularly for root and tuber crops well-suited to compact spaces like patios, rooftops, and balconies (FAO, n.d). This approach allows for resource-efficient production, requiring minimal inputs such as water, land, and labor, while minimizing dependence on chemical fertilizers and pesticides. By fostering localized food production, micro-gardening reduces food loss across supply chains and lowers greenhouse gas emissions associated with transportation, aligning with global climate-smart agricultural goals (Smit et al., 2021).

Moreover, micro-gardening can substantially improve nutrition and dietary diversity. Studies reveal that a one-square-meter microgarden can yield substantial quantities of vegetables annually, meeting key micronutrient requirements and contributing to recommended daily intake levels for fruits and vegetables (FAO, IFAD, UNICEF, WFP, & WHO., 2022). For low-income urban households, especially in regions like Abia State, Nigeria, this translates into enhanced household food security, lower food expenditures, and improved access to fresh, nutrient-dense foods. It offers a wide array of social, environmental, and economic benefits. Socially, it promotes community interaction, enhances social cohesion, and creates employment opportunities (Krishnaveni et al., 2024). Studies have shown that urban agriculture/micro-gardening can foster social cohesion (Gunapala 2025) and contribute to the development of social capital, strengthening community connections that are increasingly eroded by urbanization (White & Stirling, 2013; Wendelboe-Nelson et al., 2019; Chalmin-Pui et al., 2021). Environmentally, urban agriculture/micro-gardening supports ecosystem health, facilitates water reuse, promotes energy saving, and reduces the environmental impacts of food imports and transportation into urban areas (Lapola et al., 2010; Qui et al. 2023).

As an agricultural innovation, micro-gardening is especially relevant for densely populated urban areas with limited space and water resources, making it a crucial tool for urban food security and resilience. This study examines the adoption of micro-gardening practices among urban households in Abia State, Nigeria with a focus on root and tuber crops. By highlighting the socioeconomic and environmental impacts, the study underscores the potential of micro-gardening as a sustainable strategy to enhance food security, reduce poverty, and mitigate climate change in urban contexts.

SPECIFIC OBJECTIVES

- i. To describe the socioeconomic characteristics of the respondents
- ii. To assess the benefits of adopting climate-smart micro-gardening practices
- iii. To identify the constraints faced by urban households in adopting micro-gardening practices
- iv. To determine the socioeconomic factors influencing the adoption of climate-smart micro-gardening practices

METHODOLOGY

The study was conducted in **Umuahia (Urban Area)** and **Umudike (Peri-urban Area)**, in **Abia State, Nigeria**. These locations were purposively selected due to their growing involvement in urban agriculture and micro-gardening activities. The increasing urbanization of these areas makes them suitable setting for exploring the adoption of **climate-smart micro-gardening practices**.

A **cross-sectional survey design** was adopted to collect data from urban households practicing micro-gardening.

The study employed a **snowball sampling technique** to identify and interview participants. This approach was chosen due to the relatively small and dispersed population of households actively engaged in micro-gardening in the study area. The snowball technique relied on initial respondents referring other eligible households, enabling access to a network of participants. A total of **50 households** practicing micro-gardening participated in the study. Data were collected using a **structured questionnaire**.

The collected data were analyzed using **descriptive and inferential statistical tools**. To assess the level of adoption of micro-gardening practices among respondents, a simple additive index was employed based on

the type of materials used for cultivation. Four types of micro-gardening containers were considered: bags, plastics, tyres, and wooden structures. Each respondent received a score based on the number of different types of planting material they use. A score of 1/4 was assigned to those who adopted only one method (e.g., only bags), while a full score of 4/4 was given to those who use all four types. This approach allowed for a comparative measure of adoption intensity, with higher scores indicating broader and more diversified adoption of micro-gardening practices. Multiple **regression models** were employed to examine the relationship between **socioeconomic characteristics** and the **adoption of micro-gardening**.

Model Specification

The regression model was specified as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \epsilon$$

Where: Y = Adoption of climate-smart micro-gardening practices Adoption of micro-gardening was measured using an index based on the number of cultivation materials used.

β_0 = Constant term

X_1 = Household size (Number of persons living in the house)

X_2 = Occupation (Farming = 1; Others = 0)

X_3 = Years of Experience (Number of years of experience)

X_4 = Age (Number of years)

X_5 = Sex (Male= 1; Female = 0)

X_6 = Level of Education (Number of years spent in school)

ϵ = Error term

RESULTS AND DISCUSSION

Table 1: Socioeconomic characteristics of the respondents

Variables	Frequency	Percentages	Mean
Age			
21-35	12	24.0	42.7
36-50	30	60.0	
51-65	8	16.0	
Sex			
Male	21	42.0	42.7
Female	29	58.0	
Marital status			
Married	38	76.0	42.7
Not married	12	24.0	
Education level			
Non formal	0	0	17
Primary	5	10.0	
Secondary	11	22.0	
Tertiary	34	68.0	
Household size			
1-5	28	56.0	6
6-10	22	44.0	
Years of micro-gardening experience			
1 – 10	30	60.0	8
11 – 20	14	28.0	
21 – 30	6	12.0	
Cooperative Membership			
Yes	16	32.0	42.7
No	34	68.0	
Extension Contact			
Yes	12	24.0	42.7
No	38	76.0	

Source: Field Survey, 2024

The study reveals that women (58%) who were mostly married (76%) dominate micro-gardening, underscoring its potential as a family-centered and gender-sensitive practice. The majority of respondents are middle-aged (60%, mean age 42.9 years), with larger households (average of six members) relying on micro-gardening for food security. High educational attainment (average 18 years) supports the adoption of climate-smart technologies, though moderate experience levels (average 8 years) highlight the need for continuous learning. Low cooperative membership (32%) indicates untapped opportunities for collective benefits, while limited access to extension services (76% without contact) highlight a critical gap in technical support and outreach efforts. By implication, the socioeconomic profile suggests that micro-gardening is particularly relevant to middle-aged, educated women in urban settings. Challenges such as limited cooperative membership and lack of extension service visits hinder broader adoption.

Table 2: Materials used for Micro-gardening

Type of Material	Frequency	Percentage
Plastic		
Yes	5	10.0
No	45	90.0
Tyres		
Yes	6	12.0
No	44	88.0
Bags		
Yes	42	84.0
No	8	16.0

Source: Field Survey. 2024

The results of the study indicate that **bags** are the most commonly used material for micro-gardening in the study area, with **84%** of respondents adopting them. This is followed by **tyres** at **12%** and **plastics** at **10%**. Notably, **no respondents reported using wood**, suggesting a strong preference for **readily available and durable materials** such as bags and tyres.

Table 3: Benefits of adopting Climate-smart Micro-gardening Practices

S/N	Benefits	Means	SD
1	Reduces household food expenses	3.64	1.29
2	Increases interaction with neighbors	3.50	1.47
3	Opportunity for urban dwellers to learn new skills	3.78	1.43
4	Increases sense of fulfillment	3.56	1.47
5	Reduces stress of cultivating in the field	3.24	1.63
6	Increases access to fresh and nutritious food within the household	4.04	1.65
7	Improves food production and availability all year round	3.62	1.58
8	Increases efficiency in use of little space	4.08	1.66
9	Zero use of synthetic fertilizer	3.20	1.80
10	Use the micro-garden waste e.g leaves, grass clippings or straw as mulch	4.18	0.88
11	Re-use of old materials e.g plastics, bags	3.15	1.66
12	Management of weeds, pest and diseases without using synthetic chemicals.	3.30	1.57
13	Biodiversity	4.38	1.07

Source: Field Survey; Mean score= 3.00: N = 50

Results of the 5-point Likert scale revealed that the respondents perceived that micro-gardening offers significant economic, social, and environmental benefits to households. These include:

Economic Benefits: It reduces household food expenses ($\bar{x} = 3.64$), increases access to fresh, nutritious food ($\bar{x} = 4.04$), and ensures year-round food production and availability ($\bar{x} = 3.62$). **Social Benefits:** It fosters better interaction with neighbors ($\bar{x} = 3.50$), creates opportunities for skill development ($\bar{x} = 3.78$), increases sense of fulfillment ($\bar{x} = 3.56$) and reduces the stress of field cultivation ($\bar{x} = 3.24$).

Environmental Benefits: Households acknowledged the environmental value of micro-gardening such as zero use of synthetic fertilizers ($\bar{x} = 3.20$), organic pest control ($\bar{x} = 3.30$) and biodiversity ($\bar{x} = 4.38$).

Resource Management: Efficient use of small space ($\bar{x} = 4.08$), mulching with micro-garden waste ($\bar{x} = 4.18$), and re-use of old materials like plastics, bags ($\bar{x} = 3.15$).

With all variables scoring above the mean score of 3.0, the respondents perceive micro-gardening as highly beneficial. The practice not only supports food security but also enhances social, personal, and environmental well-being, making it a valuable climate-resilient strategy for urban households.

Table 4: Constraints to the adoption of Climate-smart Agricultural Practices

Constraint Category	Frequency (*)	Percentage
Financial Constraints	24	48.00
Resource Access	18	36.00
Infrastructure and Space	11	22.00
Environmental Challenge	8	16.00
Pests and Diseases	6	12.00
Production and Operational	8	16.00

- Multiple responses

Financial Constraints: These are constraints related to financial resources for expanding operations, purchasing inputs, and managing activities. The constraints include: "Money to adopt new recommendations," "Lack of financial support," "Lack of funds to expand," "Problem of finance," "Finance for pest and disease control," "Lack of funds for acquiring more bags, and poultry manure." Financial constraints (26%) are the most significant challenge faced by respondents.

Resource Access: Challenges with obtaining seeds, soil, and other essential inputs. These constraints include "Accessing good and healthy seeds," "Gathering of soil," "Insufficient nutrients for crops," "Some micro-garden requirements are difficult to obtain."

Infrastructure and Space: Challenges related to land space, storage, and structural requirements. These include "Lack of space to keep bags," "Space to plant," "Land space and livestock menace (e.g., goats and sheep)," "Bags tear and require replacement." Infrastructure and space issues (16%) and resource access (18%) follow closely, indicating operational and structural barriers.

Environmental Challenges: These are issues with water supply, irrigation, and nutrient depletion during farming. These include: "Irrigation will always be a problem during the dry season," "Water supply," "Dry season causes plants to dry up," "Soil loses nutrients at a fast rate."

Pest and Diseases: These are challenges in managing pests and diseases. This include: "Lack of skills in pest control for peppers and vegetables."

Production and Operational Challenges: These are miscellaneous production-related challenges. These include: "Meeting demands," "They require more special attention," "Weed control." Environmental challenges, production difficulties, and pest/disease management are also notable, each constituting 16%, 16% & 8% of the total responses respectively.

Table 5: Regression results for socioeconomic factors affecting the adoption of Climate-smart Practices.

Variable	Linear	Exponential	Semi-Log	Double-log +
Constant	0.400	-1.005	0.040	-1.908

Variable	Linear	Exponential	Semi-Log	Double-log +
	(3.03)***	(-3.02)**	(0.12)	(-2.15)**
Household size	-0.033 (-2.92)**	-0.086 (-2.98)**	-0.170 (-2.66)**	-0.439 (-2.73)**
Occupation	-0.047 (-2.46)**	-0.113 (-2.34)**	-0.037 (-2.07)**	-0.087 (-1.93)**
Years of micro-gardening	0.0119 (3.13)***	0.031 (3.28)***	0.089 (3.24)***	0.234 (3.40)***
Age	0.0040 (1.42)	0.011 (1.50)	0.127 (1.14)	0.333 (1.19)
Sex	0.0276 (0.62)	0.065 (0.57)	0.016 (0.36)	0.034 (0.30)
Education	-0.0031 (-0.46)	-0.010 (-0.58)	0.005 (0.04)	-0.012 (-0.04)

F =3.44** R²=0.44 F =3.57** R²=0.45 F =3.61** R²=0.45 F =3.76** R²=0.46

Source: Field Survey, 2024, *** Significant at the 1% level; **Significant at the 5% level; *Significant at the 10% level

The regression analysis presented in **Table 5** examines the relationship between selected socioeconomic factors and the adoption of climate-smart micro-gardening practices among urban households in Abia State, Nigeria. Double-log form was chosen as the lead equation because it has three significant variables, highest f-ratio of 3.76 and r-square of 0.46. **R-squared value of 0.46** indicates that approximately **46% of the variability** in the adoption of climate-smart practices is explained by the independent variables included in the model. The **F-ratio (3.76)** is statistically significant at 5% level of significance, indicating that the model is a good fit for explaining the relationship between socioeconomic factors and adoption of micro-gardening practices.

Household size shows a negative and significant relationship with adoption at 5% level of significance. This indicates that larger households tend to adopt micro-gardening less, possibly due to higher labor demands or limited garden space. This aligns with findings of Mugisha et al. (2025) indicating that household size can have a positive impact on the adoption of certain climate-smart agricultural practices, such as mulching.

Occupation (being a farmer) also shows a negative and statistically significant relationship at 5% level of significance with the adoption of micro-gardening practices. This indicates that professional farmers are less inclined toward micro-gardening than others—possibly perceiving it as supplemental or less valuable compared to their main farming activities.

On the other hand, years of experience has a positive and statistically significant relationship at 1% level of significance. This indicates that more years of farming experience are associated with an increased likelihood of adopting climate-smart practices. Farming experience has a positive effect on the adoption of climate-smart agriculture, as farmers become more conscious of the relevance of good agricultural practices over time (Aniche & Mckee, 2023).

CONCLUSION AND RECOMMENDATIONS

The study highlights the significant potential of climate-smart micro-gardening in addressing food security, environmental sustainability, and social well-being among urban households in Umuahia and Umudike, Abia State, Nigeria. Key benefits include reduced household food expenses, improved access to fresh and nutritious food, efficient resource management, and enhanced social interactions. However, adoption is hindered by financial constraints, limited access to resources, space limitations, environmental challenges, and pest and disease control issues.

To address these barriers, the study recommends:

1. Provision of subsidies, microcredit schemes, and affordable inputs to micro-gardeners.

2. Strengthen extension services, offer regular training, and build capacity for effective adoption of climate-smart practices.
3. Promotion of micro-gardening and other innovative gardening techniques, such as vertical gardening, and provision of durable planting materials to micro-gardeners.
4. Encourage cooperative formation and collective resource sharing to enhance knowledge and market access.
5. Development of urban agriculture policies to integrate micro-gardening into urban planning frameworks.

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Theme: Agricultural Extension for Food Security and Community Empowerment

Use of Digital Technology in Agricultural Extension Services: A Case of Agricultural Extension Service Program, NRCRI, Umudike, Abia State, Nigeria

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ABSTRACT:

This study investigated the use of digital technology in agricultural extension services at National Root Crops Research Institute (NRCRI) Umudike. The study was guided by four (4) objectives. The study employed a descriptive survey design and the instrument for data collection was questionnaire. Data were analyzed using mean scores. Results showed that cost effectiveness is the main benefit of the use of digital technology in the dissemination of agricultural extension services social media and short messages (SMS) were highly adopted by agricultural extension workers in NRCRI umudike, high cost of digital devices is the greatest challenge to the adoption of digital technology in agricultural extension services. The study concludes that cost effectiveness is the main benefit of the use of digital technology in the dissemination of agricultural extension services, social media and short messages services (SMS) were the digital technologies that were highly adopted by agricultural extension workers in NRCRI Umudike., high cost of digital devices is the greatest challenge to the adoption of digital technology, Subsidizing and developing digital technologies to address language issues are the main solutions to the adoption of digital technologies in agricultural extension services. The study recommends that NRCRI Umudike provides training and support to extension agents to enhance their digital literacy and adoption of digital technology. The institute should invest in digital infrastructure, such as computers, mobile phones, and internet connectivity, to facilitate the adoption of digital technology.

Keywords: Digital Technology, Agricultural Extension Services, National Root Crops Research Institute

INTRODUCTION

Digital technology has transformed the way agricultural extension services are delivered, enabling faster and more effective dissemination of information to farmers (Aker, 2011). The use of digital tools, such as mobile phones and computers, has improved the efficiency and effectiveness of extension services (Kidd & Compton, 2015). The National Root Crops Research Institute Umudike has recognized the potential of digital technology in enhancing agricultural extension services (NRCRI, 2020). The institute has implemented various digital initiatives, including online platforms and mobile apps, to disseminate information to farmers (Opara, 2017). Mobile phones have become a vital tool in agricultural extension services, enabling farmers to access information and advisory services (Mtenga & Mgaya, 2015). The use of mobile phones has improved the timeliness and relevance of extension services, enabling farmers to make informed decisions (Sullivan, 2017).

Digital technology refers to electronic tools, systems, and devices that generate, store, and process data in various formats (Buckingham, 2019, p. 12). It encompasses a wide range of technologies, including

computers, smart phones, software, and networks, transforming modern life. Digital technology is built on binary code, enabling efficient data processing and transmission (Katz, 2017, p. 25). Its applications are diverse, including education, healthcare, finance, and communication. Digital technology has revolutionized industries and daily life, enhancing productivity and accessibility. Digital technology increases efficiency, automates tasks, and streamlines processes (Benkler, 2006, p. 15). It provides unparalleled access to information, services, and opportunities, facilitating global communication and collaboration. Digital technology has transformed the way we work, communicate, and access information. Digital technology poses cyber security risks, compromising data security and privacy (Kshetri, 2018, p. 30). The digital divide exacerbates social and economic disparities, limiting access to digital opportunities. Over-reliance on digital technology can have negative consequences on mental and physical health.

Digital platforms have also enabled the dissemination of multimedia content, such as videos and images, to farmers (Kidd & Compton, 2015). This has improved the effectiveness of extension services, enabling farmers to better understand complex agricultural concepts (Aker & Mbiti, 2010). The use of digital technology has also improved the monitoring and evaluation of extension services (Mtega & Mgaya, 2015). Digital tools have enabled the collection and analysis of data on farmer adoption and impact, enabling extension agents to refine their services (Kidd & Compton, 2015).

However, the adoption of digital technology in agricultural extension services has been hindered by various challenges, including limited access to digital infrastructure and low levels of digital literacy among farmers (Opara, 2017). Addressing these challenges is critical to realizing the full potential of digital technology in agricultural extension services. The National Root Crops Research Institute Umudike has implemented various initiatives to address these challenges, including training programs for farmers and extension agents (NRCRI, 2020). The institute has also established partnerships with private sector companies to improve access to digital infrastructure (Opara, 2017).

Digital technology has also enabled the development of precision agriculture, which involves the use of advanced technologies, such as drones and satellite imaging, to optimize agricultural production (Sullivan, 2017). Precision agriculture has improved the efficiency and productivity of agricultural production, enabling farmers to reduce costs and increase yields. The use of digital technology has also improved the coordination and management of agricultural value chains (Kidd & Compton, 2015). Digital platforms have enabled the integration of various stakeholders, including farmers, processors, and traders, improving the efficiency and effectiveness of value chains.

However, the adoption of digital technology in agricultural value chains has been hindered by various challenges, including limited access to digital infrastructure and low levels of digital literacy among stakeholders (Opara, 2017). Addressing these challenges is critical to realizing the full potential of digital technology in agricultural value chains. The National Root Crops Research Institute Umudike has implemented various initiatives to promote the adoption of digital technology in agricultural value chains, including training programs for stakeholders and the development of digital platforms (NRCRI, 2020).

Digital technology has also enabled the development of digital extension advisory services, which involve the use of digital tools to provide advisory services to farmers (Mtega & Mgaya, 2015). Digital extension advisory services have improved the timeliness and relevance of extension services, enabling farmers to make informed decisions. The use of digital technology has also improved the monitoring and evaluation of agricultural projects and programs (Kidd & Compton, 2015). Digital tools have enabled the collection and analysis of data on project outcomes and impact, enabling project managers to refine their interventions.

However, the adoption of digital technology in agricultural projects and programs has been hindered by various challenges, including limited access to digital infrastructure and low levels of digital literacy among project staff (Opara, 2017). Addressing these challenges is critical to realizing the full potential of digital technology in agricultural projects and programs. The National Root Crops Research Institute Umudike has implemented various initiatives to promote the adoption of digital technology in agricultural projects and programs, including training programs for project staff and the development of digital platforms (NRCRI, 2020).

STATEMENT OF PROBLEM

The National Root Crops Research Institute Umudike plays a crucial role in promoting agricultural development in Nigeria through its extension services. However, the effectiveness of these services is hindered by traditional methods of information dissemination, which are often limited in reach and impact. The use of digital technology has been identified as a potential solution to enhance the efficiency and effectiveness of agricultural extension services.

Despite the potential benefits of digital technology, its adoption in agricultural extension services in Nigeria remains limited. Several factors contribute to this limitation, including inadequate infrastructure, low levels of digital literacy among farmers and extension agents, and limited access to digital devices. As a result, many farmers and rural communities continue to rely on traditional methods of information dissemination, which can lead to inadequate access to relevant information and limited opportunities for agricultural development.

While several studies have investigated the adoption and impact of digital technology in agricultural extension services globally, there is a dearth of research on the specific context of the National Root Crops Research Institute Umudike. Furthermore, existing studies have focused primarily on the technical aspects of digital technology adoption, with limited attention to the social and institutional factors that influence its effective use. This study aims to address this gap by examining the adoption and impact of digital technology in agricultural extension services at the National Root Crops Research Institute Umudike.

OBJECTIVES OF THE STUDY

The general objective of this study is to examine digital technology adoption in agricultural extension services. The specific objectives were to:

- i. identify benefits of digital technology in the dissemination of agricultural extension services.
- ii. know the level of adoption of digital technology in agricultural extension services
- iii. identify challenges to the adoption of digital technology in agricultural extension services.
- iv. identify solutions to the challenges of adoption of digital technology in agricultural extension services

METHODOLOGY

The descriptive survey design was employed for the study. The population of the study is 14 extension service workers in NRCRI Extension Program. Complete census sampling technique was used since the population is manageable by the researcher. The instrument used for data collection is the questionnaire. Data collected was analyzed using mean. A total of fourteen (14) questionnaires were distributed to the respondents and were correctly filled and returned. 2.50 was used as a bench mark, therefore, any mean that is not equal to 2.5 was regarded as disagree and strongly disagree, low adoption and very low adoption but any mean that is equal to 2.5 and above was regarded as agree and strongly agree, high adoption and very high adoption.

The ratings of the questionnaire are assigned as follows:

0.50-1.49 – Strongly Disagree, Very Low Adoption

1.50-2.49 - Disagree, Low Adoption

2.50-3.49 - Agree, High Adoption

3.50- 4.00– Strongly Agree, Very High Very High Adoption

RESULTS AND DISCUSSIONS

Benefits of the Use of Digital Technology in the Dissemination of Agricultural Extension Services

Table 1: Mean Response of Extension Workers on Benefits of the Use of Digital

Technology in the Dissemination of Agricultural Extension Services = 14

S/N	Items Statement	SA	A	D	SD	$\bar{x}$	RMK
1	Increased Extension Service Accessibility by Farmers	8	2	3	1	3.21	A

2	Enhances Timely Dissemination of Agricultural Extension Services to Farmers	9	3	2	-	3.5	SA
3	Cost-Effective	7	5	2	-	3.56	SA
4	Improved Data Collection and Analysis	6	5	2	1	3.14	A
5	Enhanced Efficiency	4	8	1	1	3.07	A
6	Personalized Advice	5	7	2	-	3.21	A
	Cluster Mean					3.28	A

2

The data presented in table 1 above shows that the cluster mean of the responses of Extension Workers on benefits of the Use of digital technology in the dissemination of agricultural extension services in NRCRI Umudike is 3.28, which is greater than the criterion mean of 2.5 on 4-point rating scale. This indicated that Extension Workers in NRCRI, Umudike agreed that the items listed in table 1 above are benefits of the use of digital technology in the dissemination of agricultural extension services

Level of adoption of digital technology in agricultural extension services

Table 2: Mean response of Extension Workers on level of adoption of digital technology in agricultural extension services = 14

S/N	Items Statement	VHA	HA	LA	VLA	$\bar{x}$	RMK
1	Mobile Apps	2	2	7	3	2.21	LA
2	Social media	6	4	3	1	3.07	HA
3	Short Message Service (SMS)	7	3	2	2	3.07	HA
4	Geographic Information Systems (GIS)	2	1	7	4	2.07	LA
5	Artificial Intelligence (AI) Chatbots	4	5	3	2	2.79	HA
	Cluster Mean					2.64	HA

The data presented in table 2 above shows that the cluster mean of the responses of Extension Workers on level of adoption of digital technology in agricultural extension services is 2.64 which is greater than the criterion mean of 2.5 on 4-point rating scale. This indicated that Extension Workers in NRCRI, Umudike highly adopted digital technology in agricultural extension services.

The challenges to the adoption of digital technology in agricultural extension services

Table 3: Mean response of Extension Workers on the challenges to the adoption of digital technology in agricultural extension services = 14

S/N	Items Statement	SA	A	D	SD	$\bar{x}$	RMK
1	Limited Access to Internet and Mobile Network	5	3	4	2	2.79	A
2	Low Digital Literacy	6	5	2	1	3.14	A
3	High Cost of Digital Devices	7	4	3	-	3.29	A
4	Cultural Barriers	4	5	3	2	2.79	A
5	Language Barriers	6	4	2	2	3.00	A
6	Limited Technical Support	5	3	4	2	2.79	A
	Cluster Mean					2.79	A

The data presented in table 3 above shows that the cluster mean of the responses of Extension Workers on the challenges to the adoption of digital technology in agricultural extension services in NRCRI Umudike is 2.79 which is greater than the criterion mean of 2.5 on 4-point rating scale. This indicated that Extension Workers in NRCRI Umudike agreed that the items listed in table 3 above are challenges to the adoption of digital technology in agricultural extension services

The Solutions to the challenges of adoption of digital technology in agricultural extension services

Table 4: Mean response of Extension Workers on the Solutions to the challenges of adoption of digital technology in agricultural extension services = 14

S/N	Items Statement	SA	A	D	SD	$\bar{x}$	RMK
1	Access to Internet and Mobile Networks	5	4	3	2	2.86	A
2	Digital Literacy Training Programs	6	2	4	2	2.86	A
3	Subsidized Digital Device	7	4	3	-	3.5	SA
4	Culturally Relevant Digital Technologies	5	6	2	1	3.07	A
5	Developing Digital Technology that Addresses Languages Issues	4	5	3	2	3.5	SA
6	Technical Support Services	5	6	2	1	3.07	A
	Cluster Mean					3.14	A

The data presented in table 1 above shows that the cluster mean of the responses of extension workers on the Solutions to the challenges of adoption of digital technology in agricultural extension services is 3.14 which is greater than the criterion mean of 2.5 on 4-point rating scale. This indicated that extension workers in NRCRI agree that the items listed in table 4 above are Solutions to the challenges of adoption of digital technology in agricultural extension services in NRCRI Umudike.

CONCLUSION

The study concludes that cost effectiveness is the main benefit of the use of digital technology in the dissemination of agricultural extension services, social media and short messages services (SMS) were the digital technologies that were highly adopted by agricultural extension workers in NRCRI Umudike., high cost of digital devices is the greatest challenge to the adoption of digital technology, Subsidizing and developing digital technologies to address language issues are the main solutions to the adoption of digital technologies in agricultural extension services.

RECOMMENDATIONS

The study recommends that NRCRI Umudike provides more training and support to extension agents to enhance their digital literacy and adoption of digital technology. It was also recommended that the institute should invest more in digital infrastructure, including computers, mobile phones, and internet connectivity, to facilitate the adoption of digital technology.

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**SOCIETY FOR COMMUNITY & COMMUNICATION DEVELOPMENT RESEARCH
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4th Biennial Conference, 2025

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Theme: Agricultural Extension for Food Security and Community Empowerment

Women's Issues in Community Development: A Case of Amizi Olokoro, Umuahia South Local Government Area, Abia State, Nigeria

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ABSTRACT:

This study examined the women's issues that arise in community development initiatives in Amizi Olokoro, Umuahia South. Objectives of the study were to identify gender issues in Amizi, identify benefits of gender equality and inclusivity, know the factors militating against gender equality and inclusivity in Amizi and proffer solutions to the challenges of gender equality and inclusivity in Amizi. Instrument used for data collection was the questionnaire. Summary of the findings showed that: Limited / no access to Land and property are the greatest gender issues in Amizi with the highest mean value of 3.33., enhancing decision making is the main benefit of gender equality and women inclusivity in Amizi with the highest mean value of 3.48, the major challenge to gender equality and women inclusivity in Amizi is economic dependence with the value of 3.23 and the main solution to the challenges to gender equality and inclusivity in Amizi are: addressing violence against women and equal representation with equal mean value of 3.17 respectively. The study concludes that women's issues are critical component of community development initiatives in Amizi. The study highlights the importance of empowering women and addressing the specific needs of women in community development initiatives, in order to promote more equitable and sustainable community development outcomes. The study recommends that community development initiatives in Amizi, prioritize the empowerment of women, through education, training, and economic empowerment programs. Additionally, the study recommends that community development initiatives address the specific needs of women, including healthcare, education, and economic opportunities

Keywords: Women Issues, Community Development, Gender equality, Inclusivity

INTRODUCTION:

Gender issues play a significant role in community development, as they can either facilitate or hinder the progress of community projects (Moser, 1993). In many communities, women are often marginalized and excluded from decision-making processes, leading to lack of representation and participation in community development initiatives (Kabeer, 1994). This is particularly evident in rural areas, where traditional gender roles and stereotypes can perpetuate inequality and limit opportunities for women.

Furthermore, gender-based violence and discrimination can also undermine community development efforts, as they can create a culture of fear and mistrust among community members (Heise, 1994). In addition, the lack of access to education and economic opportunities can further exacerbate gender inequality, making it even more challenging for women to participate in community development initiatives (Sen, 1999). As such, it is essential to examine the gender dynamics at play in community development projects, including those in Amizi Olokoro Umuahia South.

In Amizi Olokoro Umuahia South, community development projects are often implemented without adequate consideration for the unique needs and experiences of women (Ogbu, 2014). This can result in projects that fail to address the root causes of poverty and inequality, ultimately perpetuating the status quo. Therefore, it is crucial to investigate the gender issues that arise in community development projects in Amizi Olokoro Umuahia South, with a view to identifying strategies for promoting greater gender equality and inclusivity.

By examining the gender issues that arise in community development projects in Amizi Olokoro Umuahia South, this study aims to contribute to a deeper understanding of the complex relationships between gender, community development, and social change (Cornwall, 2003). Through a critical analysis of the gender dynamics at play in community development projects, this study seeks to identify practical strategies for promoting greater gender equality and inclusivity, ultimately contributing to more effective and sustainable community development outcomes.

Gender issues are a pervasive problem in many societies, with women and girls often facing discrimination, marginalization, and exclusion from decision-making processes (Kabeer, 2015). This can have far-reaching consequences, including limited access to education, healthcare, and economic opportunities (Sen, 1999). Furthermore, gender-based violence and harassment can also undermine women's empowerment and participation in society (Heise, 2011).

Moreover, gender issues are not only a problem for women, but also have broader implications for society as a whole (Cornwall, 2016). For instance, research has shown that countries with higher levels of gender equality tend to have better economic outcomes, higher levels of human development, and more stable societies (World Bank, 2019). Therefore, addressing gender issues is not only a moral imperative, but also a strategic one.

In addition, the intersectionality of gender with other forms of identity, such as race, class, and sexuality, can also exacerbate gender-based inequalities (Crenshaw, 2017). For example, women of color may face both racism and sexism, leading to compound forms of marginalization and exclusion (Collins, 2019). Therefore, it is essential to adopt an intersectional approach to addressing gender issues, one that takes into account the multiple forms of identity and oppression.

Finally, addressing gender issues requires a multifaceted approach that involves not only policy and legislative changes, but also shifts in cultural attitudes and social norms (Kandiyoti, 2016). This can involve working with men and boys to challenge patriarchal norms and promote more equitable forms of masculinity (Espino, 2017). By adopting a comprehensive and inclusive approach, it is possible to create a more just and equitable society for all.

Community development is a process that aims to empower communities to take control of their own development, improving their quality of life and promoting social justice (Kenny, 2016). This approach recognizes that communities have the capacity to drive their own development, and that external interventions should support and facilitate this process, rather than imposing solutions from outside (Taylor, 2017). Community development is a holistic approach that addresses the social, economic, and environmental needs of communities, and seeks to build on their strengths and assets (Green, 2018).

Moreover, community development is a participatory process that involves community members in all stages of decision-making, from planning to implementation and evaluation (Arnstein, 2019). This approach ensures that community development initiatives are responsive to the needs and priorities of community members, and that they are owned and sustained by the community itself (Chaskin, 2018). Community development also recognizes the importance of building partnerships and collaborations between community organizations, government agencies, and other stakeholders to leverage resources and expertise (Huxham, 2017).

In addition, community development is a context-specific approach that takes into account the unique history, culture, and geography of each community (Matarrita-Cascante, 2017). This approach recognizes that communities are not homogeneous entities, but rather complex systems with diverse needs and interests (Asthana, 2017). Community development initiatives must therefore be tailored to the specific needs and context of each community, and must be flexible and adaptable to changing circumstances (Frisby, 2018).

Gender equality enhances economic growth, increasing GDP and productivity (McKinsey, 2015, p. 12). Studies show that gender-diverse workplaces outperform homogeneous ones. Equal opportunities and fair compensation promote economic empowerment. Organizations prioritizing gender equality attract top talent, driving innovation and competitiveness. By promoting gender equality, organizations can boost economic performance. Inclusivity fosters creativity and innovation, driving business success (Phillips, 2015, p. 78). Diverse teams bring unique perspectives, enhancing problem-solving and decision-making. Inclusive workplaces encourage collaboration, improving employee engagement and retention. Organizations embracing inclusivity attract diverse customers, expanding market reach. By prioritizing inclusivity, organizations can drive innovation. Gender equality improves health and well-being, reducing mortality rates (WHO, 2015, p. 23). Equal access to healthcare and education promotes healthy lifestyles. Empowering women and girls enhances family and community well-being. Organizations prioritizing health and well-being create positive work environments. By promoting gender equality, organizations can improve health outcomes.

Inclusivity enhances organizational reputation, attracting top talent (Glass & Cook, 2015, p. 145). Organizations prioritizing diversity and inclusion build positive brands. Employees feel valued, improving job satisfaction and engagement. Inclusive workplaces foster positive relationships, driving business success. By prioritizing inclusivity, organizations can enhance their reputation. Gender equality promotes social justice, reducing inequality (UN, 2015, p. 10). Empowering women and girls challenges discriminatory norms. Organizations prioritizing social justice create inclusive environments. By promoting gender equality, organizations can drive social change.

Inclusivity improves employee engagement, driving productivity (Shore et al., 2015, p. 567). Employees feeling valued and respected are more motivated. Inclusive workplaces foster positive relationships, improving collaboration. Organizations prioritizing inclusivity attract and retain top talent. By prioritizing inclusivity, organizations can boost employee engagement. Gender equality enhances education, improving learning outcomes (Unterhalter, 2015, p. 34). Equal access to education promotes academic achievement. Empowering girls and women enhances educational attainment. Organizations prioritizing education create positive social impact. By promoting gender equality, organizations can improve education. Inclusivity drives business growth, expanding market reach (Hunt et al., 2015, p. 12). Organizations prioritizing diversity and inclusion tap into diverse markets. Inclusive workplaces foster innovation, driving business success. By prioritizing inclusivity, organizations can drive growth.

Societal norms perpetuate gender inequality, limiting opportunities (Ridgeway, 2015, p. 456). Cultural expectations influence individual behavior, reinforcing stereotypes. Organizations can challenge norms through education and awareness. By recognizing and addressing biases, organizations can promote inclusivity and equality. Stereotyping and bias hinder gender equality, affecting women's advancement (Heilman & Caleo, 2015, p. 123). Implicit biases influence decision-making, perpetuating inequality. Organizations can address biases through training and policies. By promoting fairness and objectivity, organizations can reduce biases.

Lack of representation limits women's opportunities, perpetuating inequality (Glass & Cook, 2015, p. 145). Underrepresentation in leadership positions affects women's career advancement. Organizations can promote diversity through mentorship and development programs. By increasing representation, organizations can drive positive change.

Discrimination and harassment affect women's well-being, limiting participation (Cortina & Berdahl, 2015, p. 78). Hostile work environments perpetuate inequality, driving turnover. Organizations can address discrimination through policies and training. By promoting respectful workplaces, organizations can foster inclusivity. Limited access to education and training hinders women's empowerment (Unterhalter, 2015, p. 34). Unequal access to resources affects women's career advancement. Organizations can support education and training initiatives, promoting women's empowerment. By investing in women's development, organizations can drive growth.

Cultural and social norms restrict women's participation, perpetuating inequality (Moghadam, 2015, p. 567). Patriarchal societies limit women's opportunities, affecting their well-being. Organizations can challenge norms through advocacy and education. By promoting cultural change, organizations can drive

inclusivity. Policy and legislative gaps hinder gender equality, limiting progress (ILO, 2015, p. 12). Inadequate laws and policies perpetuate inequality, affecting women's rights. Organizations can advocate for policy changes, promoting equality. By supporting legislative reforms, organizations can drive positive change. Lack of accountability perpetuates inequality, limiting progress (ILO, 2015, p. 23). Organizations can promote accountability through monitoring and evaluation. By tracking progress and addressing gaps, organizations can drive meaningful change.

Finally, community development is a long-term process that requires patience, persistence, and commitment from all stakeholders (Kretzmann, 2017). This approach recognizes that community development is not a quick fix, but rather a sustained effort to build capacity, mobilize resources, and promote social change (Chaskin, 2018). Community development initiatives must therefore be designed to be sustainable and scalable, and must be evaluated and adapted over time to ensure that they remain responsive to the evolving needs of the community (Hernandez, 2019).

STATEMENT OF PROBLEM

Despite the importance of community development in promoting social and economic progress, gender issues remain a significant challenge in many communities, including Amizi Olokoru Umuahia South (Moser, 1993). Women in these communities often face discrimination and marginalization, which can limit their participation in community development initiatives (Kabeer, 1994). This can result in community development projects that fail to address the unique needs and experiences of women, ultimately perpetuating the status quo.

Furthermore, the lack of attention to gender issues in community development can also perpetuate poverty and inequality among women (Sen, 1999). In Amizi Olokoru Umuahia South, women are often responsible for managing household resources and caring for family members, yet they may have limited access to education, healthcare, and economic opportunities (Ogbu, 2014). This can make it difficult for women to participate in community development initiatives, even when they are designed to benefit them.

The failure to address gender issues in community development can also undermine the effectiveness and sustainability of community development projects (Cornwall, 2003). In Amizi Olokoru Umuahia South, community development projects may be implemented without adequate consideration for the unique needs and experiences of women, leading to projects that are not responsive to the needs of the community. Therefore, it is essential to investigate the gender issues that arise in community development initiatives in Amizi Olokoru Umuahia South, with a view to identifying strategies for promoting greater gender equality and inclusivity.

OBJECTIVES

The broad objective of this study is to examine women's issues in Amizi Olokoru, Umuahia South. Specific objectives were to:

- i. identify women's issues in Amizi Olokoru Umuahia South LGA;
- ii. identify benefits of women equality and inclusivity;
- iii. assess the factors militating against women equality and inclusivity; and
- iv. proffer solutions to the challenges of women equality and inclusivity in Amizi Olokoru Umuahia South.

METHODOLOGY

Descriptive survey design was employed for the study. The population of the study is 150 women from Amizi village meeting women wing. Complete census sampling technique was used by the researcher since the population is manageable by the researcher. The instrument used for data collection was the questionnaire and data collected was analyzed using mean scores. A total of one hundred and fifty (150) copies of questionnaires were distributed, completed and returned at the spot to the researcher. The benchmark mean used for decision making was 2.50, therefore, any mean that is less than 2.5 was regarded as disagree and strongly disagree, but any mean that is equal to 2.5 and above was regarded as agree and

strongly agree. Key: SA – Strongly Agree, A – Agree, D – Disagree, SD – Strongly Disagree 0.50-1.49 - Strongly Disagree, 1.50-2.49 - Disagree, 2.50-3.49 - Agree and 3.50- 4.00 –Strongly Agree

Women's Issues in Amizi Olokoro, Umuahia South LGA

Table 1: Mean response of Respondents on women's issues in the study Area **n = 150**

Items Statement	SA	A	D	SD	$\bar{x}$	RMK
Limited Access to Education	40	30	50	30	2.53	A
Early Marriage and Childbearing	70	50	20	10	3.2	A
Domestic Violence	80	50	15	5	2.7	D
Cultural and Social Exclusion	70	60	12	8	3.28	A
Limited / no Access to Land and Property	60	80	6	4	3.31	A
Limited Representation in Decision-Making	50	70	20	10	3.07	A
Cluster Mean					3.02	A

The data presented in table 1 above shows that the cluster mean of the responses of Amizi Women on gender issues in Amizi Olokoro, Umuahia South is 3.02 which is greater than the criterion mean of 2.5 on 4-point rating scale. This indicated that the respondents agreed that the items listed in table 1 above are gender issues in Amizi Olokoro Umuahia South.

Benefits of women equality and Women inclusivity in Community Development

Table 2: Mean response of Respondents on the Benefits of Women Equality in study area **n = 150**

Items Statement	SA	A	D	SD	$\bar{x}$	RMK
Improved Economic Growth	80	50	15	5	2.7	D
Enhanced Decision Making	85	55	7	3	3.48	A
Reduced Conflict and Violence	80	40	20	10	3.27	A
Cultural and Social Inclusion	70	50	18	12	3.19	A
Access to Land and Property	70	60	14	6	3.29	A
Equal Representation in Decision-Making	50	70	20	10	3.07	A
Cluster Mean					3.17	A

The data presented in table 2 above shows that the cluster mean of the responses of Amizi Women on benefits of gender equality and Women inclusivity in Community Development in Amizi Olokoro, Umuahia South is 3.17 which is greater than the criterion mean of 2.5 on 4-point rating scale. This indicated that the respondents agreed that the items listed in table 1 above are benefits of gender equality and Women inclusivity in Community Development

Challenges to women equality and inclusivity in Amizi Olokoro Umuahia South LGA

Table 3: Mean response of Respondents on Challenges to women equality and inclusivity in stud area **n = 150**

Items Statement	SA	A	D	SD	$\bar{x}$	RMK
Socio-Economic Constraints	70	60	15	5	2.63	A
Discriminatory Laws and Policies	75	25	30	20	3.03	A
Violence Against Women	65	55	20	10	3.17	A
Lack of Representation and Voice	55	70	15	10	3.13	A
Cultural and Social Exclusion	60	70	12	8	3.21	A
Economic Dependence	70	55	15	10	3.23	A
Cluster Mean					3.07	A

The data presented in table 3 above shows that the cluster mean of the responses of Amizi Women on challenges to gender equality and inclusivity in Amizi Olokoru, Umuahia South is 3.07 which is greater than the criterion mean of 2.5 on 4-point rating scale. This indicated that the respondents agreed that the items listed in table 3 above are challenges to gender equality and inclusivity in Amizi Olokoru Umuahia South.

Solutions to the challenges of Women equality and Women inclusivity in Amizi Olokoru Umuahia South LGA

Table 4: Mean response of Respondents on solutions to the challenges of Women equality and Women inclusivity the study area **n = 150**

Items Statement	SA	A	D	SD	$\bar{x}$	RMK
Empowerment Programs	70	50	20	10	3.2	A
Women Friendly Laws	74	26	35	15	3.06	A
Addressing Violence Against Women	64	56	22	8	3.17	A
Equal Representation	56	69	20	5	3.17	A
Cultural and Social Inclusion	62	68	11	9	3.15	A
Economic Independence	70	50	20	10	3.2	A
Cluster Mean					3.16	A

The data presented in table 4 above shows that the cluster mean of the responses of Amizi Women on solutions to the challenges of gender equality and Women inclusivity in Amizi Olokoru, Umuahia South is 3.16 which is greater than the criterion mean of 2.5 on 4-point rating scale. This indicated that the respondents agreed that the items listed in table 4 above are solutions to the challenges of gender equality and Women inclusivity in Amizi Olokoru, Umuahia South.

DISCUSSION

Women's Issues

The study revealed that the following are women's issues in Amizi Olokoru: Cultural and Social Exclusion. Limited / no Access to Land and Property, Limited Representation in Decision-Making, Limited Access to Education and Early Marriage and Childbearing. Domestic violence was not considered a gender issue. This finding is in agreement with the study carried out by Agnes R. Q (2004), his findings revealed that women face the challenge of accessing and owning land in Africa, including cultural and social exclusion, limited access to land property, and discriminatory laws and practices. The authors argue that women's land rights are essential for their economic empowerment and well-being.

Benefits of Women Equality and Women Inclusivity in Community Development

The study revealed that the following are benefits of women equality and women inclusivity in community development: Enhanced Decision Making, Reduced Conflict and Violence, Cultural and Social Inclusion, Access to Land and Property and Equal Representation in Decision-Making. This finding is in agreement with the study carried out by, Human Sciences Research Council (2022,), his findings emphasize the importance of addressing gender-based violence (GBV) to promote cultural and social inclusion, reduce conflict and violence, and enhance decision-making. the study highlights the need for economic empowerment of women, which can be linked to access to land and property rights. The author argues that women's land rights are essential for their economic empowerment and well-being, promote cultural and social inclusion, reduce conflict and violence, and enhance decision-making. the study highlights the need for economic empowerment of women, which can be linked to access to land and property rights in Amizi Olokoru:

Challenges to Women Equality and Inclusivity

The study revealed that the following are challenges to women equality and inclusivity in Amizi Olokoru: socio-economic constraints, discriminatory laws and policies, violence against women, lack of representation and voice, cultural and social exclusion and economic dependence. This finding is in

agreement with the study carried out by Omowole, I. (2016), his findings revealed that Women in Nigeria face significant challenges, including limited access to education due to poverty, cultural beliefs, and practices such as early marriage. This results in a low adult female literacy rate of 49.68% in Nigeria. This study highlights social economic constraints and cultural exclusion as major challenges faced by women in Nigeria.

Solutions to the Challenges of Women Equality

The study revealed that the following are solution to the challenges of Women equality and inclusivity: empowerment programs, women friendly laws, addressing violence against women, equal representation, cultural and social inclusion and economic independence. This finding is in agreement with the study carried out by Nnadozie, (2019). Findings: revealed that Women's participation in leadership and decision-making positions can have a positive impact on promoting gender equality and addressing women's empowerment. This study supports equal representation as a means to promote gender equality and address women's empowerment.

RECOMMENDATIONS

The study recommends that:

- 1 Women should be given access to Land and Property
- 2 Women should be allowed to enjoy cultural and social inclusion
- 3 Women should also be allowed equal representation in the society
- 4 Community development initiatives should be promoted to empower women, through education, training, and economic empowerment programs.

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Analysis of Men and Women Involvement in Oil Palm Fruit Processing in Imo State, Nigeria

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ABSTRACT

The study analyzed men and women involvement in oil palm fruit processing in Imo State, Nigeria. The study specifically identified the methods used by men and women in the processing of oil palm fruits, ascertained the level of involvement of men and women in oil palm fruit processing and examined the constraints faced by men and women in oil palm fruit processing in the study area. Multi-stage sampling procedure was adopted in selecting 240 respondents comprising 120 men and 120 women oil palm fruit processors for the study. Primary data was used for this study. Data were collected with the use of structured questionnaire and analyzed with the use of both descriptive (frequency, percentage and mean) and inferential statistics (Z-test). The results revealed that semi-modern (52.50%) method was the major method used by men in the processing of oil palm fruits in Imo State. It also revealed that semi-modern (60.00%) method was the major method used by women in the processing of oil palm fruits in the study area. The results also showed that men ($\bar{x} = 2.45$) and women ($\bar{x} = 2.76$) were highly involved in oil palm fruits processing activities in the study area. Unavailability of improved technology and equipment ($\bar{x} = 2.27$), poor access to improved seedlings ($\bar{x} = 2.26$), inadequate land ($\bar{x} = 2.21$) and distance to processing mills ($\bar{x} = 2.19$) were the serious constraints faced by men in oil palm fruit processing in Imo State. Unavailability of improved technology and equipment ($\bar{x} = 2.43$), inadequate land ($\bar{x} = 2.41$), poor access to improved seedlings ($\bar{x} = 2.35$) and distance to processing mills ($\bar{x} = 2.16$) were serious constraints faced by women. The Z-test result revealed a significant difference in the level of involvement of men and women in oil palm fruit processing at 5% level of probability. The study concluded that both men and women were highly involved in oil palm fruit processing in the study area. The study therefore recommended that the state government gears up efforts in providing processing mills and modern, efficient processing equipment which would further enhance men and women involvement in oil palm fruit processing in the study area.

Keywords: Men, Women, Oil palm fruit, processing

INTRODUCTION

Oil palm (*Elaeis guineensis*) is one of the most economically significant oil crops to have been cultivated in Nigeria (Adeomi and Fadoju, 2023). The high demand for palm oil is making oil palm cultivation become a means of livelihood for many rural families, and indeed the farming culture of millions of people in Southeast Nigeria, Imo State inclusive (Onu, Ekwe and Onuekwusi, 2021). In Nigeria, oil palm serves as a crucial livelihood resource for many rural families, particularly smallholder farmers who cultivate it as a communal cash crop (Abushe, Ikenga, Umehai, Emenim, Ototoh and Ofuoku, 2025).

In Nigeria, oil palm fruit processing is an economically significant activity, particularly in Southern Nigeria. Oil palm fruit processing is defined as a process by which palm fruits are processed into palm oil through

threshing or stripping, milling and digestion, pressing and clarification (Onu *et al.*, 2021). Oil palm fruit processing involves harvesting, threshing or bunch quartering, fruit loosening, boiling, digestion, pressing/oil extraction, clarification and packaging/storage (Adeomi and Fadoju, 2023). Oyeronke and Adedotun (2019) stated that oil palm fruits can be processed by using the traditional method or industrial method. Traditionally, the process of producing palm oil involves distinct gender roles with women primarily responsible for tasks such as carrying harvested bunches and processing while men typically engage in activities related to land preparation and maintenance and harvesting of bunches (Abushe *et al.*, 2025). Onu, Ekwe and Nwachukwu (2021) also reported that oil palm fruit processing is mostly carried out by women under manual and subsistence methods in Southeast Nigeria, Imo State inclusive.

Empirically, the traditional method of oil palm processing is very tedious and labourious compared to mechanical methods and requires a substantial proportion of labour force. Similarly, Nwandu, Ike, Okonye and Onwuaroh (2021) noted that traditional oil palm processing is labour-intensive and involves the following activities; threshing, picking, parboiling, digestion, extraction and separation and these result in the production of low-quality palm oil with a high proportion of free fatty acid (FFA) contents and a large quantity of dirt and water. This suggests the need for the increased involvement of men and women in oil processing activities in order to increase palm oil output to bridge the demand-supply gap. However, the level of involvement of men and women in oil palm fruit in Imo State has not been extensively studied. However, despite oil palm processing being a major economic activity of rural households in Imo State, Adam (2018) opined that men and women involvement in agricultural activities is still a challenge due to the disparity in access to agricultural resources by both men and women notwithstanding the equal roles they play in agricultural activities. Similarly, Esu and Akam (2023) noted that unequal access to resources by men and women results in different levels of their involvement in the production, processing and marketing of high-rated crops such as oil palm. Onu *et al.* (2021) further reported that rural households in Imo State faced constraints such as lack of modern processing equipment, lack of infrastructure, high cost of labour and difficulty in obtaining credit facilities in oil palm processing. Obviously, oil palm fruit processing activities are dominated by smallholders located in the rural communities of Imo State. These smallholders account for the greater percentage of palm produce output in the State but their output cannot even satisfy local demands both quantitatively and qualitatively (Onu *et al.*, 2021). Onyinyechukwu (2023) noted that gender inequality in access to land and other farm inputs has been identified as one of the causes of the declining productivity in agriculture in various parts of Nigeria, Imo State inclusive. Chakma, Ruba, Senthil and Rahman (2021) also reported that women have limited access to resources such as land, capital, input, technology, training, and marketing facilities as well as farm machinery, and transport equipment. These could have huge implications for the level of involvement of men and women in oil palm fruit processing in the study area. Onu *et al.* (2021) noted that the scarcity of gender-disaggregated data was the biggest constraint to the effective recognition of the roles and levels of involvement of men and women in agro-enterprises. It is against this backdrop that the study sought to empirically analyze men and women involvement in oil palm fruit processing in Imo State.

The broad objective of this study was to analyze men and women involvement in oil palm fruit processing in Imo State. The specific objectives include the following: identify the methods used by men and women in the processing of oil palm fruits; ascertain the level of involvement of men and women in oil palm fruit processing and examine the constraints faced by men and women in oil palm fruit processing in the study area. It is hypothesized that, there is no significant difference in the level of involvement of men and women in oil palm fruit processing in the study area.

METHODOLOGY

The study was carried out in Imo State. Imo State is one of the Southeastern States of Nigeria. The State is subdivided into 27 Local Government Areas (LGAs). The State has a population of 4.6 million persons with women constituting about 2.7 million (National Bureau of Statistics, 2017). The State lies between latitude 5°10'N and 6°35' and longitudes 6°35'E of the Equator and 7°28'E of the Greenwich Meridian. It is bounded on the East by Abia State, on the West by Anambra and Rivers States, on the North by Isu and Isiala Mbano Local Government Area of the State (Imo State Agricultural Development Programme

(ISAP), 2015). The major crops cultivated include cassava, yam, maize, cocoyam, plantain, banana, oil palm, melon and vegetables. The animals reared include pigs, poultry, sheep, goats, rabbits, snails and apiculture (Mgbada, Ohajianya, Nzeh, Unaeze, Nwibo and Nwachukwu, 2021). Agriculture in the State is practiced by both men and women.

Multistage sampling procedure was adopted for the study. In the first stage, the three (3) agricultural zones (Okigwe, Orlu and Owerri) that make up Imo State were selected. In the second stage, two Local government areas (LGAs) were purposively selected from each of the three zones making a total of six LGAs. The purposive selection was based on the intensity of oil palm processing activities and the presence of oil processing mills. In the third stage, two communities were randomly selected from each of the six LGAs making it a total of twelve (12) communities. In the final stage, simple random sampling technique was used to select ten (10) men oil palm processors and ten (10) women oil palm processors respectively from each of the 12 (twelve) selected communities, which gave a grand total of one hundred and twenty (120) men oil palm processors and one hundred and twenty (120) women oil palm processors for the study. Primary data were obtained with the aid of structured questionnaire, and analyzed using descriptive and inferential statistics such as frequency, percentages, means and Z-test.

Model Specification

To identify the methods used by men and women in the processing of oil palm fruits, the simple descriptive statistical tools such as frequency distributions, means and percentages were used in realizing this objective. To ascertain the level of involvement of men and women in oil palm fruit processing, mean score was used. The rating scores were assigned as follows: Not involved = 1; occasionally involved = 2; always involved = 3. The options were quantified as 1, 2 and 3. The mean of 1, 2 and 3 equals 2.0 i.e. $1+2+3/3 = 2.0$. For the purpose of decision making, any mean score response ≥ 2.0 was adjudged to be a high level of involvement in oil palm fruit processing, while a mean score that is < 2.0 was adjudged to be a low level of involvement in oil palm fruit processing in the study area.

To examine the constraints faced by men and women in oil palm fruit processing in the study area, the three (3) point rating scale of: very serious = 3, serious = 2, not serious = 1 was used. In using the 3-point rating scale, a mid-point was obtained by adding 3, 2 and 1 which gave 6 and when divided by 3 gave a mean score of 2.0. For the purpose of decision making, any mean score response ≥ 2.0 was adjudged to be a serious constraint, while a mean score that is < 2.0 was adjudged not to be a serious constraint faced by men and women in oil palm fruit processing in the study area.

The hypothesis testing for significant difference in the level of involvement of men and women in oil palm fruit processing in the study area was estimated using Z-test. Given as;

$$Z_{cal} = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{S^2\bar{x}_1}{n_1} + \frac{S^2\bar{x}_2}{n_2}}} \dots\dots\dots(1)$$

Where,

$\bar{x}_1$ = mean responses of men on their level of involvement in oil palm fruit processing.

$\bar{x}_2$ = mean responses of women on their level of involvement in oil palm fruit processing.

$S^2\bar{x}_1$ = variance of the mean responses of men on their level of involvement in oil palm fruit processing.

$S^2\bar{x}_2$ = variance of the mean responses of women on their level of involvement in oil palm fruit processing.

n_1 = sampled number of men involved in oil processing.

n_2 = sampled number of women involved in oil processing.

RESULTS AND DISCUSSION

Methods used by men and women in the processing of oil palm fruits

The methods used by men and women in the processing of oil palm fruits is presented in Table 1.

Table 1: Methods used by men and women in the processing of oil palm fruits

Methods of oil palm processing	Men		Women	
	Frequency (n = 120)	Percentage (%)	Frequency (n = 120)	Percentage (%)

Traditional	11	9.17	13	10.83
Semi-modern	63	52.50	72	60.00
Modern	46	38.33	35	29.17

Source: Field survey, 2019

The result in Table 1 revealed that semi-modern (52.50%) method was the major methods used by men in the processing of oil palm fruits in Imo State. It also revealed that semi-modern (60.00%) method was the major method used by women in the processing of oil palm fruits in the study area. This finding implies that men and women predominantly used the semi-modern method in the processing of oil palm fruits in the study area. The reason for the predominant use of semi-modern method may be attributed to the ease of use and the efficiency of the method of processing. This finding is in agreement with Bankole (2022) who reported that most (78.5% and 87.9%) of men and women processors respectively used semi-modern method of processing. This category of processors made use of one or two of the modern processing techniques (men-38.33%, women-29.17%) to complete the processing of oil palm fruits.

Level of involvement of men and women in oil palm fruit processing in the study area

Level of involvement of men and women in oil palm fruit processing in the study area is presented in Table 2.

Table 2: Ascertain the level of involvement of men and women in oil palm fruit processing in the study area

Oil palm processing activities	Men (n = 120)				Women (n = 120)			
	3	2	1	Mean	3	2	1	Mean
Stripping	81(67.5)	34(28.3)	5(4.2)	2.63	78(65.0)	25(20.8)	17(14.2)	2.51
Picking/removal from spikelet	44(36.7)	38(31.7)	38(31.7)	2.05	110(91.7)	4(3.3)	6(5.0)	2.87
Sterilization	51(42.5)	43(35.8)	26(21.7)	2.21	113(94.2)	5(4.2)	2(1.7)	2.93
Fruit digestion	88(73.3)	25(20.8)	7(5.8)	2.68	83(69.2)	21(17.5)	16(13.3)	2.56
Pulp processing/extraction	92(76.7)	24(20.0)	4(3.3)	2.73	79(65.8)	38(31.7)	3(2.5)	2.63
Oil	79(65.8)	24(20.0)	17(14.2)	2.52	98(81.7)	19(15.8)	3(2.5)	2.79
Clarification/drying								
Nuts/Fibre separation	48(40.0)	49(40.8)	23(19.2)	2.21	107(89.2)	7(5.8)	6(5.0)	2.84
Storage of palm oil	78(65.0)	36(30.0)	6(5.0)	2.60	116(96.7)	3(2.5)	1(0.8)	2.96
Grand Mean				2.45				2.76

Source: Field survey, 2019 **Note:** < 2.0 = low involvement; $\bar{x} \geq 2.0$ = high involvement; figures in parentheses are percentages

The result in Table 2 revealed that men were highly involved in pulp processing/extraction ($\bar{x} = 2.73$), followed by fruit digestion ($\bar{x} = 2.68$), stripping ($\bar{x} = 2.63$), storage of palm oil ($\bar{x} = 2.60$) and oil clarification/drying ($\bar{x} = 2.52$). The result also revealed that women were highly involved in storage of palm oil ($\bar{x} = 2.96$), followed by sterilization ($\bar{x} = 2.93$), picking/removal from spikelet ($\bar{x} = 2.87$), nuts/fibre separation ($\bar{x} = 2.84$), oil clarification/drying ($\bar{x} = 2.79$), pulp processing/extraction ($\bar{x} = 2.63$), fruit digestion ($\bar{x} = 2.56$) and stripping ($\bar{x} = 2.51$). This implies that men and women were highly involved in oil palm fruits processing in Imo State. However, there was a higher involvement of women ($\bar{x} = 2.76$) than men ($\bar{x} = 2.45$) in the study area. The high involvement of men and women in oil palm fruits processing could be attributed to the fact that rural households perceived oil palm processing activities as major sources of livelihood in the study area. This finding is in consonance with Ajaero, Umunakwe and Anele (2021) who reported that the majority (41.4%) of sampled women in Imo State were actively involved in oil palm processing at various stages, and perceived oil palm processing as a source of income and employment. The result also agrees with Adejo *et al.* (2023) who reported that women (62.5%) and men (37.5%) were involved in oil palm processing in Kogi State.

Constraints faced by men and women in oil palm fruit processing in the study area.

Constraints faced by men and women in oil palm fruit processing in the study area is presented in Table 3.

Table 3: Constraints faced by men and women in oil palm fruit processing in the study area

Constraints	Men (n = 120)			Mean	Women (n = 120)			Mean
	3	2	1		3	2	1	
High cost of milling	16(13.3)	17(14.2)	87(72.5)	1.41	4(3.3)	34(28.3)	82(68.3)	1.35
Lack/inadequate land	51(42.5)	43(35.8)	26(21.7)	2.21	63(52.5)	43(35.8)	14(11.7)	2.41
Poor access to improved seedlings	56(46.7)	39(32.5)	25(20.8)	2.26	66(55.0)	30(25.0)	24(20.0)	2.35
Cultural belief	0(0.0)	25(20.8)	95(79.2)	1.21	0(0.0)	21(17.5)	99(82.5)	1.18
Unavailability of improved technology and equipment	44(36.7)	64(53.3)	12(10.0)	2.27	65(54.2)	41(34.2)	14(11.7)	2.43
Lack of knowledge of use of improved technology	33(27.5)	21(17.5)	66(55.0)	1.73	33(27.5)	22(18.3)	65(54.2)	1.73
Distance to processing mills	44(36.7)	55(45.8)	21(17.5)	2.19	42(35.0)	55(45.8)	23(19.2)	2.16
Method of processing	9(7.5)	71(59.2)	40(33.3)	1.74	7(5.8)	71(59.2)	42(35.0)	1.71
Grand Mean				1.88				1.92

Source: Field survey, 2019 Note: $\bar{x} < 2.0$ = not severe constraint; $\bar{x} \geq 2.0$ = severe constraint; figures in parentheses are percentages

Table 3 showed that unavailability of improved technology and equipment ($\bar{x} = 2.27$), followed by poor access to improved seedlings ($\bar{x} = 2.26$), inadequate land ($\bar{x} = 2.21$) and distance to processing mills ($\bar{x} = 2.19$) were the serious constraints faced by men in oil palm fruit processing in Imo State, while unavailability of improved technology and equipment ($\bar{x} = 2.43$), inadequate land ($\bar{x} = 2.41$), poor access to improved seedlings ($\bar{x} = 2.35$) and distance to processing mills ($\bar{x} = 2.16$) were serious constraints faced by women in oil palm fruit processing in the study area. This implies that unavailability of improved technology and equipment, poor access to improved seedlings, inadequate land and distance to processing mills were serious constraints faced by men and women in oil palm fruit processing in Imo State. Oil palm fruit processors in the study areas may lack the required capital to afford improved technology and equipment needed for oil palm fruit processing. On the overall, the Grand Mean scores of 1.88 and 1.92 for men and women respectively reveal that women palm fruit processors were faced with more constraints than men. This finding is similar to that of Onu *et al.* (2021) who reported that high cost of labour (88.9%), lack of infrastructure (82.2%), lack of modern processing equipment (80.0%) and difficulty in obtaining credit facilities (71.7%) were major constraints to rural household engagement in processing of oil palm produce in Imo State. This finding also agrees with Alabi, Famakinwa and Akinnawonu (2020) who noted that lack of funds, poor processing facilities and transportation problems constitute the major challenges facing the oil palm industry in Nigeria.

Testing of Hypothesis

Test for significant difference in the level of involvement of men and women in oil palm fruit processing in the study area is presented in Table 4

Table 4: Z-test result of significant difference in the level of involvement of men and women in oil palm fruit processing in the study area

Mean difference in level of involvement	No. of respondents	Mean	Standard deviation	Df	Z-statistic	Z-tab
Mean level of women involvement ^a	120	2.758	1.136			
Mean level of men involvement ^b	120	2.450	0.859			

Difference (a-b)	0.308	1.377	119	2.453**	1.96

**Source: Field survey, 2019 Note: ** = significant at $P \leq 0.05$; Df = Degree of freedom
Ho rejected at 0.05 level.**

The Z-test result of significant difference in the level of involvement of men and women in oil palm fruit processing in the study area is presented in Table 4. The result shows that the mean levels of involvement of men and women in oil palm fruit processing were 2.450 and 2.758 respectively. This implies that there was a higher involvement of women in oil palm fruits processing than men in the study area. The Z-calculated value of 2.453 was also statistically significant at 5% level of probability, implying that there was significant difference in their levels of involvement. This finding is in agreement with Abushe *et al.* (2025) who reported a significant difference in gender-related tasks in oil palm processing in Delta State at 5% level of significance.

CONCLUSION AND RECOMMENDATIONS

Based on the findings of this study, the study concluded that men and women were highly involved in oil palm fruits processing activities in Imo State. However, there was a higher involvement of women than men. Men and women processors also used a combination of both semi-modern and modern methods in the processing of oil palm fruits in the study area. Unavailability of improved technology and equipment, poor access to improved seedlings, inadequate land and distance to processing mills were major constraints faced by men and women in oil palm fruit processing in Imo State. Therefore, it recommended that:

1. There is the need for the State government to gear up efforts in providing adequate infrastructure such as processing mills and equipment which would further enhance men and women involvement in oil palm fruit processing in the study area.
2. Extension agencies, ministries of agriculture, non-governmental organizations and other stakeholders in the agricultural sector should assist in improving men and women access to improved oil palm seedlings in Imo State.
3. Extension agencies, ministry of agriculture, non-governmental organizations and other related stakeholders in the agricultural sector should structure and implement policies that would assist in addressing the identified constraints faced by oil palm processors in the study area.

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**Fish Farming Information, Feeding Habits and Some Aspects of the
Biology of *Oreochromis niloticus***

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ABSTRACT

*The study examined fish farming information via radio programs, feeding habits and some aspects of the biology of *Oreochromis niloticus* from Girzhiva stream, Muchalla, and areas of Mubi zone. Data for this study were obtained from primary source collected with the aid of structured questionnaire via Kobo Collect installed on mobile devices. Purposive and simple random sampling techniques were used for this study. The target population for this study were fish farmers in the five LGAs of the Zone. Two hundred and forty (240) fish farmers were sampled. Results revealed that fish farming information and knowledge gained from the use of radio were fish seed/fingerling quality, fish feed quality, fish species/type of fish and other fish farming husbandry practices. Furthermore, a study on Water Quality and biology of *O. niloticus* from Girzhiva Stream Muchalla Mubi zone, Nigeria was also conducted for a period of four months (4) Starting from February, 2023 and ended in May, 2023. Water was collected from three (3) different sites twice a month and was analyzed using standard methods for quality and fish sample determination. The sites mean and monthly mean water temperature, conductivity, Dissolved Oxygen DO, Hydrogen Ion Concentration pH, Transparency, Total Dissolved Solid TDS, and Ammonia ranged from [26.20±0.79-25.83±0.79 and 27.53±0.18-25.50±0.06, 147.67±1.00-177.67±1.00 and 243.59-186.01±1.00, 3.73±0.31-4.33±0.31 and 3.96±0.34-4.42±1.00, 7.60±1.00-7.97±0.52 and 7.24±0.34-7.70±0.34, 31.67±1.00-48.00±1.00 and 31.19±0.11-49.90±1.00, 62.00±1.00-174.67±0.32 and 1.80±1.00-76.41±1.00, 0.26±0.24-0.28±0.24 and 0.13±1.00-0.26±0.84] respectively. The monthly water qualities were within the range set up by FEPA and WHO. The results obtained for length weight relationship regression are $r^2=0.6378$, $x=1.2206$ $y=1.8835$. The results obtained for stomach contents based on frequency of occurrence and total point method are 26.60%, 84.12 plants materials, 20.52%, 71.75% digested food materials, 18.92%, 57.01% unidentified materials, 17.63%, 46.43% insect materials and 16.41%, 48.31% detritus. The ratio of male to female obtained was 7:5. The fecundity results obtained 14086±1.00--25100±1.00 at site and 9943±1.00—28519±1.00. These indicate that fish are prolific. It was recommended that a continuous monitoring of water quality of Girzhiva stream should be done to examine their level of pollutions and that local radio stations should establish fixed and farmer-friendly time slots for agricultural programs.*

Keywords: Fish farming, Feeding habit, Radio, Information, Knowledge

INTRODUCTION

Radio is a wireless communication medium that transmits audio signals through electro-magnetic waves. Interactive radio programs in Nigeria promote farmer engagement, knowledge-sharing, and problem-solving. They are energy-efficient, cost-effective, and accessible for regions with irregular electricity access. Radio broadcasting is crucial for agricultural development, particularly among smallholder farmers, as it disseminates information in local languages, bridging the information gap (Ayanwale *et al.*, 2010; International Institute for Tropical Agriculture IITA, 2016). Radio is seen as the most effective communication medium for information dissemination, even in remote areas (Egbule, and Njoku, 2010; Alabi, 2010). In addition, some of the rural farmers do not have the resources to purchase android phones. Therefore, it is important to focus on a media that is relatively cheap, has wider coverage and can timely reach out to majority of farmers such that information can be disseminated cheaply.

Fish species need a balanced diet to perform growth, reproduction, and other physio-logical functions as described by Temesgen *et al.* (2022). The scientific studies on fish food and feeding habits provide successful management of both capture fisheries and aquaculture which recognize the trophic relationships available in water ecosystems by finding the diet structure, composition, and stability of food webs (Otieno *et al.*, 2014; Tesfahun and Temesgen, 2018). In natural water bodies, plankton (phytoplankton and zooplankton), macrophytes, aquatic insects and their larvae and pupae, nematodes (round and flatworms), and sediment are the primary food items of *O. niloticus* (Hussian *et al.*, 2019). The presence of quality foods in water bodies governs the fish's health, growth performance, and fecundity potential (Gebbru, 2020). Wagaw *et al.* (2022) also confirmed that the condition factor and length-weight relationship of fish are determined by the prey availability in the water bodies. Length-weight relationships (LWRs) of fishes are important in fish biology because they allow the estimation of the average by establishing a mathematical relationship between the relative wellbeing of the fish population. The stream of Girzhiva serve many purposes which include irrigation (dry season farming), fishing, as well as a source of domestic water used by the community and as a source of drinking water for cattle. A number of miscellaneous water users also participate in this value chain. The great commercial food value of this stream has brought impact to the human life of this community. So far, very limited data/information on water quality conditions of this stream has been documented.

MATERIALS AND METHODS

Study Area

This study was carried out in Girviza River and other parts of Mubi zone, Adamawa State which comprises of five Local Government Areas (LGAs): Madagali, Michika, Mubi North, Mubi South and Maiha. It lies between latitude 9° 00' N to 11° 00' N and longitude 13°00' E to 14°00'E of the Greenwich meridian with a total land mass of 506.4Km² and a population size of 682,026 people (NPC 2006). Mubi Zone is bounded with Borno state in the north, by Hong and Song LGA in the west and by the republic of Cameroon in the east. (Adebayo and Tukur 2020). The zone experiences a tropical climate influenced by the Inter Tropical Convergence Zone and relief. Rainfall starts in April and peaks in July/August, with high intensity (Ray, 2007). Farming and fishery activities are predominant in this zone (Adebayo and Tukur 2020). Data for this study was obtained from primary source with the aid of structured questionnaire and laboratory analysis.

Sample Size, Procedure, Sites and Duration of Sampling

Purposive and simple random sampling techniques were used for this study. The target population for this study were the food crop farmers in the five LGAs in the Zone. In the first stage, four LGAs were purposely selected due to their relative peace from *Boko Haram* insurgence activities; these are Mubi-North, Mubi-South, Maiha and Michika. In the second stage, two remote districts were purposely selected from each of the LGAs giving a total of 8 districts. In the third stage, two wards were randomly selected from each of the district making a total of 16 wards. In the final stage, two hundred and forty (240) fish farmers were selected proportionate to sampling frame (population) in each of the selected wards.

The sampling distribution is presented in Table 1:

Table 1: Sample Size and Sampling Distribution of Respondents Based on Districts and Wards

LGA	DISTRICT	WARDS	Population	SAMPLE (5%)
Mubi North	Muchalla	Duda	320	16
		Vimtim	380	19
	Mayo bani	Betso	280	14
		Didif	320	16
Mubi South	Lamorde	Yadafa	260	13
		Mujara	220	11
	Gella	Gude	280	14
		Kwaja	320	16
Michika	Minkisi	Moda	340	17
		Dibinki	240	12
	Futu	Marwa	340	17
		Himike	360	18
Maiha	Boloko	Bungel	400	20
		Jamtari	300	15
	Boken	Dude	200	10
		Ejunturi	240	12
Total			4800	240

Source: Field Survey, 2023.

Sites and duration of sampling

For the purpose of this research, Girzhiva stream which is one of the major fishing locations was divided into three (3) sites. These include inlet of the stream as site A, middle of the stream as site B and outlet of the stream as site C. The study was conducted bi-monthly in triplicate for the period of four months (120 days) starting from February-May 2023. Water and fish samples were collected from the site

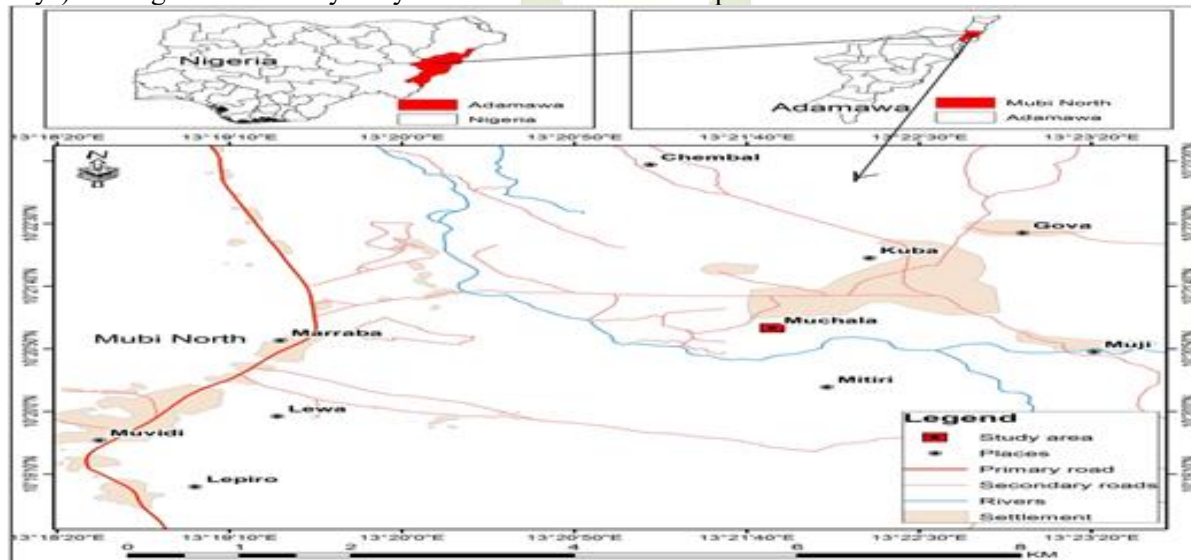


Fig 1: Map of the Study Area

Fish Sampling

Nine (9) *O. niloticus* were purchased from the fishermen at the study area bi-weekly in triplicate for the period of four months.

Length and weight Determination

Total length and standard length of fish was determined from the mouth snout to the tip of caudal fin and the hypural bone respectively using a measuring board reading was taken in centimeters (cm) as

recommended by Reed *et al.*, (1967). Weight of the fish was determined with electronic weighing balance record was taken in grams (g), the length weight relationship was determined using a formula described by Bagenal and Tesch. (1978).

$$W = aL^b$$

Was logarithmically transformed into log

$$W = \log a + b \log L.$$

W = weight of fish in grams,

L = total length of fish in centimeters,

a = proportionality constant and

b=allometric coefficient both estimated by method of least squares.

Condition factor

Condition factor (CF) was determined using the expression by Ritcher (2007):

$$K = W100 / L^3$$

K=condition factor,

W = total weight and

L = total length

Stomach Contents

Stomach contents were determined by dissecting the fish lengthwise and the stomach was removed and dissected under dissecting microscope then the stomach contents was washed into a petri dish and observe under a microscope recording each food items in the stomach of fish. The frequency of occurrence and point method was used as recommended by Hynes (1950).

Fecundity Determination

Gravimetric method was applied to determine the fecundity of *O.niloticus*. (Lagler, 1956). The fecundity (F) was calculated by the gravimetric method on gonad developmental stage IV with equation as shown below (Nichol and Acuna, 2001): In this method, the weight of two ovaries was measured on an electric weighing balance and recorded as W, then small portion of the two ovaries was taken and measured and recorded as w. Then the small portion which was recorded as w was gently counted and recorded as n. The formula below was then used to calculate fecundity;

$$F = W \times n / w$$

Where, F is fecundity, W is the weight of ovaries, n is number of eggs in subsample w is weight of subsample egg.

Data Analysis

All data obtained was subjected to Analysis of Variance (ANOVA) to test the level of significance among stations and monthly means, while Stomach contents was subjected to descriptive statistics i.e simple percentage.

RESULTS

Fish Farming Information and Knowledge Gained from the Use of Radio

The analysis in Table 2 reveals that a significant proportion of respondents, precisely 41.64%, reported that they gained knowledge across all the options provided. This high percentage indicates that the radio is indeed a comprehensive source of agricultural information for fish farmers in the study area. This result aligns with the overarching role of radio as a versatile and accessible medium that addresses various aspects of agricultural practices (UNESCO, 2020). Moving on to the specific categories, the second most prevalent knowledge gained relates to "fish seed/fingerling quality," with 20.48% of respondents indicating this aspect. This finding corresponds with previous literature that highlights the significance of quality fish seed in influencing fish farming productivity (Gebu, 2020). The radio's role in disseminating information about fish seed quality emphasizes its impact on farmers' decision-making processes (Phillip and Attuh, 2018). Similarly, "fish feed quality" emerged as a prominent knowledge area, with 19.79% of respondents selecting it. The link between radio and disseminating fish feed-related information corroborates with studies that emphasize balanced feed use for optimal fish health and yield. This result underscores the radio's effectiveness in conveying essential agricultural practices to farmers. Furthermore, "Fish

species/type of fish" garnered the attention of 16.72% of respondents. Timeliness in stocking of fingerlings and harvest is a critical factor in fish production success, thus, radio's role in educating farmers about the appropriate timing proved to be effective. This finding emphasizes radio's contribution to improving farmers' decisions related to stocking schedules and time of harvest for maximum market value. The response category "Other husbandry practices" (such as type of pond, size of pond, water quality and frequency of water change) had the lowest frequency, with only 1.37% of respondents selecting it. This could indicate that radio might not be the primary source for information related to this aspect of fish farming. This result is consistent with the idea that while radio is a versatile tool, its effectiveness might vary based on the specific agricultural domain (GFRAS, 2022).

The outcomes from Table 2 underscore the multi-faceted role of radio in disseminating fish farming information. The majority of respondents indicated gaining knowledge across various fish farming aspects, highlighting radio's comprehensive impact. The specific areas of fish seed/fingerling quality, fish feed quality, and fish species/type of fish indicates radio's effectiveness in conveying critical fish production/agricultural practices. This study's findings align with the broader literature that emphasizes radio's pivotal role in information dissemination, leading to informed decision-making and improved fish production and agricultural outcomes at large.

Table 2: Fish Farming Information and Knowledge gained from the use of Radio

Knowledge gained	Frequency	Percentage	Ranking
All of the above	122	41.64	1 st
Fish Seed/fingerling quality	60	20.48	2 nd
Fish feed quality	58	19.79	3 rd
Fish species/type of fish	49	16.72	4 th
Other husbandry practices	4	1.37	5 th
Total	293*	100	

Source: Field Survey, 2023. Note: 293* donate multiple responses.

Length-Weight Relationship and Condition Factor of *O. niloticus* of Girzhiva Stream

The result of length and weight relationship is presented in table 3 and 4. Total length was lowest at site B (9.57 ± 0.28^a) while site C (10.83 ± 0.28^a) recorded the highest total length; the lowest weight was recorded at site A (18.90 ± 0.43^a) while the highest weight was recorded at site C (21.10 ± 0.43^a). The monthly total length was recorded lowest in February (9.42 ± 0.49^b) while April (13.12 ± 1.00^a) recorded the highest total length, the lowest monthly mean weight was recorded lowest in March (16.06 ± 0.22^a) while the highest monthly mean weight was recorded in April (21.65 ± 0.22^a). There was no significant difference $P > 0.05$ of total length between sites but differs significantly $P < 0.05$ across months. Standard length was lowest at site B (8.13 ± 0.35^a) while highest standard length was recorded at site C (8.97 ± 0.35^a). The monthly standard length was in February (7.83 ± 0.57^b) while April (11.49 ± 1.00^a) recorded the highest standard length. There was no significant difference $P > 0.05$ of standard length between sites but differs significantly across months. The results for regression $r^2 = 0.6378$, $x = 1.2206$ $y = 1.8835$.

Table 3: Lenth-weight Relationship of *O. niloticus* of Girzhiva stream

Parameter	Site A	Site B	Site C	SEM
Total length (cm)	9.78 ± 0.28^a	9.57 ± 0.28^a	10.83 ± 0.28^a	0.417
Standard length (cm)	8.50 ± 0.35^a	8.13 ± 0.35^a	8.97 ± 0.35^a	0.307
Weight (g)	18.90 ± 0.43^a	21.00 ± 0.43^a	21.10 ± 0.43^a	0.951

Means with the same superscript in the row are not significantly ($P > 0.05$) different.

Table 4: Monthly Length-Weight relationship *O. niloticus* from Girzhiva Stream

Month	Total length	Standard length	Weight
Febuary	9.42 ± 0.49^b	7.83 ± 0.57^b	17.56 ± 0.22^a
March	9.54 ± 0.49^b	8.32 ± 0.57^b	16.06 ± 0.22^a
April	13.12 ± 1.00^a	11.49 ± 1.00^a	21.65 ± 0.22^a

May	10.28±0.49 ^b	8.41±0.57 ^b	19.63±0.22 ^a
SEM	0.557	0.521	0.337

Means with the same superscript in the row are not significantly different (P>0.05).

Condition Factor of *O. niloticus* from Girzhiva Stream

Results obtained for condition factor of both sites and months are presented in table 3 and 4 the lowest condition factor was recorded in site C (0.94) while the highest condition factor was recorded at site A (1.84). The lowest monthly condition factor was recorded in April (1.13) while the highest monthly condition factor was recorded in May (1.93).

Table 3: Condition Factor of *O. niloticus* from Girzhiva stream

Sites	No. of fish examined	Mean length (cm)	Mean weight (g)	Condition Factor (k)
A	24	11.02	24.6	1.84
B	24	11.2	23.2	1.65
C	24	13.5	23.1	0.94

Table 4: Monthly Condition Factor of *O. niloticus* from Girzhiva stream

Months	No. of fish Examined	Mean length (cm)	Mean weight (g)	Condition Factor (k)
Feb.	18	9.8	17.6	1.87
Mar.	18	9.4	16.7	1.89
Apr.	18	12.8	23.8	1.13
May	18	10.7	23.9	1.93

Food Identified in the Stomach of *O. niloticus* from Girzhiva Stream

The various food items Identified are shown in table 5 Plants materials dominated the dietary items with a percentage of frequency of occurrence and total point of about (26.60% and 84.12%). Digested food materials come second with a percentage of frequency of occurrence and total point of (20.52% and 71.75%). Unidentified materials had (18.92% and 57.01%) frequency of occurrence and total point. Insect materials had (17.63% and 46.26%) percentage of frequency of occurrence and total point. Detritus has the lowest percentage of frequency of occurrence and total point (16.41% and 48.36%).

Table 5: Stomach content of *O. niloticus* based on percentage of frequency of occurrence and total point

Food items	% of frequency of Occurrence	% of Total point
Plant materials	26.60	84.12
Insect material	17.63	46.26
Detritus	16.41	48.36
Unidentified material	18.92	57.01
Digested food material	20.52	71.75

Fecundity of *O. niloticus* from Girzhiva Stream

Table 5 and 6 showed the fecundity of *O. niloticus*. The total number of female fish was lowest at site B (7.33±0.57^a) while the highest was at site C (11.33±0.57^a). The monthly total number of female fish was in May (7.00±0.28^a) while the monthly total number of female fish was highest and uniform in February, March and April (8.00±1.00^a). There was significant difference P<0.05 of total number of female fish between sites and months. The total number of eggs was lowest at site C (14,0861±1.00^c) while site A (25,100±1.00^a) recorded the highest number of eggs. The monthly number of eggs was lowest in April (9,943±1.00^a) while February (28,519±1.00^a) recorded the highest number of eggs. There was significant difference P<0.05 between sites and months. Number of female fish without eggs was lowest at site B (1.00±0.18^a) while site C (7.00±1.00^a) recorded the highest. The monthly number of female fish without eggs was lowest in February (1.00±1.00^a) while the highest was recorded in May (4.00±0.27^a). There was significant difference between sites P<0.05 but not differs significantly across months. Number of female fish with eggs was lowest at site C (4.00±1.00^a) while site A (10.00±12^a) recorded the highest number of female fish with eggs. The monthly number of female fish with eggs was lowest in May (3.00±1.00^c) while

February (7.00 ± 1.00^a) recorded the highest number of female fish with eggs. There was significant difference $P < 0.05$ across site and months.

Table 6: Fecundity of *O. niloticus* from Girzhiva stream

Parameter	Site A	Site B	Site C	SEM
Total no. of female fish	12.00 ± 0.57^a	7.00 ± 1.00^b	11.00 ± 0.57^a	0.830
Total no. of eggs	25100 ± 1.00^a	19726 ± 1.00^b	140861 ± 1.00^c	1606
No. of female without eggs	2.00 ± 0.18^b	1.00 ± 0.18^b	7.00 ± 1.00^a	0.779
No. of female with eggs	10.00 ± 0.12^a	6.00 ± 0.16^b	4.00 ± 1.00^a	0.879

Means with the same superscript in the row are not significantly ($P > 0.05$) different.

Table 7: Monthly sex identification and fecundity of *O. niloticus* from Girzhiva stream

Months	Female	Fish with eggs	Fish without eggs	Total number of eggs
February	8.00 ± 0.28^a	7.00 ± 1.00^a	1.00 ± 0.10^a	28519 ± 1.00^a
March	8.00 ± 0.28^a	5.00 ± 1.00^b	3.00 ± 0.27^a	13379 ± 1.00^b
April	8.00 ± 1.00^b	5.00 ± 1.00^b	3.00 ± 0.27^a	9943 ± 1.00^d
May	7.00 ± 0.28^a	3.00 ± 1.00^c	4.00 ± 0.27^a	10344 ± 1.00^c
SEM	0.279	182	0.411	2293.74

Means with the same superscript in the column are not significantly different ($P > 0.05$).

The analysis of Length-Weight relationship of *O. niloticus* showed that the mean standard length and weight of male were higher than that of female as reported by David *et al.*, (2010). Results obtained in this study agreed with the report of Kefas *et al.* (2020), in which he reported a mean length of 9.9cm-15.9cm, and the report of Endalh *et al.* (2016). The parameters of the length-weight relationships (LWRs) might be affected by various factors including season, sex, differences in the length range of the caught specimens, population density, sexual maturity, age, habitat, stomach fullness, food quality or quantity, preservation techniques, fish health or environmental conditions (Cox and Hinch, 1997). The regression between length and weight for both males and females were closer to 1. This means that the relationship between length and weight of both males and females were higher as the length of the fish increase.

Results obtained for condition factor in this study agreed with the report of Laurat *et al.* (2019) from lower river Benue and with the report of Omitoyin *et al.* (2013), Surrjya *et al.* (2013), Getso *et al.* (2006). It contradicted the report of Bagenal and Teach, (1978). According to Laurat *et al.*, (2013), condition factor close to, or above 1 is good for fish survival. This showed that the fish in this study area are in good condition.

Analysis of the stomach content was also carried out during the period of investigation to determine the diet or type of food ingested by *O. niloticus*. Frequency of occurrence method and total point method was used to indicate the proportion of diet ingested by the fish. The results of the stomach contents analyzed revealed that *O. niloticus* species were herbivorous feeder in which their diet comprised of plants materials which dominated the stomach of the fish species, insect materials, detritus, unidentified materials and digested food materials. The results obtained in this study are in relation with the one reported by Vandi *et al.* (2019) in Kiri reservoir and the report of Kefas *et al.* (2020) in lake Geriyo and that of Abidemi-Iromini (2018) in Lagos.

Results obtained for fecundity was within the range with Shoko *et al.*, (2015) the variation fecundity in both sites and months can be due to difference in food abundance as reported by Innocent *et al.* (2023). Another author revealed that within a given species, fecundity might vary because of difference in adaptation to environmental habitat Witthames *et al.*, (1995). Even within the stocks fecundity varies annually and undergoes a long-term change and has been observed to be proportional to fish size and condition (Kjesbu *et al.*, 1998).

CONCLUSION

It was concluded that Fish farming information and knowledge gained from the use of radio were fish seed/fingerling quality, fish feed quality, fish species/type of fish and other fish farming husbandry practices. Furthermore, the length weight relationship regression was close to 1 and food identified in the

stomach revealed that *O. niloticus* species are herbivorous feeders, while the fecundity of *O. niloticus* from Girzhiva stream showed that they are prolific.

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Theme: Agricultural Extension for Food Security and Community Empowerment

Information and Communication Technology: A Tool for Agricultural Extension Services in Abia State, Nigeria

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ABSTRACT

The agricultural sector in Nigeria, particularly in Abia State, remains a cornerstone of rural livelihood and economic development. However, the delivery of effective agricultural extension and advisory services (AEAS) continues to face critical challenges such as poor farmer-agent communication, limited manpower, and slow dissemination of vital information. In response to these challenges, Information and Communication Technology (ICT) has emerged as a transformative tool with the potential to revolutionize the agricultural landscape. This study investigated the extent to which ICT is utilized as a strategic tool for enhancing agricultural extension and advisory services in Abia State. A descriptive survey design was adopted, and data were collected from 150 respondents (comprising 120 farmers and 30 extension agents) using structured questionnaires. Descriptive statistics and Pearson correlation analysis were employed for data interpretation. Findings revealed a high level of awareness and usage of ICT tools such as mobile phones, WhatsApp, SMS, and social media platforms among extension agents and farmers. Despite this, a Pearson correlation result indicated a weak and statistically insignificant relationship ($r = -0.03$, $p = 0.715$) between ICT usage and perceived effectiveness of service delivery. This suggests that while ICT tools are widely used and appreciated, their full potential is yet to be realized due to numerous constraints. Key challenges identified include poor network coverage, irregular power supply, lack of digital literacy, high cost of ICT devices, and the absence of technical support structures. These findings highlight the need for a more holistic approach involving infrastructure development, digital training, and supportive policies to fully harness ICT's potential in agricultural extension. The study concludes that while ICT holds significant promise for improving AEAS in Abia State, its impact is currently limited by systemic barriers that must be urgently addressed.

Keywords: ICT, Agricultural Extension, Advisory Services, Rural farmers, Abia State.

INTRODUCTION

The goal of information and communication technology, or "e-agriculture," is to boost agricultural and rural development by means of better information and communication systems. To put it another way, ICT includes a variety of technologies that facilitate the processing, distribution, and storage of data and information (Radhika et al., 2024). Social media has taken over communication in the twenty-first century, and digital communication has infiltrated every industry. The importance of ICT tools in extension services is demonstrated by the highest use of digital tools by livestock and poultry farmers, followed by mass media exposure and extension agencies (Ifeoma et al., 2024).

The low level of agricultural information exchange among the various stakeholders in the agricultural sector has been one of the main obstacles to Nigeria's agricultural development. This is typically caused by a lack of access to up-to-date and pertinent information sources as well as inadequate documentation, storage, and retrieval methods (Agwu and Uchemba, 2004). Furthermore, low agricultural output performance is the result of farmers' lack of knowledge or exposure to agricultural information and communication channels (Agwu and Adeniran, 2009). These indicate that farmers continue to require agricultural information. Information and communication technology, or ICT, has transformed human thought, aptitude, and capacity as well as all life processes and activities. It is used in all areas of human endeavor and business (Maximo and Braun, 2006).

The implementation of Information and Communication Technology (ICT) across various global economic sectors has proven beneficial in enhancing productivity and efficiency. In particular, the agriculture sector has seen significant integration of ICT in all aspects of its operations. ICT's practical applications have the potential to address key agricultural challenges, such as pest and disease outbreaks, extended droughts, seasonal and spatial farming variations, information gaps, and high transaction costs (Anh *et al.*, 2019). Utilizing ICT throughout the agricultural value chain, from production to consumption, can provide stakeholders with timely, accurate, and relevant information, thereby increasing profitability, improving food security, and promoting sustainable and profitable agriculture (Purnomo and Lee, 2010). ICT also offers solutions to issues faced by farmers, governments, and land users in areas such as land registration, valuation, and taxation (Daum, 2020). ICT in agriculture is becoming more popular worldwide and is playing a key role in changing agricultural enterprises. By linking farmers with research and bringing improved technology from the lab to the field, agricultural extension services aim to increase production and productivity. Extension specialists used to visit farmers on their farms or at field schools to offer these services (Radhika *et al.*, 2024). Technology and agricultural information can only be beneficial if it is disseminated to the intended audience. To do this, agricultural extension agents need to distribute information through a range of channels (Ifeoma *et al.*, 2024).

It is currently beyond the capacity and resources to attend to the particular wants, requirements, and inquiries of farmers due to the high number of farmers per extension agent (more than 3000 families per officer) (Obiechina, 1999). Effective communication will be made possible by ICT applications, which will help extension services overcome time and location constraints. Reaching many farmers at once is a problem that can be solved with this approach (Richardson, 2006). People are empowered by ICT because it gives them the chance to study, make money, and actively participate in decision-making (ADB, 2004). Stakeholders' abilities and competencies must be enhanced while giving the required advocacy in order to provide solutions on suitable ICT applications for enhancing extension services. ICTs and mobile-enabled agricultural services act as instruments to deliver extension services and help to create awareness amongst farmers (Mittal *et al.*, 2010). ICT have shown potential to improve extension and advisory services. Advances in information technology, biotechnology, and nanotechnology have put agriculture at the threshold of an exciting frontier of opportunities to advance economic growth, sustainability, and the building of human capabilities. Acknowledging this, Chamala (1990) said that extension practitioners in the Cooperative extension system will need to develop new educational curricula, programs, and delivery systems to facilitate adoption of these technologies. This will enable farmers to receive updates on temperature, humidity, rainfall, and other parameters like atmospheric pressure, solar radiation, soil moisture, and wind speed (Ifeoma *et al.*, 2023).

STATEMENT OF PROBLEM

Agriculture remains a vital sector for economic growth and food security in Nigeria, particularly in Abia State, where a significant proportion of the population depends on farming for their livelihoods. However, despite ongoing efforts to improve agricultural productivity, many smallholder farmers still struggle with access to timely, relevant, and practical information on improved farming techniques, pest and disease control, market access, and climate adaptation strategies. Traditional agricultural extension services in the state have been largely ineffective due to inadequate manpower, logistic challenges, and poor funding.

With the global advancement of Information and Communication Technology (ICT), there is a growing recognition of its potential to transform agricultural extension and advisory services by bridging communication gaps between extension agents and farmers. ICT tools such as mobile phones, radio, television, internet platforms, and social media can facilitate faster dissemination of information, real-time feedback, and participatory learning among stakeholders. However, the effective adoption and integration of ICT in extension service delivery in Abia State remain limited by several challenges including lack of infrastructure, digital illiteracy among farmers and extension workers, and weak institutional support.

This study, therefore, seeks to investigate the extent to which ICT is currently being utilized as a strategic tool to enhance agricultural extension and advisory services in Abia State. It also aims to identify the barriers hindering its effective application and to explore strategies for improving ICT-based extension delivery systems to better serve the needs of rural farmers.

OBJECTIVES OF THE STUDY

The specific objectives of the study were to:

- i. identify the types of ICT tools used in agricultural extension and advisory services in Abia State.
- ii. assess the extent the ICT adoption and utilization among agricultural extension agents and farmers in the state.
- iii. identify the challenges hindering the effective use of ICT in agricultural extension and advisory services in Abia State.

HYPOTHESIS

The hypothesis was tested at a 0.05 level of significance

H₀₁: ICT adoption and utilization do not significantly influence the performance of agricultural extension agents in Abia State.

METHODOLOGY

The study was carried out in Abia State Agricultural Development Programme (Abia ADP). Abia State is located in the Southeastern zone of Nigeria. The population of the study consists of agricultural extension agents working under the Abia State Agricultural Development Programme (ADP) and the registered and practicing farmers in selected local government areas of Abia State. Multi stage sampling technique was used. Stage 1 three agricultural zones (Aba, Ohafia and Umuahia) was purposively selected. Stage 2: From each zone, two local government areas were randomly selected (making 6 LGAs). Stage 3: Each selected LGA, 20 farmers and 5 extension agents were purposively selected based on their engagement with extension services and ICT tools. Hence, 120 farmers (20 x 6), 30 extension agents (5 x 6 LGAs) making a total 150 respondents. Data were collected with well-structured questionnaire were analyzed using descriptive statistics and Pearson correlation at 0.05 level of significance on SPSS ver. 23.

RESULTS

Table 1: ICT for extension and advisory services delivery

ICT devices/tools	Percentage
Mobile phones	100
WhatsApp	100
SMS	98.3
Twitter	98.3
Tele-meeting	98.3
Google meet	97.8
Google classroom	97.5
Television	97.5
Videos	96.6
Close circuit television camera	95.0
Digital Camera	93.3
YouTube	91.6

Radio	89.2
Facebook	86.6
E-books	83.3
Crowd mapping	82.5
Emails	78.3
Instagram	78.3
Voice mail	46.6

Source: Field survey, 2024

Multiple responses

A number of ICT devices that are widely used for the delivery of extension and advisory services were identified in Table 1. Mobile phones (100%), WhatsApp (100%), SMS (98.3%), Twitter (98.3%), tele-meeting (98.3%), Google Meet (97.8%), Google Classroom (97.5%), television (97.5%), videos (96.6%), close circuit camera (95.0%), digital camera (93.3%), YouTube (91.6%), radio (89.3%), Facebook (86.6%), e-books/journals/e-data (83.3%), crowd mapping (82.5%), and emails (78.3%) are a few of these. Anyakoha (2005) outlined ICT and digital technologies, including the use of multimedia personal computers (PCs), laptops and notebooks with internet connectivity, digital cameras and videos connected to PCs and laptops, land area networks and wide area networks; the world wide web (www), e-books, e-journals, e-databases, floppies, CDs, and DVDs, cell phones with internet access, moving pictures, close circuit television (CCTV) cameras, computer-mediated video conferencing, virtual reality, telecommunication satellites, interactive televisions, and more. The most notable of these is the computer, a significant ICT instrument whose uses have drastically altered farming and animal husbandry and led to an astounding rise in output (Asenso-Okyere and Mekonnen, 2012).

Table 2: Perceived use of ICT in service delivery

Use of ICT devices	Mean	SD
Reaching farmers through SMS and mobile phones is very effective	3.51	0.68
Mobile phones are effective and good in disseminating agricultural information	2.98	1.28
Dissemination of agricultural information through website is effective	3.21	0.63
Increases efficiency of extension staff	2.86	1.26
Minimizes work load of extension officers	2.74	0.98
Efficient and effective agricultural information and services	3.01	1.42
Saves cost and time	2.67	0.74
Rapid spread of agricultural information	2.84	0.64
Establishment of better communication	2.80	1.01
Increases extension officers' responsibility	2.74	0.74
Improves the rural livelihood of staff	3.10	1.34
Better than traditional face to face method	3.10	0.94
Linking of all farm stakeholders easily	2.97	0.84
Enhance the importance of extension work	2.88	1.02
Serves as method of professional development	3.51	0.81
Improves practice of extension profession	2.76	0.99

Source: Field survey, 2024

With a discriminating mean index of 2.50, Table 2 showed a positive attitude of the Extension agents towards the use of ICT to reach farmers. They responded as follows- reaching farmers through SMS and mobile phone is very highly effective ($\bar{x}$ = 3.51), mobile phones are effective and good in disseminating agricultural information ($\bar{x}$ = 2.98), disseminating of agricultural information through website is effective ($\bar{x}$ = 3.21), improving /increase efficiency of extension staff ($\bar{x}$ = 2.86), minimizes work load of extension staff ($\bar{x}$ = 2.70), makes extension activities effective ($\bar{x}$ = 3.01), saves cost and time ($\bar{x}$ = 2.67), spreads agricultural information rapidly ($\bar{x}$ = 2.84), establishment of better communication ($\bar{x}$ = 2.86), increases extension workers responsibility ($\bar{x}$ = 2.74), improves rural livelihoods of staff ($\bar{x}$ = 3.10) better than traditional face to face method ($\bar{x}$ = 2.10), bringing together of stakeholders easily ($\bar{x}$ = 2.97), improve the

practice of extension profession ($\bar{x} = 2.76$). This overall mean value indicates that the respondents generally had a positive attitude towards the use of ICT devices. This corresponds to similar studies by (Adekunle et al., 2007; Albirini, 2004) who analyzed attitudes of extension workers towards the use of ICTs with identical results conducted in different countries. Majority of the respondents (90.6%) agreed with the statement, “Contacting farmers through mobile and SMS is very highly effective”, with a mean value of ($\bar{x} = 3.51$). The statement, “serve as method of professional development” witnessed also a mean value of ($\bar{x} = 3.51$) from the respondents. 88% of the respondents agreed with the statement, “Mobiles are effective in disseminating agricultural information with a mean value of ($\bar{x} = 3.21$). Whether it is a developed country or a developing country, mobile phones have become a regular part of daily life. Mobile phones have made our daily communication very easy and cheap between distant locations. They are also an important part of ICT services; farmers and extension workers can communicate with each other easily without the hindrance of scheduling face-to-face or roundtable meetings.

Table 3: Challenges on the effective use of ICT in extension and advisory services

Challenges	Percentage
Lack of experience in use of ICT	97.5
Poor network coverage	100
Poor power supply	100
Illiteracy	87.5
High cost of ICT equipment	77.5
High maintenance cost	61.6
Lack of technical expertise	81.6
Non-existence of maintenance shops	91.6

The obstacles to the efficient use of ICT technologies by Agricultural Extension and Advisory Services Providers (AEASP) in Abia State were displayed in Table 3. These difficulties include: illiteracy (87.5%), inconsistent power supply (100%), insufficient network coverage (100%), and lack of operational know-how on ICT tools (97.5%). Additional difficulties include the high cost of ICT equipment/devices (77.5%), message delivery delays caused by network outages (61.6%), a lack of expertise for maintaining ICT devices (81.6%), and the absence of repair shops in the service area (91.6%). These conforms to Nikola et al. (2019) that the utilization of digital innovations is influenced by literacy, digital skills, and technology availability.

Pearson Correlation

Table 4: Correlation between ICT Usage and Effectiveness in Extension Services

Variables Compared	Correlation Coefficient (r)	P-value	Statistical Significance
ICT Usage vs. Effectiveness	-0.030	0.715	Not Significant

Source: SPSS output ver. 23

Table 4 showed the correlation coefficient of -0.030 suggests a very weak negative relationship. The p-value of 0.715 indicates that the result is not statistically significant at the 0.05 level. This implies that higher ICT usage does not necessarily correlate with improved effectiveness of extension services, possibly due to infrastructural or skill-related constraints.

DISCUSSION

The Pearson correlation analysis conducted showed a very weak and non-significant negative correlation ($r = -0.03$, $p = 0.715$) between ICT usage and perceived effectiveness of extension and advisory services in Abia State. This implies that increased use of ICT tools does not necessarily correlate with higher perceived performance or effectiveness in extension service delivery. This result appears to contrast with the descriptive findings where extension officers expressed a positive attitude toward ICT use. For instance, Table 2 reports high mean values for statements such as: “Reaching farmers through SMS and mobile

phones is very effective” (Mean = 3.51), “Serves as a method of professional development” (Mean = 3.51) and “Improves rural livelihood of staff” (Mean = 3.10). These suggest a strong subjective belief in the benefits of ICT among extension agents. However, the gap between high subjective ratings and weak statistical correlation could be explained by implementation challenges such as despite the enthusiasm toward ICT tools, real-world constraints significantly hinder their effective use, as highlighted in Table 3 namely poor power supply, poor network coverage, lack of ICT experience, illiteracy and lack of technical expertise. These are critical barriers that prevent even the most promising ICT platforms from translating into real gains in extension effectiveness. The disconnect shown by the Pearson correlation may therefore reflect this practical dysfunction: although ICT is widely acknowledged as useful, many users cannot leverage it to full capacity due to infrastructural, technical, or literacy-related limitations.

Similar issues have been identified in other regions of Nigeria; Albert (2014) found that poor ICT infrastructure severely limited extension activities in Rivers State. Salau et al. (2008) reported poor access to ICTs among extension officers in Nasarawa State, despite growing interest in digital tools. Nwobodo and Nwabugwu (2016) noted that while ICT usage improved communication in Anambra State, digital skill gaps and tool maintenance remained unresolved barriers.

Another layer of complexity involves the digital divide among rural farmers. As Nikola et al. (2019) and the document note, most rural dwellers use mobile phones primarily for social or basic communication due to low digital literacy and inability to operate complex apps or e-learning platforms. This observation is consistent with the findings that only 46.6% of respondents use voicemail, social platforms like Instagram and emails are among the least used tools. Furthermore, even when devices are owned, high maintenance costs and lack of repair services (reported by 91.6% of respondents) reduce long-term usability. This echoes Mittal et al. (2010), who emphasized that successful ICT adoption requires training, affordability, and user-centered design.

ICT adoption in agriculture has been more successful in other regions when support systems are present such as in Kenya, platforms like iCow and M-Farm have been effective due to combined efforts in training, telecom partnerships, and local language content. In India, mobile-based agricultural helplines succeeded because of state-level investment and user-friendly technologies tailored to rural farmers (Mittal et al., 2010). Abia State and similar regions in Nigeria can learn from these models by localizing content, investing in farmer training programs and creating public-private partnerships for ICT deployment.

The high mean scores in the descriptive analysis of ICT perception suggest that respondents believe in the value of ICT, but the weak correlation outcome may reflect incomplete integration of ICT into daily operations, lack of technical depth in usage (e.g., using WhatsApp vs. using data-logging apps), a "perception vs. performance" gap, where agents recognize ICT's potential but lack enabling conditions to realize it. This supports the study's conclusion that adoption alone is not enough there must be systemic investment in infrastructure, skills, and device sustainability for ICT to truly enhance extension performance.

CONCLUSION

While extension agents and farmers in Abia State display a positive attitude toward ICT tools, their practical effectiveness remains limited due to infrastructural, financial, and technical challenges. The findings align with broader Nigerian trends where enthusiasm for ICT exists but is tempered by systemic barriers. ICT remains a strategic tool with transformative potential, but its success depends on contextual adaptation and support structures, especially in underserved agricultural communities. The study therefore recommends that based on the findings of the study, the weak statistical correlation reinforces the need for holistic policy interventions not just providing tools, but ensuring they can be used effectively, affordably, and sustainably through skills and training.

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**SOCIETY FOR COMMUNITY & COMMUNICATION DEVELOPMENT RESEARCH
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Theme: Agricultural Extension for Food Security and Community Empowerment

**Effect of Ginger Disease Outbreak on the Livelihood of Farmers in
Southern Kaduna, Nigeria**

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ABSTRACT

The study assessed the effect of the ginger disease outbreak on the livelihoods of farmers in Southern Kaduna, Nigeria. It specifically evaluated how the disease affected ginger yields, examined its effects on farmers' livelihoods, identified control measures adopted by ginger farmers, and recommended strategies to manage fungal infestations in ginger. A purposive and multistage random sampling technique was used to select 120 ginger farmers for the study. Data were collected through structured interview schedules and analyzed using descriptive and inferential statistics, such as mean scores, percentages, and an OLS multiple regression model. The findings revealed a significant decline in ginger yields for farmers in Southern Kaduna, with average production dropping from 16 tons per hectare (t/ha) in 2022 to just 3.2 t/ha in 2023. The results of the regression analysis revealed that the outbreak of ginger disease had a significant negative impact on crop yield and farm income, potentially leading to increased debt burdens for farmers. Additionally, the analysis indicated that the ginger disease had a significant positive effect on labour use, debt burden, and the diversification of farming activities as a means for farmers to cope with their losses. The results indicated that ginger farmers adopted several control measures to mitigate the disease, including maintaining a weed-free environment on their farms ($x = 4.78$), spraying fungicides ($x = 4.99$), shifting to alternative crops ($x = 3.96$), and implementing erosion control ($x = 3.25$). The outbreak of ginger disease significantly affected the livelihoods of farmers in Southern Kaduna, causing major crop losses that led to decreased income, financial hardships, and potential debt burdens. To prevent the spread of the disease, ginger farmers should practice good field hygiene, use healthy seed, and treat the soil before planting. Furthermore, the government should provide extension services focused on disease prevention strategies for ginger farmers.

Keywords: Ginger disease, disease outbreak, farmers' livelihood, Southern kaduna

INTRODUCTION

Ginger farming is a vital economic activity for many rural households in Southern Kaduna, contributing significantly to their income and food security. Tragically, during the 2023 cropping season, an alarming 95% of ginger cultivation was devastated by a rampant disease outbreak, primarily attributed to fungal pathogens, with *fusarium oxysporum* leading the charge (Dabo, 2024). This insidious disease manifests through the sudden yellowing and wilting of the ginger plants' leaves, followed by the troubling decay of their rhizomes nestled in the soil (Mohammed, 2024). The fungal infection, which spreads both through the air and the soil, has caused a wave of despair among farmers (Ahmed, 2024). The disease outbreak has been a growing concern, threatening yields and destabilizing farmers' livelihoods (Bello, 2024). These

outbreaks not only reduce production but also lead to financial losses, food scarcity, and economic hardship for affected communities (Dabo, 2024).

This study evaluated the effect of the disease on ginger farmers in Southern Kaduna, the coping strategies employed by farmers to mitigate these challenges, and identified appropriate control measures to tackle fungi infestation in ginger. The paper aims to provide insights into the vulnerabilities of ginger farmers and recommend sustainable solutions to protect their livelihoods. Understanding the effect of these outbreaks is crucial for policymakers, agricultural researchers, and stakeholders in developing effective intervention strategies to support affected communities.

METHODOLOGY

The study was conducted among ginger farmers in Southern Kaduna, and information was collected on the extent of ginger yield reduction, and disease's effect on farmers. Purposive and multi-stage sampling techniques were used to select 120 ginger farmers. The agricultural zone in Southern Kaduna was purposively selected, three blocks were randomly selected, and two circles in the selected blocks were randomly selected namely Makera, Kakuri, Trikania, Kudenda, Barnawa, and Narayi in Southern Kaduna. Twenty ginger farmers were randomly selected from each circle, giving a total of 120 respondents. Data were analyzed with descriptive statistics such as mean score, percentage, and an Ordinary Least Squares (OLS) multiple regression model. A 5-point likert rating scale was used to measure the level of agreement with the disease control measures adopted by farmers using strongly agree (5), agree (4), undecided (3), disagree (2), strongly disagree (1). Respondents with mean score of 3.0 and above shows that they are in agreement that the adopted the measure, while respondents with mean score of less than 3.0 were not in agreement. To determine the mean likert level = $X_s = OX$. X_s of each item was calculated by multiplying the frequency of each response pattern with its appropriate nominal value and dividing the sum by the number of respondents to the items. The effect of the ginger disease outbreak on the livelihood of farmers in the study area are implicitly represented using the OLS multiple regression model as follows:

$$Y_i = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, e_i)$$

Where:

Y_i = ginger disease in the farmer's field (disease score)

X_1 =farm income (amount from ginger in naira); X_2 = crop yield (ton per hectare); X_3 = labour use (number of labour engaged); X_4 = access to input (dummy variable; yes =1, no = 0); X_5 = debt burden (outstanding loan in naira); X_6 = diversification index (no of different income-generating activities pursued); X_7 = Access to extension services; e_i = error term. Among the functional forms tried namely linear, semi log, exponential, and double log functional forms; the linear functional form is the best fit and therefore was chosen as the lead equation with a high R^2 value of 0.835.

RESULTS AND DISCUSSION

Disease Impact on Crop Yield

The results indicate a significant decline in ginger yields for farmers in Southern Kaduna, with an average production of 16 tons per hectare (t/ha) recorded in 2022. However, during the 2023 cropping season, this figure plummeted to an average yield of just 3.2 t/ha. This dramatic reduction can be attributed primarily to severe disease infestations that adversely affected ginger crops. The impact of these diseases not only diminished the quantity of the harvest but also posed a serious threat to the economic stability of the farmers who rely on ginger as a key cash crop. Effective disease management strategies will be essential to restore productivity and safeguard the livelihoods of these farmers in the future.

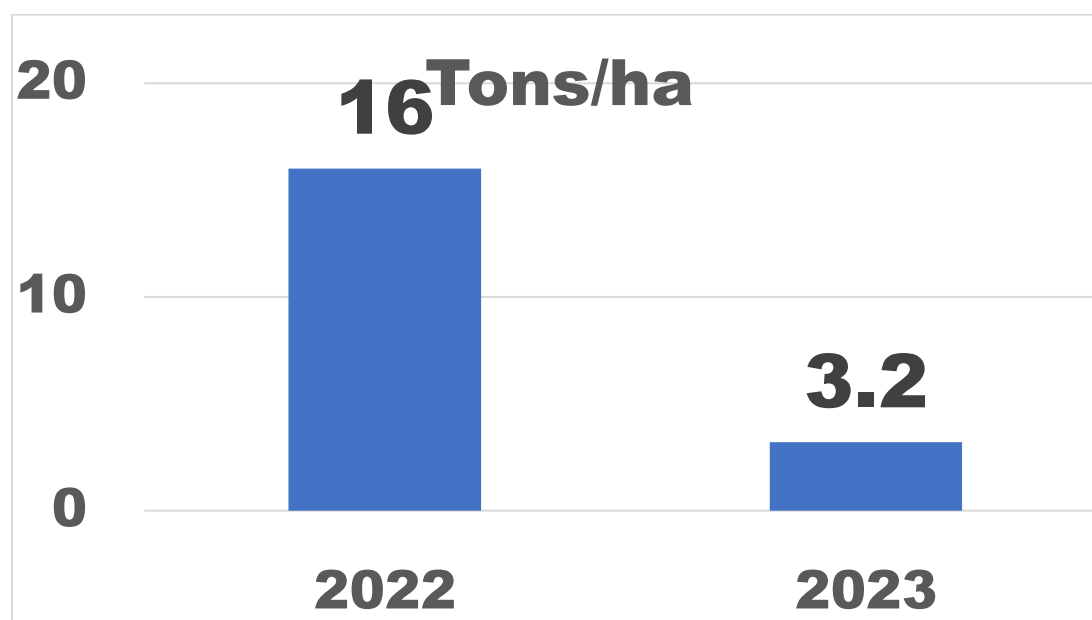


Fig. 1. Mean Yield of Ginger in 2022 and 2023 Cropping seasons

Effect of ginger disease on the livelihood of farmers

Table 1 presents the estimated results of an OLS multiple regression analysis on the effect of ginger disease on the livelihoods of farmers in the study area. The findings indicate that ginger disease has a significant negative effect on crop yields. This means that the disease directly reduces ginger production, leading to decreased harvests and sales for farmers. Additionally, the results show that ginger disease significantly negatively affects farm income. This implies that outbreaks of the disease lead to lower income levels, likely due to diminished yields, increased costs for disease management, and losses in the market. The analysis reveals that the ginger disease has a significant positive effect on labour use. This indicates that farmers may need to hire more labour to manage affected crops—such as applying fungicides, weeding, or replanting—resulting in higher production costs. The burden of debt is also identified as positively and significantly related to the outbreak of ginger disease. This implies that farmers are likely to incur more debt to cope with their losses, purchase necessary inputs, or manage the disease. Lastly, the ginger disease shows a significant positive effect on diversification into different income-generating activities. This suggests that farmers who diversify their income sources, such as engaging in livestock farming or cultivating other crops, are less vulnerable to the shocks caused by the disease.

Table 1: OLS Estimate of Effect of Ginger Disease Outbreak on the Livelihood of Farmers in Southern Kaduna, Nigeria

Variable	+Linear	Exponential	Double log	Semi log
Intercept	0.3156 (0.83)	-0.29817 (-1.51)	0.0917 (0.59)	1.0798 (3.41)***
Farm income	-0.009 (3.054)***	-0.157 (-2.674)**	-0.78(-2.986) **	-0.133 (-2.94)**
Crop yield	-0.643 (3.629)***	-0.010 (-0.111)	0.193 (2.015)**	-0.550(-1.915)**
Labour use	0.2948(4.21)***	1.22 (1.808)*	0.094 (2.945)**	0.128 (1.286)
Access to input	-0.010(-0.111)	-1.196 (-1.94)**	-0.034(-0.328)	0.687(0.830)
Debt burden	0.316 (4.03)***	0.033 (0.340)	0.147 (-0.069)	0.123 (1.865)**
Diversification index	0.1500 (4.14)***	0.1666 (2.47)**	-0.0667 (1.91)*	0.1625(2.29)**
Access to extension services	-0.069 (-0.709)	0.010 (0.031)	0.022 (0.44)	0.012 (0.061)
R ²	0.835	0.760	0.414	0.511
F-Ratio	6.047***	0.988	2.843**	2.017**

Source: Field survey, 2023

Note: ***, **, * = significant at 1%, 5% and 10% respectively; Figures in parenthesis are t-values.

Control measures adopted by ginger farmers

In Southern Kaduna, ginger farmers have implemented a variety of proactive control measures to mitigate disease infestation in their crops. One of the most crucial strategies is maintaining a weed-free environment in their fields, which has been rated highly effective with an average score of 4.78. This practice helps to reduce competition for nutrients and minimize habitats for pests that could exacerbate disease spread. Additionally, the farmers have adopted the use of fungicides, with an impressive average rating of 4.99, demonstrating their commitment to safeguarding their ginger crops against fungal infections. These chemical treatments target specific pathogens, ensuring that the crops remain healthy and productive. Some farmers are also exploring the option of shifting to alternative crops, which received an average rating of 3.96. This strategy allows them to diversify their agricultural practices and potentially reduce the risk of disease by breaking the disease cycle associated with ginger. Lastly, erosion control measures, rated at 3.25, are employed to protect the soil structure and prevent the runoff of soil that might carry pathogens. By safeguarding the land from erosion, farmers not only preserve the fertility of their soil but also enhance the overall resilience of their farming practices. Together, these measures reflect a comprehensive approach to managing agricultural health in the study area.



Decision rule: Adopted measure ≥ 3.0 , Not an adopted measure ≤ 3.0 .

Fig 1. Disease Control Measures Utilized by Farmers

Recommended Control Measures to Tackle Fungi Infestation in Ginger

To effectively combat ginger disease infestation, several comprehensive control measures are recommended:

1. **Crop Rotation:** Implementing a well-planned crop rotation strategy can significantly reduce pathogen build-up in the soil. Alternating ginger with non-host crops such as legumes or cereals helps disrupt disease cycles and improve soil health.
2. **Good Field Hygiene Practices:** Maintaining high standards of field hygiene is crucial. This includes removing infected plant debris, cleaning tools and machinery before and after use, and preventing the movement of contaminated soil between fields to minimize disease spread.
3. **Use of Healthy Seed:** Sourcing disease-free ginger seed is vital to ensure the establishment of a healthy crop. Selecting robust ginger seeds that are resistant to common diseases can also improve yields.
4. **Soil Treatment:** Prior to planting, treating the soil can help eliminate pathogens. Practices such as solarization, where soil is heated using sunlight, or incorporating organic matter to enhance microbial activity can foster a more conducive growing environment.
5. **Heat Treatment of Ginger Seed:** Subjecting ginger seed to heat treatment before planting can help eradicate any potential pathogens. This method involves exposing seed rhizomes to controlled temperatures to eliminate harmful organisms while preserving seed viability.
6. **Timely Application of Fungicides:** Regularly monitoring for disease symptoms and applying fungicides as recommended, especially during periods of high disease pressure, can significantly reduce infection rates. It's essential to follow integrated pest management principles, combining chemical and biological control methods.
7. **Capacity Building:** Educating farmers and fieldworkers about best practices for ginger cultivation, disease identification, and management strategies is imperative. Workshops and training sessions can empower communities to implement these measures effectively.

Implementing these control measures with attention to detail can lead to healthier ginger crops and improved overall productivity.

CONCLUSION

The ginger disease outbreak severely impacted the livelihoods of farmers in Southern Kaduna, by causing significant crop losses, leading to reduced income, financial hardship, and potential debt burdens. Ginger farmers should practice good field hygiene, use healthy seed, and treat the soil before planting to avert the spread of the disease. The government should provide extension services for the prevention of fungal diseases in ginger farming.

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12 – 14 Aug. @ Michael Okpara University of Agriculture, Umudike, Abia State

Theme: Agricultural Extension for Food Security and Community Empowerment

Awareness of Precision Agricultural Technologies among Crop Farmers for Rural Livelihoods' Enhancement in Ebonyi State, Nigeria

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ABSTRACT

Precision Agriculture offers opportunity to increase crop quality and yield because through it, data are collected to assist farmers in making guided sub-field decisions. There seem to exist dearth of knowledge on awareness of Precision Agricultural Techniques (PATs) in Ebonyi State, Nigeria. This study assessed awareness of PATs in Ebonyi State. Specifically, the specific objectives were to: ascertain farmers' awareness of PATs, describe their sources of information on PATs; identify PATs adopted and analyze constraints to adoption of PATs four-stage sampling procedure was used for the selection of 120 respondents. Primary data were collected using structured interview schedule, and analyzed with percentages, mean scores and factor analysis. Result showed that awareness of PAT increased for variable rate of fertilizer application ($\bar{X} = 3.75$), studying weed/pest population ($\bar{X} = 3.58$), control and use of farm machineries/equipment ($\bar{X} = 3.58$). Furthermore, radio (63.3%), television (57.5%), extension agents (59.2%) and contact farmers (50.3%) were major sources of information on PAT. Factor analysis results yielded three composite factors that limited adoption decision, all having eigen values above 1 namely: 'socio-economic', financial and 'institutional' factors. It was concluded that several factors were associated with farmers' adoption decision of PATs. A concerted effort focusing on addressing the isolated factors by extension organizations is thereby recommended.

Keywords: Awareness, Precision Agriculture, Rural Livelihoods, Factor analysis

INTRODUCTION

Traditional agricultural practices have rarely achieved optimal efficiency, either in terms of optimum yield or minimal cost of production. Under such systems, inputs (e.g. fertilizer and pesticides) are applied, in order to prevent nutritional deficiency or losses in stand or yield, at a uniform rate over an entire farm (Khanna *et al.* 2020). Such decisions which are typically made to avoid more risk, are often not knowledge driven. More specifically, they overlook field variability. Over-application of fertilizers, as an example, results in input losses through leaching and runoff. These practices generate adverse effects on resource quality (e.g. soil and water). There are, in turn, consequential impacts for plants, ecosystems, the economy, and population. Resource misallocation, therefore, has serious implications for sustainability vis-a-vis food security and enhanced rural livelihoods. Such realizations have focused attention on increasing the efficient use of scarce farm resources. One answer to specific aspects of this problem is the adoption of

precision agriculture, which is a production system that involves crop management according to field variability and site-specific conditions (Seelan *et al.* 2013). Precision farming can be defined as a management system, which it depends upon the information and technology or is site-specific management and it uses one or more of the following data sources: soils properties, crop growth parameters, nutrient maps, pests, soil moisture and yield map, for maximization of the economics, sustainability and conservation of the environmental farm USDA (2007). It refers to the system that assesses variability in soil and crops through the field. Then, information, which was collected in these assessments, could be then used to develop site-specific management practices for optimizing soil and crop yield production (Baroudy *et al.*; 2020 and Paxton *et al.*; 2011).

Precision Agriculture (PA) is a whole-farm management approach using information technology, satellite positioning, remote sensing and proximal data gathering. Precision agricultural techniques (PATs) are those technologies which are either used singly or in combination, as the means to realize precision farming and achieve its noble aims. Using PATs, data are collected to assist farmers in making regular and guided sub-field decisions, including applications of fertilizers and pesticides, distribution densities for seeds, irrigation application rates, and tillage regimes (Daberkow and McBride 2015). The ultimate objective is the management of crop and soil variability in a manner which increases profitability and reduces environmental destruction (Fountas *et al.* 2017). According to Folnovic, (2015), the goal of precision farming is to increase agricultural yield production and decrease the environmental risks. These technologies have the goal of optimizing returns on inputs whilst potentially reducing environmental impacts. However, the benefits could include the following points: detecting soil properties and plant physicochemical parameters, real time data collection through remote sensing instruments, saving time and decreasing costs through reducing fertilizer costs and other agrochemicals as well as reducing tillage operation, supplying the farmers with good farm information and databases and integrating farm management software, like Agrivi, to make all farm activities easier and to increase farm productivity. The increased efficiency of the management plan will come about through a good understanding of the interaction between environment, soil, crop and more detailed information using of new advanced and current information technologies such as short and long-term crop growth modeling, soil conservation, climate predictions and agro-economics modeling (A. A Belal *et al.*, 2021). The new tools for precision farming are content hardware, software and recommended practices Singh (2004). Others include: Global Position System (GPS), Remote Sensing, Soil and Crop Sensors, Variable Rate Technology (VRT), Yield Monitoring Systems and Mapping, Site-Specific Management Zones (SSMZ) and Crop Modeling. Implementation of this technique to increase soil and crop production, reduce costs, increase farm profitability, reduce environmental risks and desertification processes and as well enhance rural livelihoods is necessary.

Many researchers such as Swinton and LowerbergDeBoer 2011, Sunding and Zilberman (2011), Tey and Brindal (2012), Filho *et al.* (2011) and Pierpaolia *et al.*, (2013) have investigated the factors influencing the decision to adopt Precision Farming (PF) technologies. The principal factors influencing the adoption of PF technologies are operator characteristics, farm physical attributes, sources of information, and financial and structural characteristics of the farm business. Examples of operator characteristics include age, formal education, years of farming experience, and computer literacy (Fernandez-Cornejo, Beach, and Huang, 2016). Examples of farm physical attributes include farm size, owned or rented land (Banerjee *et al.* 2018), and sub-field variability in pH, organic matter, soil type and texture, topography, and drainage that influence crop yields (Daberkow and McBride, 2017). Extension Agents, contact farmers, Crop consultants, input suppliers, and equipment dealers with expertise in PF services are expected to provide information that can influences PF technology adoption by farmers (Velandia *et al.* 2010; Wolf and Nowak, 2013). The financial position of the farm also influences PF adoption decisions (Daberkow and McBride, 2017), while profitability and environmental benefits are correlated with the PF technology adoption decision (Batte and Arnholt, 2013).

Despite the quanta of researches conducted in this area of study in developed and developing countries, there seems to exist dearth of knowledge on precision Agricultural techniques (PATs) and its adoption by farmers in Ebonyi State. Till date, no empirical studies have been undertaken to unravel the adoption and

utilization of PATs in the study area. This necessitated this study with the aim of addressing the following research questions: Are farmers' aware of available PATs? How do these farmers perceive usage of PATs? What information sources are available to the farmers about PATs? What are the constraints to awareness of precision agriculture in the study area?

OBJECTIVES OF THE STUDY

The broad objective of this study was to assess the awareness of precision agricultural technologies by crop farmers in Ebonyi State Nigeria. The specific objectives were to:

- i. ascertain farmers' awareness of precision agricultural techniques;
- ii. describe farmers' perception of PATs;
- iii. identify sources of information on PATs; and
- iv. identify constraints to awareness of PATs in the study area.

METHODOLOGY

This study was carried out in Ebonyi State, Nigeria which lies on latitude 6°31'N and longitude 8°15'E (Ezeh, Eze and Eze, 2021), with a population of 2,173,501 peoples (NPC, 2006). The mean temperature, range between 20°C and 28°C, while the topography and soil types of Ebonyi State are very favourable to agricultural activities. Thus, farming remains the major economic activities of the people of Ebonyi State, with rice being one of the major crops farmed in the State. The crops produced in this area mainly are Okra (*Abelmoschus esculentus*), yam (*Dioscorea* spp), Cassava (*Manihot esculenta*), Maize (*Zea mays*) and vegetables.

A four-stage sampling procedure involving both random and purposive sampling were used for the selection of respondents. Firstly, two (2) Local Government Areas (LGAs) were purposively selected from each of the three agricultural zones of the State to give a total of 6 LGAs. Secondly, random selection of two (2) autonomous communities from each of the six LGAs to make a total of 12 communities was made. Thirdly, there was random selection of two (2) villages from each of the 12 communities to make a total of 24 villages. Lastly, five crop farmers were randomly selected from each of the 24 villages to make a total of 120 respondents that was used for the study.

Primary data for this study were sourced using a well-structured questionnaire augmented with interview schedule and analyzed with descriptive and inferential statistics such as frequency count, mean scores, percentages and principal factor analysis respectively.

Model Specification

Mean Score analysis

$$\bar{X} = \sum X/N$$

Where:

$\bar{X}$ = mean score

$\sum$ = summation

X = likert value

N = number of respondents

Decision rule for the five-point likert scale;

5 = Very great extent, 4 = Great extent, 3 = fairly great extent, 2 = Low extent, 1 = Very low extent.

$$X = 5+4+3+2+1/5 = 15/5 = 3.0$$

This means that by using 3.0 as decision point, any item with mean score less than 3.0 was rejected whereas those with 3.0 and above were accepted.

Factor-analysis model

Mathematically, factor analysis is expressed in a linear equation as;

$$Y_i = \beta_{i0} + \beta_{i1}F_1 + \beta_{i2}F_2 + \beta_{i3}F_3 + \dots + \beta_{in}F_n + e_i$$

Where;

β_{i0} = parameters or loadings hence, $\beta_1 - \beta_n$ is the coefficient of loading of variables on F_1 to F_n .

F = the loading factor

ϵ_i = error term

Using Kaiser's criterion, factors with eigen value above 1 were isolated. Based on the rule of thumb as developed by **Kasier**, variable with a minimum loading of **0.4** can be separated and identified as being positive to the attribute in question and vice versa. The extracted factors were named based on underlying similarities reposed in the variables with highest loadings under each factor.

Measurement of Variables

A five-point Likert-type scale was used to evaluate farmers' awareness of Precision Agricultural Technologies in the study area.

Farmers' perception on PATs was measured using frequency counts and percentage values obtained from a list of 10 variables. The numbers of chosen points were calculated to obtain both the frequency and percentage values. Multiple responses were allowed.

Possible sources of information on PATS were listed, categorized into mass media and interpersonal sources and measured using frequency counts and percentages. The farmers were asked to select most important source (s) information on PATs. These were summed and calculated accordingly allowing multiple responses.

As a preliminary check on appropriateness of use of factor analysis for the study, the Kaiser-Meyer-Olkin measure of sampling adequacy of 0.613 reported is adjudged satisfactory being greater than 0.60 minimum required (International Business Machines (IBM) Knowledge Center, 2020), thus indicating that the sample size of the study was adequate to justify the use of factor analysis. Also, Bartlett' test of sphericity yielded chi-square of 423.210, which was significant at $p < 0.01$. Again, the significant chi-square test is necessary for conduct of factor analytical procedure. IBM-SPSS Statistics (version 23) was used for data analysis.

RESULTS AND DISCUSSION

Farmer's Awareness of Precision Agricultural Techniques in Ebonyi State

Table 1: Mean score rating of the respondents according to their awareness of precision agriculture in the area

Precision Agriculture	Weighted mean ($\bar{X}$)
Remote sensing	1.34
Crop yield monitors	2.69
Field/Soil testing	1.82
Variable rate of fertilizer application	3.75
Studying weed/pest population and control	3.58
GPS and mapping systems	1.25
Use of autonomous vehicles	2.19
Use of drones	1.21
Use of satellite imagery	1.14
Use of farm machineries/equipment	3.58

Source: Field Survey, January 2024. * $\bar{X} = 3.45$

Result of the analysis on the farmers' awareness of precision agriculture in the area as shown in Table 1 revealed that farmers were aware of precision agriculture in the area. Their responses were recorded using mean score. Result showed that their awareness increased positively for variable rate of fertilizer application, Studying weed/pest population and control, Use of farm machineries/equipment with mean scores of ($\bar{X} = 3.75$), ($\bar{X} = 3.58$), ($\bar{X} = 3.58$). This could be because the farmers were more aware of those precision technologies that conform to their usual practice and those which are not too expensive to afford. Other precision agricultural technologies such as use of autonomous vehicle ($\bar{X} = 2.19$), remote sensing ($\bar{X} = 1.34$), GPS and mapping ($\bar{X} = 1.25$), use of drone ($\bar{X} = 1.21$), crop yield monitors ($\bar{X} = 2.69$) and use of satellite imagery ($\bar{X} = 1.14$) were not too known to the farmers. This could be due to the fact that the farmers were not computer literate enough and most of them do not have ability to use smart phones.

Table 2: Distribution of the Respondents According to their Perception on Precision Agriculture

Precision Agricultural techniques (PAT)	Frequency	Percentage
Decreased field-average input application	87	72.5
Increase field-average yield	73	60.8
Increase farm return (profit)	75	62.5
Increase in farmers' well-being	47	39.2
Decrease negative environmental impacts of crop production	51	42.5
Efficient use of equipment	21	17.5
Risk reduction	27	22.5
Reduction in post-harvest losses	37	30.8
Time savings	41	34.2
Efficient uses of farm resources	33	27.5
Average response	49	40.8

Source: Field Survey, January, 2024. *= Multiple responses recorded

Farmer's perception refers to a subjective assessment of attributes and personal innovation. Among the perceived attributes suggested by Rogers (2003), perceived relative advantage is used to evaluate the perception of relative benefits of adopting new technologies and the gain that it brings to overcome other technologies. Farmer's perception was based on decreased field-average input application, increased farm return (profit), increased field average yield, decreased negative environmental impacts of crop production and increased farmer's well-being representing 72.5%, 62.5%, 60.8%, 42.5% and 39.2% respectively. Among other advantages, profitability was a major concern when considering increase in any capital intensity of agricultural technology, including PAT technologies. Realistically and perceptibly, farmers do not want to get losses in their investments. Therefore, the probability of PAT adoption will be higher if the results of this adoption can be seen. These assumptions are supported by the results of the work of Walton (2008) and Anselmi (2012). Other perceptions include; time saving (34.2%), reduction in post-harvest losses (30.8%), efficient use of farm resources (27.5%), risk reduction (22.5%) and efficient use of equipment (17.5%). The findings of this present study is in conformity with that of Yusuf et al (2020) who reported that farmers who perceived Pro-vitamin A cassava variety to be beneficial would be willing to cultivate it.

Table 3: Distribution of the Respondents according to Sources of Information on Precision Agricultural Techniques in the area

Sources of information	Frequency	Percentage
Mass media		
Radio	76	63.3
Television	69	57.5
Newspapers	27	22.5
News letter	11	9.2
Film show	9	7.5
Posters/handbills	32	26.7
Interpersonal channel		
Extension agents	71	59.2
Contact farmers	61	50.3
Opinion leaders	63	52.5
Friends/neighbours	55	45.8
Faith organization (Church)	43	35.8
Men/Women organization (Age grade)	34	28.3
Cooperative societies	46	38.3
Family members	13	10.8
Average response	44	36.7

Source: Field Survey, January 2024. *= Multiple responses recorded

Result identified two broad categories of information for precision agricultural technologies by the farmers namely; mass media and interpersonal channel. The interpersonal channels have higher relative usage by farmers than mass media. Table 5 gives the details of the various sources of information for precision agricultural technologies by the farmers. Extension agents (59.2%) constituted the most regularly used interpersonal channels followed by opinion leaders (52.5%) and then contact farmers (50.3%). Generally, majority (63.3%) of the respondents indicated use of radio in obtaining precision agricultural technologies information. Posters/handbills, Newspaper and film show have very low frequency of usage as 26.7%, 22.5%, % and 7.5% of the respondents had respectively indicated their non-use of all the sources of information for precision agricultural technologies dissemination. The low or non-usage of mass media could be due to low socioeconomic status of the farmers and lack of facilities such as electricity to operate them. The low or non-usage of print media such as newspapers, extension bulletins/ newsletters can be attributed to low literacy level of the rural farmers. These findings corroborated those of Iwueke, (2016) which revealed that television, extension publications (bulletins, newsletters, posters and hand bills) were not considered as important sources of agricultural information among the farmers in Nigeria while friends/neighbours/relations, extension agents and contact farmers were considered important in terms of availability and usage.

Constraints to Awareness of Precision Agriculture

Table 4: Varimax Rotated Principal Component factor analysis on the constraints to adoption of Precision Agriculture in the study area

Constraints	Socio-economic constraint	Financial constraint	Institutional constraint
Poor health status of rural farmers	0.100	0.132	0.246
Poor access to credit facility	0.268	0.096	0.587
Natural disaster such as flood or drought	-0.096	0.115	0.168
Untimely dissemination of technologies by extension institutions	0.251	-0.320	0.552
Poor understanding of Precision agricultural technologies by farmers	0.488	0.258	0.059
Distance to sources of precision agriculture	0.063	-0.029	0.276
Low income to access precision agriculture	0.100	0.383	0.537
Low level of education of rural farmers	0.691	0.172	0.242
Religious belief	0.052	-0.237	0.106
Poor income realized from farming	0.159	0.475	0.214
Lack of technical know-how to operate precision agricultural tools & equipment	0.783	0.352	0.275
Poor extension service delivery	0.248	0.176	0.448
Irregular use of technologies	0.580	0.330	0.260
No observable change in yield	0.007	0.379	0.040
Technologies incompatibility with indigenous practices	0.844	0.119	0.055
Climatic factors such as rain fall, temperature and solar radiation	0.048	0.214	0.192
Poor access to information about PAT	0.419	0.349	-0.051
Ageing farming population	0.291	0.196	0.177
Lack of youths' interest in agriculture	0.472	0.000	0.024
Poor access to farm insurance	0.069	0.175	0.092
Lack of political will to improve agriculture	-0.177	0.204	0.754
Land tenure system	-0.077	0.317	0.254
Poor access to weather/climate related information services	0.327	0.243	0.267
High cost of phones/computer device	0.390	0.429	0.379
Inability to use modern ICTs	0.581	0.040	0.135
Lack of farmers interest on precision agricultural technologies	0.477	0.241	0.248

Source: Field Survey, January 2024.

As presented in Table 5, principal component analysis (PCA) was used as a data reduction technique to achieve this result. From the analysis three components were extracted. The first component was named as socio-economic constraints. The second component was classified as economic constraints while the third component was named political constraints. All these three components extracted the items in which the loadings were greater than 0.4 and vice versa. Specifically, Technologies incompatibility with indigenous practices (0.844), Lack of technical know-how to operate precision agricultural tools & equipment (0.783) and low level of education of rural farmers (0.691) were the major factors that loaded under socio economic constraints; Poor income realized from farming (0.475) and High cost of phones/computer device (0.429) loaded high under economic constraints while Lack of political will to improve agriculture (0.754), Poor access to credit facility (0.587) and Untimely dissemination of technologies by extension institutions (0.552) were classified under political or institutional constraints. This implies that socio-economic, economic and political constraints limited farmers' awareness of precision agriculture in the study area. Technologies incompatibility with indigenous practices was a major socio-economic constraint to farmer's awareness of precision agricultural technology in the area. This could be because the farmers lack the knowledge of operating the device and as such could make them rather continue with their normal practices than adopting new ones. This is in tandem with the finding of Umeh (2009) who identified complexity of technology as a constraint to adoption of agro forestry recommendations among farmers in Ebonyi State Nigeria. Consequently, poor income realized from farming and high cost of phones/computer device was also a constraint. This is obvious as the farmers were still low-income earners who are constrained by lack of funds. These findings conform to Chukwu, Eze and Osuafor (2016) who identified funds as a major constraint to continuous adoption of technologies. They further contended that agricultural technologies that are at exorbitant prices are not easily adopted.

CONCLUSION

The study established that farmers in Ebonyi State are aware of precision agriculture and had positive perception about it; sourcing information from both mass media (radio and television) and interpersonal sources (extension agents and contact farmers). But their awareness was constrained by socio-economic, financial and institutional factors.

RECOMMENDATIONS

Based on the findings of this research, the following recommendations were made:

1. Extension organizations should restructure their extension delivery system to ensure timely dissemination of information on precision agricultural technologies to farmers in the area.
2. Credit facilities should also be made available to the farmers at all time as this is expected to improve or facilitate their adoption of precision agricultural technologies to fight food insecurity.
3. Increased and effective utilization of identified channels such as radio, television, extension contacts among others for continuous education of the people on the benefits of precision agriculture could enhance adoption.
4. Conscientious efforts should be made by both government and private sector to improve the socio-economic status of the farmers and enhance their awareness.
5. More advocacy on the benefits of PATs should be carried out to increase its awareness in the area.

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Theme: Agricultural Extension for Food Security and Community Empowerment

**Introduction of Cassava Peels as Alternative Feed Source to Maize in
Broiler Production to Farmers in Ohokobe Ndume Community of Abia
State, Nigeria**

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ABSTRACT

This study is on the introduction of cassava peels as alternative feed source to maize in broiler production to farmers in Ohokobe Ndume community, Abia State, Nigeria for broiler production. The specific objectives were to: ascertain the Cost Benefit of Boiler production, Compare the costs of Foreign Feed (Commercial Feed) and cost of Alternative Feed (Cassava Peels) in broiler production and that of commercial feed; and ascertain the effectiveness of group demonstration method in training farmers in the use of cassava peels for broiler feed formulation. Purposive sampling technique was used to select thirty (30) contact farmers and fifty (50) follower farmers for the project. Major findings in the study showed that the cost benefit analysis of producing 50 broilers with a total revenue of ₦500,000 less total Cost (₦281,540) gave a profit of ₦218,460 and the difference between the cost of feeding 50 birds with feed formulated with cassava peels as alternative feed source to maize and another set of 50 birds with foreign feed/commercial within the same period was ₦60, 760 per bag. Furthermore, the study found out that group demonstration method was effective in training poultry farmers as over 90% of the farmers gained more knowledge after the training on the use of cassava peels for feed formulation than before. The study concluded that cassava peels can serve as alternative feed source in broiler production for increased income and therefore, recommended that extension officers should create more awareness on the use of cassava peels as alternative source of broiler feed source as well as carry out constant training of the poultry farmers using group demonstration method for effective information dissemination.

Keywords: Cassava peels, alternative feed, broiler production

INTRODUCTION

Domestication of the chicken according to Phillip (2015) dates back to at least 2000 B.C. and their ancestry can be traced back to four species of wild jungle fowl from Southeast Asia. According to him, the chicken belongs to the genus *Gallus* of the family *Phasianidae*. Domestic chickens are simply classified as *Gallus domesticus*. These are some types of poultry farming: Chicken for eggs and meat, Turkey for meat only, Guinea fowl for eggs and meat, Geese for eggs, meat and down feathers, Quail for eggs and meat and Pigeon for meat mainly (Garrigus, 2024).

Poultry industry has a lot of challenges as feeding was identified as a global challenge to the poultry industries. The price of raw materials for feed production also influences poultry farming. Estimate feed production also influences poultry farming. Estimate feed stuff prices will be higher than the historical average between 2020 and 2019. Animals that are reared in poor welfare conditions are not able to express

their maximum genetic potentials. The animal feed sector is estimated at more than £2 billion continues to attract significant local and foreign investment in large-scale feed mill operation. The poultry feed industry (broiler) dominates the animal feed industry and in the gear zoo, accounted for approximately two third (Penz-Jr and Bruno, 2010).

Poultry feed are specially formulated diets given to livestock in the course of animal husbandry. According to Commodity Port Report (2020), Prices of poultry feed have increased across the country week after the Central Bank of Nigeria (CBN) stopped the issuance of forex for importation traders and farmers attributed to the hike in prices to the scarcity and sudden increase in the cost of grain. In almost all the Federation, survey showed that 25kg bag of poultry feed starter that sold for ₦3,500 before now has since risen to ₦6,000. The feed meant for older birds, called “finisher” now goes for ₦6,000 from the previous price of ₦3,500. (PTCIJ, 2010).

Poultry farming has grown in Nigeria in recent years, helping to increase food supply and generate employment. But harsh conditions have kept the cost of business high and profit margins low. Maize is a key ingredient used in production of poultry feed. On July 14th 2010, the Central Bank announced the ban of maize importation in an effort to boost production. Nigeria over 10years has imported some 2,700,000 tons of maize. In 2019, Nigeria produced about 11.4 million metric tons (USDAI, 2019).

In view of the foregoing, the poultry industry in Nigeria is greatly challenged with sourcing adequate feed stuff to meet feeds demand in the industry. Most farmers have resorted to several alternatives as the replacement for maize, for example, cassava peels as an alternative energy source. Cassava peels have a low protein content < 6% dry matter (DM) and a high and variable fibre content (crude fibre in the 10-30% DM range). Cassava tuberous roots are composed of a peel which contain about 10-20% of the tuberous roots. A study on nutritional status of cassava peels was 5.3% cellulose and hemicellulose contents were 5.4% and 21-65% respectively.

A case study conducted by Etchu, Tapong, Adamukong and Enokewa (2015), cassava peels was used to replace maize and the result showed that digestibility of nutrients showed no particular pattern and was negative in the case of ash and crude fibre (CF). Cost of 50kg feed, feed consumed per bird, final weight and weight gain per bird decreased with increase in level of substitution. They therefore concluded that cassava peels can replace maize up to 100% in ratio for broilers without any adverse effect with increase in economic benefits.

However, according to Aderemi et al (2017), for a good weight gain and live weight, partial substitution is preferred among poultry farmers in rural communities (such was in the study area). In terms of availability of cassava peels, it is readily available because almost every household produces cassava. It is not costly and one can equally get them free from cassava processing centers or families/neighbours.

According to Pertiwi *et al* (2019), cassava peels have a high potential as a feed source to cut production cost, therefore the farmer income increases slightly. The ingredients used in compounding the cassava-based feed of 100kg (4 bags of feed of 25kg each) included:

Cassava Peels (68.91kg), Groundnut Cake (10.40kg), Palm Kernel Meal (7.00kg), Fish Meal (9.60kg), Bone Meal (0.50kg), Palm Oil (2.59kg), Salt (0.40kg), Vitamin Premix A (0.50kg), Vitamin Premix B (0.05kg), Methionine 0.05kg.

STATEMENT OF PROBLEM

Nigeria is known as one of the largest producers of cassava tubers in the world and cassava is very rich in carbohydrate and other food elements (FAO, 2019). However, emphasis have been on the production of tubers for export and processing same for garri, fufu, tapioca, etc for consumption and marketing. There are few research results showing the usefulness of cassava peels as alternative source (replace maize) in poultry production unlike that of livestock feeding where much work has been done.

Similarly, poultry business is a lucrative one in Nigeria but farmers most times are unable to break-even due to high cost of production. This invariably increases the price of birds and putting many out of the poultry business.

However, farmers lack the knowledge and the skill to formulate their own feed thereby making it very difficult for the poultry farmers to break-even in the business.

This study therefore sought for alternative means of replacing the major feed formulation ingredient which is maize in order to reduce the cost of production to enable farmers maximize profit, hence, carrying out this work that is introducing cassava peels as alternative feed source in broiler production in Ohokobe Ndume community of Abia State, Nigeria.

OBJECTIVES

The specific objectives were to:

- i. ascertain the Cost Benefit of Boiler production
- ii. Compare the costs of Foreign Feed / Commercial Feed and cost of Alternative Feed (Cassava Peels) in broiler production; and
- iii. ascertain the effectiveness of group demonstration method in training farmers on the formulation of poultry feed using cassava peels as an alternative feed source.

JUSTIFICATION OF THE STUDY

The results from this work will reduce the cost of feeding the birds and maximize profit thereafter. It will also provide quality feed to the farmers and thereby reduce the incidence of spreading of diseases and also help to attain maturity faster for sales.

This study will also provide knowledge on how to convert waste (cassava peel) as an alternative feed source for feeding broilers. This will in turn add value to cassava production and increase cassava production in the study area.

It will boost broiler production in terms of value addition benefit since cassava peels which are regarded as waste both to the cassava farmers and Cassava Processing Centres was converted into meaningful produce (poultry feed for broiler production) to reduce cost of production and increase income.

Finally, poultry farmers on how to have access to market by linking them up to off-takers to distribute their formulated feed and birds in order to make more profit.

METHODOLOGY

This study is on the Introduction of cassava peels as alternative feed source to maize in broiler production to farmers in Ohokobe Ndume community, Abia State, Nigeria for broiler production.

Ohokobe Ndume is one of the villages in Mbaocha Autonomous Community of Umuahia North Local Government of Abia State, Nigeria.

Purposive sampling technique was used to select thirty (30) contact farmers and fifty (50) follower farmers based on the willingness of the poultry farmers to volunteer their own budgets and make available their resources for the project.

This was after training was conducted at Ohokobe Town Hall for one day through Group Demonstration Method. Poultry farmers were availed all the ingredients that were used in formulating broiler feed (starter).

Table 1: Research Design

Objective	Specific Data Required	Source Of Data	Method Of Data Collection	Method Of Data Analysis
Ascertain the Cost Benefit of Boiler production	Cost of various feed ingredients used in feed formulation including cassava peels	30 poultry farmers Female =20 Male =10	Interview Questionnaire Group discussion	Descriptive statistics
Compare the costs of Foreign Feed / Commercial Feed and cost of Alternative Feed (Cassava Peels) in broiler production	Availability of feed ingredients Cost Nutritional value	30 poultry farmers Female =20 Male =10	Interview Questionnaire Group discussion	Descriptive statistics
Ascertain effectiveness of group demonstration method in training farmers on the feed formulation of	Harvesting of cassava, peeling of	50 poultry farmers Female =30 Male =20	Interview Questionnaire	Descriptive statistics

poultry feed using cassava peels as alternative feed cassava, drying of cassava peels

RESULTS AND DISCUSSION

Cost Benefit Analysis in Boiler production

Entries in Table 1 on the cost benefit analysis of broiler production, showed that, the total cost of raising 50 birds for 8 weeks was N281,540 and selling the broilers at 8 weeks (1.8kg life weight) at the rate of ₦10,000 each, with no mortality recorded, brought the total revenue to ₦500,000. Then less cost of birds, cost of medications, cost of feeding, cost of labour and other contingencies, the profit became ₦218,460 (*Two hundred and eighteen thousand, four hundred and sixty naira only*). It should be noted that poultry business is a viable and profit-oriented business, especially when cassava peels serve as alternative feed source in broiler production.

Table 2: Cost Benefit Analysis in Boiler production

S/N	ITEMS	QUANTITY	UNIT COST (₦)	TOTAL (₦)
A	FIXED COST			
1.	Construction of poultry house	Nil	Nil	Nil
2.	Equipment/Materials			
	Weighing scale	1	45,000	45,000
	Feeding Trays	4	2100x 4	8,400
	Drinkers for day old chicks	4	1100 x 4	4,400
	Drinkers for grower birds	2	1000 x 2	2,000
	Feeders for grower birds	2	3000 x 2	6,000
	Total			65,800
B	VARIABLE COST			
2.	Cost of stocking broiler	1 carton (50pcs)	950 x 50	47,500
3.	Medication: assume administered by the seller.	%	Nil	Nil
	Vaccine			
	Gumboro I	ii dose 100	1800 + 2	3,200
	Lasota I	ii dose 100	1800 + 2	3,200
	Cornflox	1 sachet	1400	1,400
	Stressroak (Antistress)	1 sachet	4500	4,500
	Vitamin drug	1 sachet	700 x 1	700
	Tetracycline	1 sachet	700 x 1	700
	Coccidiostat	1 sachet	800 x 1	800
	Wormazin	1 sachet	700 x 1	700
4.	Feed ingredients			
	Cassava peels	68.91kg	3,000	3,000
	Groundnut cake	10.40kg	3.640	3,640
	Palm kernel cake	7.00kg	950	950
	Fish meal	9.60kg	3,000	3,000
	Bone meal	0.50kg	500	500
	Palm oil	2.59kg	500	500
	Salt	0.40kg	150	150
	Vitamin premix A	0.50kg	500	500
	Vitamin premix B	0.05kg	500	500
	Methionine	0.05kg	300	300
	Total			75,740
5.	Labour	56 days (8 wks)	2500	140,000
C	REVENUE			
	Sale of Birds	50	10,000	500,000
Total Revenue (C) - Total Cost (A + B) ₦500,000 - ₦281,540.000 = ₦218,460.00				
Two hundred and eighteen thousand, four hundred and sixty naira only				

Source: Field Survey, 2024

Comparing the costs of Foreign Feed / Commercial Feed and the cost of Alternative Feed – Cassava Peels in broiler production

Furthermore, Tables 3a and 3b showed that the cost of producing fifty (50) broilers for four (4) weeks through local feed formulation (cassava peels as alternative feed source) was reduced from ₦76,800 (which is ₦19,200 per bag) using commercial feed to ₦13,040 (which is ₦3,250 per bag). The study, found out that the difference between the cost of feeding 50 birds with feed formulated with cassava peels as alternative feed source to maize and another set of 50 birds with foreign feed/commercial within the same period was ₦60,760 per bag. This therefore indicated that value can be added to cassava peels which hitherto are regarded as waste both to the cassava farmers and the Cassava Processing Centers by converting them into meaningful produce (poultry feed for broiler production) which then reduced cost of production and the farmers' increased income.

Table 3a: Cost of Feed (Foreign Feed / Commercial Feed)

Feeds	Kg	₦
Ultima Super Starter	25	19,200
4 bags of the Ultima Super Starter =	25kg x 4 = 100kg	
Amount per bag =	19,200 x 4	
Cost of 4 bags =	76,800	

Source: Field Survey, 2024

Table 3b: Cost of Feed (Alternative Feed – Cassava Peels)

Feed Ingredients	Kg	₦
Cassava cake	68.91	3,000
Groundnut cake	10.40	3,640
Palm kernel meal	7.00	950
Fish meal	9.60	3,000
Bone meal	0.50	500
Palm oil	2.59	500
Salt	0.40	150
Vitamin premix A	0.50	500
Vitamin premix B	0.05	500
Methionine	0.05	300
TOTAL	100 (÷ by 4 bags = 25kg)	13,040
Amount per bag (25kg) =	3,250;	
Cost of 4 bags =	13,040	

Source: Field Survey, 2024

Effectiveness of group demonstration method in training farmers on the formulation of poultry feed using cassava peels as an alternative feed source

Entries in Table 4 showed the Contact farmers knowledge of work norms on how to formulate the broiler feed using cassava peels in place of maize before and after the training. After the training, the following percentages were recorded against each component of the training: identification of feed ingredients (95.00%), collection of materials for feed formulation (82.50%), processing of materials/feed Ingredients (75.00%), weighing of the appropriate ration in feed formulation (76.25%) and bagging of feed (13.75%). This showed that majority of the Contact farmers gained more knowledge in each component of the training after the training than before the training indicating that group demonstration method is very effective in training farmers on the formulation of poultry feed using cassava peels as an alternative feed source to minimize cost of production and maximize output.

Table 4: Distribution of Farmers showing their knowledge of work norms Before and After Group Demonstration
n=80 (30 Contact farmers and 50 Follower farmers)

Variables	Knowledge of work norms Before				Knowledge of work norms After			
	Yes	%	No	%	Yes	%	No	%
Identification of feed ingredients	20	25.00	60	75.00	76	95.00	4	5.00
Collection of materials for feed formulation	19	23.75	61	76.25	66	82.50	14	17.50
Processing of materials /Feed ingredients	16	20.00	64	80.00	60	75.00	20	25.00
Weighing of the appropriate ration in feed formation	13	16.25	67	83.75	61	76.25	19	23.75
Bagging of feed	43	53.75	37	46.25	69	86.25	11	13.75

Source: Field Survey, 2024

CONCLUSION

The study found out that there was a significant reduction in the cost of production through the use of cassava peels as alternative feed source to broiler production and therefore, affirmed that cassava peels can serve as alternative feed source in broiler production in Ohokobe Ndume community of Abia State, Nigeria. Finally, the study found out that Group Demonstration Method was effective in training farmers on the formulation of poultry feed using cassava peels as an alternative feed source to minimize cost of production and maximize output

RECOMMENDATIONS

1. Based on the findings of the study, the following recommendations were made:
2. Extension agents should disseminate this technology on the use of cassava peels as alternative feed source in broiler production to poultry farmers to assist them reduce production cost and maximize profits thereafter.
3. There should be further studies by those in the engineering sector to fabricate machines that will mill the cassava peels for the formulation of feed for various ages of broilers.
4. More farmers should be availed the knowledge of all the feed ingredients, the required ration from each feed ingredient from starter feed to finisher feed and how to process it in order to break-even. This will help boost poultry production in Nigeria.
5. Finally, there is need for continuous training of the poultry farmers through group demonstration method to update their knowledge on how best to carry out the feed formulation for cost reduction and increased income.

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4th Biennial Conference, 2025

12 – 14 Aug. @ Michael Okpara University of Agriculture, Umudike, Abia State

Theme: Agricultural Extension for Food Security and Community Empowerment

**Urban Households' Perception towards Sack Farming Activities in
Umuahia North Local Government Area, Abia State, Nigeria**

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ABSTRACT

*This study assessed urban households' perception on sack farming in Umuahia North Local Government Area of Abia State, Nigeria. Specifically, it, identified sources of information on sack farming; identified the types of crops grown in sacks and assessed households' perception about sack farming; A Multistage random sampling procedure was used to select sixty (60) urban households. Data for the study were collected through a structured questionnaire and analyzed using descriptive statistics (frequency counts, mean scores and percentage). The results indicate that majority of the respondent's sourced information on sack farming from personal observation (96.66%) and fellow farmers (90.00%). Majority (86.66%) of the respondents grew yam, 80.00% grew *Amaranthus* spp, and *Telferia* spp (78.33%) in sack bags. Result also showed that they grew fluted pumpkin (68.33%), okra (66.66%), tomatoes (60.00%) and melon (56.66%) on sack bags. The urban households had favourable perception ($\bar{x}=3.0$) of sack farming practices. The study therefore recommended need to strengthen agricultural extension and training programmes to create awareness on sack farming practices in the study area.*

Key words: Assessment, urban households, perception, sack farming

INTRODUCTION

Sack farming as a method of growing crops in soil-filled sacks or polythene bags, containers or plastics. It involves filling of bags with soil, manure, and pebbles for drainage, and growing plants on the top and in holes in the sides (Agbaji, 2024). Tosheva and Delijska (2013) affirmed that sack farming as a system of farming whereby sacks that were formally used for storing food is now used for farming by filling it up with compost. Urban dwellers who live in own building or rented houses are best placed to undertake sack farming. They can grow vegetables in sacks on verandahs, either for their own consumption or for sale to earn extra income. The engagement of sack farming practices would help increase food security of households as people can grow crops in their domain with little containers filled with soil, there will be abundant of food in the country (Yusuf 2020) As urbanization continues to expand in Nigeria, traditional farming methods are becoming increasingly challenging due to limited space and resources. However, a growing trend known as sack farming is emerging as a viable solution to urban agriculture. Individuals can embark on on the innovative method, contributing to food security, sustainability and income generation with urban environments (Noba Africa, (2024).

The Urban Agriculture Network UAN (2019) has defined urban agriculture as an industry that produce, processes, and market food, fuel, and other outputs, largely in response to the daily demand of consumers within a town, city, or metropolis. There are many privately and publicly held farming enterprise found throughout intra-urban and semi-urban areas. Urban agriculture, urban farming, or urban gardening is the

practice of cultivating, processing, and distributing food in or around urban and semi-urban areas (United States Department of Agriculture USDA, 2022). Lin (2015) asserted that urban agriculture can reflect varying levels of economic and social development. It may be a social movement for sustainable communities. McAleese (2017) pointed that food security, nutrition, and income generation are key motivations for the practice of urban farming. In both scenarios, more direct access to fresh vegetables, fruits, and meat products through urban agriculture can improve food security and food safety.

These farms produce various food crops and animals which are supplied to consumers within the urban area instead of relying on food supply from rural areas. Typically, urban agriculture applies intensive production methods, frequently using and reusing natural resources and urban wastes, to yield a diverse array of land-, water-, and air-based fauna and flora contributing to food security, health, livelihood, and environment of the individual, household, and community (UAN, 2019). The need for sack farming is increasing due to increase in rural urban migration, forcing population in the rural areas where more food is produced to urban area. More so, the problem of logistical delays leading to spoilage of perishable agricultural products such as tomatoes has made urban farming a reliable alternative to relying on food transportation from rural producers

Based on the perception that sack farming techniques is not cost effective, this has reduced the number of urban households who intend to engage in the practices to make crops readily available for home consumption and as a small-scale business (Izuka, 2024). However, urban households still believe that sack farming technique is still better imagined to the thoughts of some urban farmers while many others consider it not enough to provide suitable condition required for their tomato production. Despite the numerous practices of urban households in sack farming, their perception towards the practice is yet to be ascertained, hence the need for this study

OBJECTIVES OF THE STUDY

The broad objective of this study was to assess rural households' perception towards sack farming in Umuahia North Local Government Area of Abia State, Nigeria. The specific objectives were to:

- i. identify sources of information on sack farming;
- ii. identify the types of crops grown in sacks; and
- iii. assess households' perception towards sack farming;

METHODOLOGY

The study was conducted in Umuahia North Local Government Areas. Umuahia North is a Local Government Area of Abia State, Nigeria. Its headquarters are in the city of Umuahia. The Local Government Area is made up of Umuahia- Ibeku, Umukabia, Umuawa Alaocha, Umuagu, Umuda Isngwu and Ohuhu. The villages in Umuahia North Local Government: Umuahia, Umukabia, Umuawa Alaocha, Amaogwugwu, Umuagu, Umuekwule, Ofeme, Amafo Isingwu, Umuda Isingwu, Umuoriehi, Isingwu Okpuala Amafo Ihungwu, Umuokoro Umuoka Umuda Okorocho and Nkwoegwu. The urban areas of the Local Government Area are; Afaraukwu, Amuzukwu, Ndume, Isieke, Ugba, Nkata, Ossah, Isingwu and Umuagu (Abia State Sub-Division, 2024; Chinedu, 2014)). According to the Federal Republic of Nigeria, the projected population growth of Abia State at 2.6% from 2006 population figure is 10,3157 people (National Population Commission (NPC), 2020). The Local Government Area lies between Latitude 5°31' 29.68'' N of the Equator and Longitude 7° 29' 40.60''E of the Greenwich Meridian. The temperature typically varies from 18.9°C to 30.5°C and is rarely before 15°C above 32.2°C. The climate is classified as tropical. During most months of the year, there is significant rainfall and typically receives about 273,49 mm of precipitation and has 263.53 rainy days (72.2 percent of the time) annually, with Relative Humidity of 75.46 percent. Umuahia is renowned for being a railway and agricultural market center, which attracts traders and farmers from neighbouring towns to sell their farm produce. Most of the people in Umuahia North Local Government Area are especially the rural dwellers are engaged mainly in subsistence farming. The major farm crops grown include yam, cassava, cocoyam, rice, maize, plantain, okro and melon (Umuahia North Local Government Area, 2024).

Sampling procedure and Sample Size

Purposively six (6) communities were selected out of the nine (9) urban communities that make up the Local Government Area of the State. Simple random sampling procedure were employed in the selection of ten (10) households to give a total of sixty (60) urban households that were used for the study. Objectives i and ii were realized using descriptive statistics such as; frequency counts, mean scores and percentages, while objective iii was achieved with 4-point Likert rating scale

Perception of respondents on sack farming practices

This objective was measured and rated on a 4-point Likert rating scale of; Strongly Agree=4, Agree= 4, Disagree= 2, Strongly Disagree = 1. Based on the twelve (12) perception item statements, respondents mean scores were computed for each perception statement by adding the weights of $4+3+2+1 = 10/4=2.5$. Mean score greater than or equals 2.5 implied favourable and below, unfavourable perceptions of the sack farming practice.

RESULTS AND DISCUSSION

Sources of Information on Sack Farming

The result in Table 1 indicates that majority of the respondent's sourced information on sack farming from personal observation (96.66%) and fellow farmers (90.00%). However, they affirmed that they also sourced from ADP/Ministry of Agriculture and printed materials (45.00%) each, agricultural workshops (41.66%), television programmes (40.00%), research institutes (38.33%), radio and training programmes (31.66%) each as against extension agents (28.33%). The result suggest that respondents sourced information on sack farming from personal observation and fellow farmers. Nwaobiala *et al.*, (2022b) noted that farmers' sources of information on any technology facilitate its participation and adoption by users of the innovation.

Table 1: Distribution respondent according to Sources of information about sack farming

Source of Information	Frequency (n=60)	Percentage *
Research Institutes	23	38.33
ADP/ministry of Agriculture	27	45.00
Agricultural workshops	25	41.66
Extension Agent Visits	17	28.33
Radio programme	19	31.66
Television Programme	23	40.00
Fellow farmers	54	90.00
Printed materials	27	45.00
Training programmes	19	31.66
Personal observations	51	96.66

Source: Field Survey, 2025

*Multiple Responses Recorded

Crops Mostly Grown in Sack Bags by Urban Households

The distribution of respondents according to crops mostly grown in sack bags by urban households is shown in Table 2. The result Table 2 revealed that majority (86.66%) of the respondents grew yam, 80.00% grew *Amaranthus spp*, and *Telferia spp* (78.33%) in sack bags. Also, they grew fluted pumpkin (68.33%), okra (66.66%), tomatoes (60.00%) and melon (56.66%) on sack bags. However, they grew medicinal plants (40.00%), cucumber (38.33%), sweet potatoes (35.00%) and water melon (23.33%). The result suggests that the major crops grown in sack bags may be attributed to their yield performance. Iziuka *et al.*, (2024) in their study found that yam and other vegetable crops were the crop mostly grown by urban households in Abia State, Nigeria.

Table 2: Distribution respondents according to crops mostly grown in sack bags by urban households in the study area

Crops	Frequency	Percentage*

Yam	52	86.66
Sweet potatoes	21	35.00
Okra	40	66.66
Telferia spp	47	78.33
Amaranthus spp	48	80.00
fluted pumpkin	41	68.33
Tomatoes	36	60.00
Medicinal plants	24	40.00
Cucumber	34	38.33
Water melon	14	23.33
Melon (Egusi)	34	56.66

Source: Field Survey, 2024 *Multiple Responses Recorded

Urban Households' Perception about Sack Farming Practices

The result Table 3 shows that the respondents perceived that sack farming practices are environmentally friendly ($\bar{x}=3.8$), requires limited land spaces ($\bar{x}=3.4$), combat food insecurity in households, control and regulate soil nutrients with mean ratings of 3.3 respectively, to be a part-time business/hobby, has increased my yield and income and is very convenient to practice with mean scores of 3.2 each, perceived to be a part-time business/hobby ($\bar{x}=3.2$), practices are crop selective, help control diseases and pest infestation on crops with mean scores of 3.1 each and Sack farming practices are suitable for every location ($\bar{x}=3.0$). The respondents also perceived that sack farming practices are labour intensive ($\bar{x}=2.6$) and are costly to practice ($\bar{x}=2.4$).

The grand mean perception score of 3.0 indicate that respondents had favourable perception of sack farming practices in the study area. Sack farming as an initiative that has given a new vista to those who preferred to toe the line of farming, either to get quick cash or for subsistence purpose. Sack farming in urban areas has proved to be a reliable means of ensuring sufficient and sustainable production of vegetables, this is because of the benefits that follow sack farming such as water retention, weed control among others. Vegetable sack farming is purely organic, and this is to ensure adequate supply of required nutrient to the crop within the sack environment (Mbazu, 2021). This result corroborates with the findings of Nwaobiala *et al.*, (2022a) as they found that the farmers' perception of crop technology attributes influences its engagement and adoption. Also, Noba Africa (2024) noted that sack farming is a cost-effective solution to urban agriculture which contributes to household food security.

Table 3: Distribution of respondents according to their perception about sack farming practices

Perception about sack farming practices	SA	A	DA	SD	Total	Mean	Decision
Sack farming practices are is environmentally friendly	45(180)	15(45)	0(0)	0(0)	225	3.8	Favourable
Sack farming practices are labour intensive	13(60)	15(45)	24(48)	5(5)	158	2.6	Favourable
Sack farming are costly to practice	12(48)	10(30)	29(58)	9(9)	145	2.4	Unfavourable
Sack farming practices are crop selective	23(92)	25(75)	10(20)	2(2)	189	3.1	Favourable
Sack farming practices are suitable for every location	17(68)	32(96)	8(16)	3(3)	183	3.0	Favourable
Sack farming is perceived to combat food insecurity in households	31(124)	20(60)	3(6)	6(6)	196	3.3	Favourable
Sack farming is perceived to be a part-time business/hobby	24(96)	27(81)	8(16)	1(1)	194	3.2	Favourable
Sack farming practices has increased my yield and income	25(100)	23(69)	11(22)	1(1)	192	3.2	Favourable
Sack farming practices requires limited land spaces	32(128)	19(57)	9(18)	0(0)	203	3.4	Favourable
Sack farming practices control and regulate soil nutrients	22(88)	24(72)	9(18)	5(5)	183	3.3	Favourable
Sack farming is very convenient to practice	26(104)	25(75)	4(8)	5(5)	192	3.2	Favourable

Sack farming practices help control diseases and pest infestation on crops	23(94)	27(81)	2(4)	7(7)	186	3.1	Favourable
Total Mean ($\bar{x}$)						36.4	
Grand Mean ($\bar{x}$)						3.0	Favourable

Source: Field Survey, 2025

Key: Strongly Agree=SA, Agree=A, Disagree=DA, Strongly Disagree=SD

CONCLUSION AND RECOMMENDATIONS

The result has shown that urban households sourced information on sack farming from personal observations and fellow farmers. Majority of them grew yam, 80.00% grew *Amaranthus spp* and *Telferia spp*, fluted pumpkin, okra, tomatoes and melon on sack bags. The study concluded that urban households had favourable perception of sack farming practices. The study therefore recommended need to strengthen agricultural extension and training programmes to more create awareness on sack farming systems in the study area.

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4th Biennial Conference, 2025

12 – 14 Aug. @ Michael Okpara University of Agriculture, Umudike, Abia State

Theme: Agricultural Extension for Food Security and Community Empowerment

**Adoption of improved Production Practices Among Rice
Farmers in North-western Zone of Nigeria**

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ABSTRACT

This study examined the adoption of improved rice production practices by farmers in Northwestern Nigeria. Data were collected from 609 farmers purposively selected from 16 Local Government Areas in Kebbi, Sokoto, Kaduna and Jigawa States using structured interview schedule and Focused Group Discussions. The data were analyzed using descriptive and inferential statistics. The socioeconomic characteristics of respondents showed that majority 40.2% are youth below 40 years, 58.3% are educated and 53% have farming experience above 10 years. Findings from the study showed that 95.25% of the respondents were aware of improved varieties (95%), while planting techniques were adopted by 94.25% of the farmers. Focused Group Discussion showed that, farmers prepared to grow indigenous variety (Danboto) because it is high yielding. Majority (31%) of the farmers are in the moderate adopter category. High cost of fertilizer recommendations (43.28%), low availability of improved seeds (22.89%) and lack of improved storage facilities (16.92%) are the major constrain affecting the adoption of improved production practices. This study concludes that majority of the farmers were moderate adopters. Hence, the study recommended improved farmers' access and use of agricultural inputs especially, fertilizer recommendations and to explore inherent characters of indigenous varieties by breeders to develop ecology specific, high yielding and climate smart rice varieties.

Keywords: Adoption, Production Practices, Rice farmers

INTRODUCTION

A sectoral analysis of Nigeria's Gross Domestic Product (GDP) according to Food and Agriculture Organization (FAOSTAT, 2020) revealed that agricultural sector accounted for 22.35% of the Gross Domestic Product (GDP) with over 70% of the over 210 million people in Nigeria engaging in agriculture mainly at subsistence level. According to FAO (2020) report, land area under rice cultivation grew from 3.1 million hectares in 2015 to 5.9 million hectares in 2018 then slide down to 5.3 million hectares in 2020. Rice is a critical staple food in Nigeria with an estimated monthly per capita consumption of about 46.3 kg making Nigeria the highest consumer in West Africa Nigeria also account for 20% of Africa's consumption in 2020 (PWC, 2018). The three main rice production systems in Nigeria include rain-fed lowland, rain-fed upland and irrigated lowland that is increasingly being cultivated (Onyeneké, 2015). Daramola (2020) reported that rain-fed lowland ecological systems contributed about 47% of total rice production while irrigation systems accounted for about 16% and rain-fed upland systems, 30%. However, combined output from these rice production systems cannot meet the annual rice demand of over 7 million tonnes in 2020. (Daramola, 2020)

Given the importance of rice, the Nigerian government has accorded high priority to rice production leading to a peak record production of 5.04 million tonnes in 2020 (USDA, 2022). However, production still falls short of the desired quantity due to low yield of just 2 tonnes per hectare as against 4-5 tonnes Asian average. Also, population explosion and influx of people to urban areas really calls for concerted efforts to improve rice production given the foremost position occupied by rice in the Nigerian diet by using best general agronomic practices.

Wollburg *et. al.* (2024) also reported continued decline in farm productivity in most sub-Saharan Africa farms mainly due to non-optimal use of improved agricultural practices and technologies.

The effect of adopting new innovative farming techniques can be evaluated from its pro-pooriness; that is the extent to which low-income, small-scale farmers benefit from the practices more than the non-poor (Wossen *et. al.*, 2022) This, along with several studies were carried out on adoption of new innovations on farm practices, which is dependent on careful assessment of socio-economic, technical and institutional factors as indicated by Ayim *et al.* (2022).

However, according to some studies, only few rice farmers use improved production practices with seeds obtained from past harvests. Abdoulaye, (2023) and most other adoption behaviour studies examined adoption of a single component of the technology package instead of the whole package. It must be mentioned that farmers mostly adopted components of the package sequentially as indicated by Abdoulaye, (2023). The development, dissemination and acceptance of these new practices or innovations could hold the key to the achievement of self-sufficiency in rice production in Nigeria leading to the desired food security and improvement in the standard of living of the population. In this regard, it is therefore, pertinent to analyze the adoption pattern of improved production practices observed in the main rice production system among rice farmers in North-western Nigeria. Specific objectives of this study were to describe some of the socioeconomic characteristics of the rice farmers in the study area, examine status and adoption levels of the improved production practices while establishing constraints observed in the use of the improved production practices.

METHODOLOGY

Description of the Study Area

The study was conducted in the North-western Nigeria, which comprises Sokoto, Kebbi, Zamfara, Katsina, Kaduna, Kano and Jigawa States. The zone is located between latitude $9^{\circ} 10'N$ and $13^{\circ}50'N$ and longitude $3^{\circ}35'E$ and $9^{\circ}00'E$. The area has a combined projected population of 49,942,306 from a projected growth rate of 2.9% - 3.3% per annum (UNFPA, 2015). The area is about 217,000 square kilometres representing almost a quarter of Nigeria's land area. The study area. has international boundaries with Niger Republic to the North and on the southwest, with Benin Republic. The elevation of the study area is between 250 and 350 metres above sea level. The river system represents the principal drainage network in this region.

The vegetation of States in the Northwest region of Nigeria ranges from the dry Sahel surrounded by sandy savannah and isolated hills to Guinea and Sahel Savannahs (StopLearn, 2023). The area is a region marked by distinct weather conditions- the wet and dry seasons. Within the zone, there is considerable variation in rainfall distribution with mean annual rainfall ranging from 450 mm at Kurdula in Sokoto State in the extreme northwest, to 1,150 mm in Kafanchan, Southern Kaduna State. The rainy season, which usually starts from March or April of each year, lasts till September or early October. Between November and March is the dry Harmattan period, which is completely without rain, but dust-laden and cold winds that blow in from the northwest. The departure of Harmattan and the onset of rainfall are usually marked by a hot sunny season, having a temperature range of 37-40 °C with the highest temperature in April (Scribd, 2025).

Over 80% of the inhabitants of the study area are practicing one form of animal and or crop farming or the other. They produce crops such as millet, guinea corn, maize, rice, potatoes, cassava, groundnuts and beans at a subsistence level; wheat, sesame, sugarcane, cotton and assorted crops and vegetables for cash (StopLearn, 2023). Local crafts such as blacksmithing, weaving, dyeing, carving and leather works also play an important role in the economic life of the people. The area is also one of the fish producing areas of the country. Thus, a large number of people along the river basin engage in fishing as well. The area is

a potential base of raw materials for agro-allied industries. These include cotton, groundnut, sorghum, gum Arabic, maize, wheat, sugar cane, cassava and tobacco.

Sampling Procedure and Data Collection

The study used a multi-stage stratified sampling framework. Four levels of stratification were employed, which included the State, the Local Government Area, the village and the household levels. Due to logistic and budgetary limitations, the study was limited to four States. The 4 States selected representing about 60% of the total States in the study area were Kebbi, Sokoto, Kaduna and Jigawa States which was done on the basis of the share of each State in national rice cropped area. Also, four Local Government Areas were selected from each of the State with three villages randomly selected from each Local Government Area giving a sum of forty-eight villages from the study area.

A total of 20,304 rice farmers were obtained from the Rice Farmers Association of Nigeria (RIFAN) in the four States that constituted the study area from which 3% of the rice farmers were randomly selected for enumeration from the 48 villages selected for the study. This gave a total of 609 farmers who form the sample size for this study. The sampling frame used has some important implications for the interpretation of the results. It has to be reiterated that the results are from a survey of current rice farmers, which purposefully omitted farmers that have never cultivated rice and also those farmers that may have stopped producing rice. Furthermore, the stratified sampling used also implied selection of areas where rice production is relatively established and widespread.

Table 1: Study Population and Sample Size Selection

STATES	LGAs	Selected Villages	Population Frame	Selected (3%)	Farmers
KEBBI	Argungu	Tungar Zazzagawa	321	10	
		Sauwa	349	10	
		Gulma	581	17	
	Bunza	Zogirma	323	10	
		Mai da hini	298	9	
		Tungardannupe	356	11	
	Augie	Augie	672	20	
		Yola	401	12	
		Bagaye	283	8	
	Suru	Dakin-gari	502	15	
		Zagga	342	10	
		KukanaYelwa	466	14	
SOKOTO	Wurno	Huchi	292	8	
		Lukwa	298	8	
		Yar'wurno	533	16	
	Goronyo	Taloka	272	8	
		Goronyo	723	22	
		FuraGarke	356	11	
	Tambuwal	Tambuwal	455	14	
		Romo	362	11	
		Dogon-daji	462	14	
	Rabah	Gandi	391	12	
		Rabah	558	17	
		Mai-kujera	366	11	
KADUNA	Kudan	KauranWali	384	12	
		Hunkuyi	524	16	
		Kudan	477	14	
	Kajuru	Kajuru	643	19	
		Buda	298	9	
		Kallah	336	10	
	Kauru	Kauru	592	18	

JIGAWA	Lere	Dan-Daura	466	14
		Kwasan	388	12
		Saminaka	877	26
		Dan-Alhaji	455	14
	Gwaram	Lere	611	18
		Zandam	340	10
		Maruta	333	10
		Jikas	377	11
	Kazaure	Gada	299	8
		Jekarabe	352	11
		Daba	326	10
	Kafinhaus	Kafinhaus	462	14
		Mezan	403	12
		Sabon-gida	298	8
	Miga	Miga	469	14
		Kwaki	333	10
Tanni		299	8	
4 STATES	16 LGAs	48 VILLAGES	20,304	609

Source: Rice farmers Association of Nigeria, 2019

Data Collection Methods

Primary data and secondary information were collected to answer the research questions and achieve the objectives of this study using interview schedules and focus group discussion. Information about adoption and other relevant information on rice production such as use of seed of improved varieties, fertilizer application, choice of chemicals used, planting spacing, weed control, harvesting and storage were also collected. The questionnaire was administered to 609 individual rice farmers, but only 463 (76.03%) of the questionnaires were found useful due to excessive missing data.

Both descriptive and inferential statistics were used in the analysis of data. Descriptive statistics such as range, ranking, means, weighted means, percentage and frequency distributions were used to achieve objectives of the study. The adoption level of rice farming refers to the number of improved practices for rice farming adopted by a rice farmer when the farmer has complete information on how to use the practice and its merits. For this study, the level of adoption was measured as the ratio of each practice adopted by the farmer against the recommended ratio of that technology. The adoption index shows the extent a farmer has adopted a whole set of packages of practices calculated using the formula adapted from Tadesse (2008). The scores were further subjected to descriptive statistics using frequency and percentages to identify the real distribution of each technology in the category of the adoption index so that a generalized conclusion can be drawn with respect to the category the practice was recorded by the rice farmers. Thus, low, moderate and high adoption of recommended practices.

The adoption index is a continuous variable that varies from 0 - 1 depending upon a farmer's degree of adoption of the practice. On the basis of adoption index, farmers were therefore classified into three categories: low, medium and high adopters. The overall adoption index of all the farmers was categorized into four distinct categories, that is, none=0, low adoption =0. 01-0.33, medium adoption=0. 033-0.66 and high adoption level=0. 67-1.0. The adoption score of 0 indicates non-adoption of improved rice production package and the adoption score of 1 implies the farmers have adopted all the practices according to the recommendation. If the adoption score falls above the value of 1, it indicates the farmers used some of the practices above the recommended rate. In order to identify the level of adoption of improved rice production package, the adoption index of individual farmers was calculated as modified from Tadesse (2008):

$$AI_i = \frac{\sum_{i=1}^n \left| \frac{RTAI}{RV} + \frac{PTAI}{PJ} + \frac{PDCI}{PDC} + \frac{WMI}{WM} + \frac{NTAI}{NT} + \frac{STAI}{ST} \right|}{N^n}$$

Where i = 1, 2, 3 -----n, and n= total number of farmers

AI_i = Adoption index of ith farmer

N_p	=	Number of recommended practices
RVA_i	=	Improved rice varieties used by the i^{th} farmer
RV	=	Rice varieties recommended for rice production
PTA_i	=	Planting practices adopted by the i^{th} farmer
PT	=	Recommended planting practices
PDC_i	=	Pest and disease control practices used by the i^{th} farmer
PDC	=	Recommended pest and disease control practices
WMI	=	Water management practices used by i^{th} farmer
WM	=	Recommended water management practices
HTA_i	=	Harvesting practices used by the farmer
HT	=	Recommended harvesting practices
STA_i	=	Storage practices used by the farmer
ST	=	Recommended storage techniques for rice cultivation.

RESULTS AND DISCUSSION

Socio-economic Characteristics of the Respondents

The results in Table 2 of selected socio-economic variables of the respondents revealed that over two-thirds of the respondents were between the age category of 31-50 with a mean age of 41 years, implying presence of youthful and agile population. The presence of youths is an important asset for efficient production and change in the study area. The result on age agrees with the findings of Adekunmi (2022) in the study of rice farmers awareness and perception of climate change in Ondo State, Nigeria who equally reported similar age range for rice farmers. Also, almost all of the respondents were male and married and male.

Over half of the respondents (58.3%) had low formal education with no membership of any associations. The literacy level of farmers could enhance their level of understanding and desirability of adopting innovation and farm technologies or interacting with extension agents. Educated farmers are in better position to comprehend associated issues related to climate change as attested by Mwinkom *et al.* (2021) in their study of factors influencing climate change coping and adaptation strategies in North-western Ghana. Similarly, majority (39%) had farm size of less than 1 hectare. The average farm size is 1.5, mainly acquired through inheritance, thus indicating that rice cultivation in the study area was on a marginal technical smallholder unit.

Table 2: Distribution of respondents' socio-economic characteristics **n=463**

Variables	Frequency	Percentage (%)	Mean
Age (Years)			
21-30	94	20.4	41
31-40	186	40.2	
41-50	140	30.3	
>50	43	9.1	
Gender			
Male	435	93.9	
Female	28	6.1	
Marital status			
Married	435	93.9	
Single	20	4.5	
Divorced	4	0.8	
Widow/widower	4	0.8	
Household size			
1-5	70	15.2	6
6-10	256	55.3	
11-15	95	20.5	
>15	42	9.0	
Education level			
Primary	115	25.0	
Secondary	88	18.9	

Tertiary	67	14.4	
Non-Formal	193	41.7	
Membership of association			
Member	193	41.7	
Non-member	270	58.3	
Rice farming experience (years)			
1-5	56	12.1	
6-10	161	34.8	3
11-15	102	22.0	
16-20	88	18.9	
>20	56	12.1	
Farmland size (ha)			
< 1.0	182	39.4	
1.0-2.0	130	28.0	1.5
2.1-3.0	147	31.8	
> 3.0	4	0.8	
Source of land acquisition			
Inheritance	260	56.1	
Rent	130	28.0	
Purchase	63	13.6	

Source: Field Survey, 2019

Status and adoption levels of the improved production practices

Table 3 showed improved rice production practices tried and adopted by the respondents. The results showed that seed of improved varieties (87.47%), harvesting practices (62.20%) and planting practices (60.91%) ranked first, second and third respectively of the rice farming practices the farmers have tried before adoption. Other practices the farmers have adopted include planting practices (94.25%), seed of improved varieties (79.05%) and storage methods (66.30%) of the farmers had adopted these practices. The least practices which farmers were aware of, tried and adopted are water management (61.99%), storage method (34.13%) and fertilizer application (41.25%) respectively. This might be in agreement with Armengot, et. al., (2023) who observed the decision to accept or reject an innovation is based on some trade-off of sorts between perceived benefits of the system to the user and the complexity of learning ways of using the system.

The very low adoption rate of fertilizer application (41.25%) might be because the farmers used varying doses of fertilizer, which in most cases was less than the recommended rate. This might be due to the high cost or non-availability of fertilizer to farmers. The practices with low adoption values may imply that the respondents have not known their relevance to their production. However, the low adoption of some of the practices could just be a matter of choice.

Focus group discussions with some respondents revealed birds control practices to be the main pest control practices. This study also showed non-adoption of improved seeds might have been stalled by the use of “*Dan boto*” indigenous seed. *Dan boto* is capable of giving an extremely high yield based on its unique agronomic traits in contrast to the other varieties they use suggesting the need to explore the inherent potentials of this variety.

Table 3: Distribution of Farmers Based on Trial and Adoption Status of Improved Rice Production Practices (n=463)

Varia	T	Adop	Non-
Planting technologies	282(6)	441(9)	22(1)
Water	271(5)	197(4)	266(5)
Seed of	395(8)	269(7)	55(2)
Fertilizer	209(4)	191(4)	273(5)
Pest and	258(5)	293(6)	170(3)
Harvesting	288(6)	250(5)	213(4)
Storage	158(3)	307(6)	156(3)
T			

Source: Field survey, 2019

The categorization of farmers based on adoption of improved rice practices on Table 4 indicated that 30.57% of the farmers were in the moderate adopter category, 28.19% were in the non-adopter category while 23.11% were low adopters. Only 17.93% were high adopters. Fertilizer application, water management and harvesting techniques were not adopted by most of the farmers. In other words, over 82% of the respondents were partial adopters with 17.93% being full adopters of above-mentioned practices. The reason for this non-adoption might be due to the costs involved in these practices thus, the recommended practice is not fully practicable.

Omonona and Arulegba (2023) observed that diffusion of improved practices depends on availability of farm inputs such as fertilizer. Other factors negating adoption of new practices may be the high cost of agricultural innovations, unavailability of the practice, risk element involved, ignorance of the existence of new innovations and the conservative attitudes of most farmers (Osabuohien *et al.* 2023).

Table 4: Distribution of Farmers Based on Level of Adoption of Improved Rice Production Practices

Adoption Category	Adoption Index Score	Frequency	Percentage
Non-Adopters	0.0	131	28.29
Low Adopters	0.01-0.33	107	23.11
Moderate Adopters	0.34-0.66	142	30.67
High Adopters	0.67-1.0	83	17.93
TOTAL		463	100

Source: Field Survey, 2019

Constraints observed in the use of the improved production practices.

Entries in Table 4 showed that some of the respondents had some issues in comprehending the complete use of some practices due to high cost of fertilizer (43.28%), low availability of improved seeds (22.89%) and lack of improved storage facilities (16.92%). However, the practices that had the least problems were pest and disease control (4.98%) and harvesting techniques (11.93%). This finding is in agreement with that of Omonona and Arulegba (2023) which showed that adoption of some practices is impeded by high cost and low availability of farm inputs.

Focus group discussion, however, revealed that some area that produce irrigated rice with a very high achievable yield of over 5 tonnes per hectare faced serious threat of flooding caused by the bursting of the dam embankment. This is seen as a constraint on the use of improved water management practices.

Table 5: Distribution of Respondents based on Constraints in the Use of Improved Rice Production Practices. n=463

Constraint	Frequency	Percentage
High-cost Fertilizer	200	43.28
Low availability of improved seed	106	22.89
Lack of improved Storage facility	78	16.92
Pest and diseases	24	4.98
Poor harvesting technique	55	11.93
TOTAL	463	100

Source: Field survey, 2019

CONCLUSION AND RECOMMENDATIONS

Based on the findings of the study, the majority of the farmers were Moderate adopters of recommended practices. Farmers were aware of seeds of improved varieties but planting techniques was the most adopted practices by the farmers while fertilizer application was the major un-adopted rice farming practice. The main constraints encountered by the respondents related to the use of improved rice production practices has to do with high cost of fertilizer.

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

1. Improve farmers' use of agricultural inputs, especially fertilizers by educating the farmers on fertilizer rate, time and methods of applications by the extension workers.
2. Develop indigenous crop varieties by research agencies to increase their positive traits for increased adoption by the farmers.
3. Encourage farmers' participation in on-farm demonstration trials during variety development, release, seed multiplication and dissemination of improved rice varieties and production practices. This will promote uptake of newly developed rice varieties and production practices.

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Effectiveness of the Anchor Borrower's Programme on the Livelihood of Rice Farmers in Anambra State, Nigeria

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ABSTRACT

This study assessed the effectiveness of the Anchor Borrowers' Programme (ABP) on the livelihood of rice farmers in Anambra state, Nigeria. A multistage sampling procedure was employed in selecting 80 respondents. With the aid of a questionnaire, data were collected on effect of ABP on rice farmers' productivity, perceived effect of ABP on the farmers' standard of living, effectiveness of ABP on their livelihood, and problems encountered by the ABP beneficiaries in accessing the programme. Collected data were analysed using percentages and mean and hypothesis tested using Pearson's Product Moment Correlation. Results show that the ABP had marginal impact ($\bar{x} = 2.52$) on the productivity of the farmers, with input supplies having most significant impact. The effect of ABP on the farmers' standard of living was high ($\bar{x} = 2.62$), and the beneficiaries perceived the ABP to be effective ($\bar{x} = 3.75$) in line with all the objectives of the programme. The result also shows that the beneficiaries encountered severe constraints such as; Lack of adequate training ($\bar{x} = 3.75$), lack of proper supervision ($\bar{x} = 3.68$) among others, and further revealed that there is a significant relationship between the constraints faced by the farmers and the effect of the programme on their productivity. The study concludes that though the programme was rated high in its effectiveness, this could not translate to increased productivity for the rice farmers. It therefore recommends improving the Anchor Borrowers' Programme by enhancing monitoring, ensuring timely and adequate input distribution, and fully implementing all project components such as training.

Keywords: Anchor Borrower, Beneficiaries, Effectiveness

INTRODUCTION

In most Sub-Saharan African nations, rice is a vital staple grain that sustains millions of farmers and households (Elum and Ibraye, 2022). Given its demand in all 36 States, including Anambra, all Local Governments, and across all sociodemographic groups, it has also become an important staple food crop in Nigeria (Opeyemi, Idowu, and Romanus, 2020). The rise in milled rice from 2,818 million metric tonnes in 2010 to 5,000 million metric tonnes in 2021 indicates that Nigeria has lately seen a large boost in rice production (Sasu, 2022). This degree of expansion in the country's rice production sector will not only provide Nigerian households with the 2,400 calories per person per day that the country needs for food security, but it will also raise the country's rice sector from its current subsistence level to a commercial one (Obianefo, Nwigwe, Meludu, and Anyasie, 2022). Given its increasing significance and prominent position among major food crops, as well as the fact that it provides a living for many Nigerian farmers, rice is one of the crops considered under the Anchor Borrowers' Programme (ABP) (Salisu, Adebayo, Jirgi, and Ojo, 2022).

In order to improve farmers' livelihoods through guaranteeing credit performance and boosting farmers' input usage, the Nigerian government launched the anchor borrowers' programme in 2015. This was

intended to be accomplished by expanding the recipients' access to credit, farm financing, and agricultural inputs such as fertilizer, agrochemicals, and better seeds and seedlings, as well as equipment like tractors, ploughs, harrows, and other machinery in exchange for cash and in-kind assistance. The Anchor Borrowers' Programme also sought to remedy the country's negative food balance of payments, stabilize the input supply to agro processors, and boost the country's output of specific commodities of interest, such as rice, maize, wheat, or cassava (Opeyemi, Idowu, and Romanus, 2020). According to the Central Bank of Nigeria (CBN), risk sharing and insurance coverage are two other noteworthy goals of the anchor borrowers' scheme. By increasing productivity and lowering rice imports, the nation's foreign reserve will be preserved. Additionally, the government's cashless policy and financial inclusion will be strengthened, a new generation of farmers and entrepreneurs will be created, employment will be created, poverty levels among farmers will be decreased, and rural farmers will be helped to transit from subsistence to commercial production levels. The financial institutions, mostly banks, were instructed to lend to rice farmers at a maximum of 9% after receiving 2% loans from the CBN (CBN, 2016).

The anchor borrowers' programme, launched through the CBN, was broadly aimed at creating a linkage between anchor companies involved in the processing and the farmers who required essential agricultural commodities (CBN, 2016).

Despite Government's intervention through ABP to improve rice production in Anambra State, the cost of rice has continually been on the rise, production has remained mostly the job of smallholder farmers who produce on a small scales and farmers still scamper for inputs. How well ABP has delivered on her mandate on improving the livelihood of rice farmers in Anambra state is not known to the best of the researcher's knowledge. This study was set up to assess the effectiveness of the Anchor Borrower's Programme (ABP) on the livelihood of rice farmers in Anambra state, Nigeria. It specifically ascertained the effect of ABP on the productivity of the farmers, determined the perceived effect of ABP on the standard of living of the farmers, determined the effectiveness of ABP on rice farmers' livelihood, and ascertained the problems encountered by the ABP beneficiaries in accessing the programme. The hypothesis for the study stated that there is no significant relationship between the constraints faced by ABP beneficiaries in accessing the intervention and the effect of the programme on their productivity.

METHODOLOGY

The study was conducted in Anambra State, Nigeria. The state is located in the south-eastern part of Nigeria between longitude 6°36'E and 7°21'E and latitude 5°38'N and 6°47'N. Anambra has an estimated population of 5,953,500 projected from 2006 census at 2.2% annual population change (Brinkhoff, 2022). The State is bounded in the North by Kogi State, in the West by Delta State, in the South by Imo State and in the East by Enugu State. It occupies an area of about 4,844km², 70% of which is arable land (Ugwumba and Oko, 2010). The State is sub-divided into four agricultural zones (Onitsha, Anambra, Awka and Aguata) to aid planning and rural development. It comprises of 21 Local Government Areas (Aguata, Awka North, Awka South, Anambra East, Anambra West, Anaocha, Ayamelum, Dunukofia, Ekwusigo, Idemili North, Idemili South, Ihiala, Njikoka, Nnewi North, Nnewi South, Ogbaru, Onitsha North, Onitsha South, Orumba North, Orumba South and Oyi). The state is known to produce crops like yam, cassava, cocoyam, maize, banana, pineapples and different types of fruits. Also, livestock like goats, cattle, pigs and poultry are also produced in the area.

A multistage sampling procedure was used in selecting respondents for the study. In the first stage, two agricultural zones were randomly selected from the four agricultural zones in Anambra state, Nigeria. The second stage was the random selection of one L.G.A from the selected Agricultural zones making up two L.G.As. In the third stage, was a random selection of 5 communities which gave a total of 10 communities. In the fourth stage, one village was randomly selected from each of the ten communities, giving a total of 10 villages for the study. In the last stage, 8 rice farmers who are beneficiaries of anchor borrowers' programme were purposively selected with the aid of the village heads and extension officers, making a total of 80 respondents for the study.

This study made use of primary data which were collected using structured questionnaire and analysed using descriptive statistics such as frequency distribution, percentage and mean. The study hypothesis was

analysed using Pearson Product-Moment Correlation (PPMC) to test the significant relationship between the constraints faced in accessing ABP and the effects of ABP on Rice farmers' productivity.

RESULTS AND DISCUSSION

Effect of ABP on the Productivity of the Rice Farmers

Table 1 shows the result of the effect of the ABP on the productivity of Rice farmers in the study area. From the result, a grand mean of 2.52 shows the rice farmers agreed that ABP had marginally high effect on their productivity. The beneficiaries agreed that the ABP improved Seeds/seedling support has enhanced their productivity ($\bar{x} = 3.26$), their fertilizer support has enlarged their productivity ($\bar{x} = 3.10$) and their agrochemicals support enhanced their productivity ($\bar{x} = 3.18$). These results had mean scores above the benchmark of 2.5, while the other items on the effect of ABP on productivity of rice farmers were below the benchmark, showing that the beneficiaries did not agree that they enhanced their productivity. This result shows that the ABP input supplies made significant impact on the productivity of the rice farmers while cash and machinery supplies did not. The implication of this result is that timely and easy access to farm inputs such as seeds/seedlings, fertilizers and agro chemicals from ABP boosted the productivity of the farmers. This finding is in consonance with that of Balogun et al. (2021) who observed that ABP farmers received input supplies orchestrated by the ABP and Akinbile (2023) who stated that access to improved seeds will ensure good yields that have high quality. However, cash and equipment support were seen not to enhance productivity because they were not available to the farmers, perhaps as expected. The short supply of equipment and machines may not be unconnected with the small land holdings of farmers in the southeast due to land fragmentation. Affirming this, Odinaka (2023) noted that land tenure system in his study area was a clog in the wheel that makes it difficult for people to own large expanses of land that can be used for commercial farming.

Table 1: Effect of ABP on Rice Farmers' Productivity

Effect of ABP on Productivity	SA 4	A 3	DA 2	SDA 1	Σfx	$\bar{x}$	Remark
Cash support has enhanced my productivity	25 (31.3)	12 (15.0)	10 (12.5)	33 (41.3)	189	2.36	Low
Improved Seeds/seedling support has enhanced my productivity	38 (47.5)	26 (32.5)	15 (18.8)	1 (1.3)	261	3.26	High
Fertilizer support has enhanced my productivity	24 (30.0)	48 (60.0)	0 (0.0)	8 (10.0)	248	3.10	High
Agrochemicals (Herbicides, Pesticides) Support have enhanced my productivity	32 (40.0)	38 (47.5)	2 (2.5)	8 (10.0)	254	3.18	High
Plough support has enhanced my productivity	0 (0.0)	0 (0.0)	66 (82.5)	14 (17.5)	146	1.83	Low
Tractor support has enhanced my productivity	2 (2.5)	17 (21.3)	47 (58.8)	14 (17.5)	167	2.09	Low
Harrow support has enhanced my productivity	0 (0.0)	3 (3.8)	60 (75.0)	17 (21.3)	146	1.83	Low
Grand Mean						2.52	

Source: Field Survey, 2023 **Note:** SA=Strongly Agree, A=Agree, SDA=Strongly Disagree and D=Disagree **Decision mean=2.5; Figures in parenthesis are percentages**

Perceived Effect of Anchor Borrowers Programme on Rice Farmers' Standard of Living

Table 2 shows the result of the effect of the programme on the standard of living of the farmers in the study area. From the result, a grand mean of 2.69 shows that, respondents' assessment of the effect of the programme on their standard of living was high. Furthermore, apart from the mean ($\bar{x} = 1.85$) on their ability to afford and live in better houses, which was below the benchmark of 2.5, all the other items on the effect of ABP on the standard of living of rice farmers were above the benchmark. This result shows that the ABP programme had improved the standard of living of the rice farmers in the study area and the result

is in consonance with the works of Umeh and Adejo (2019) who said ABP improved the standard of living of its beneficiaries.

Table 2: Perceived Effect of ABP on Rice Farmers' Living standard

Effect of ABP on Living standard	SA 4	A 3	DA 2	SDA 1	$\sum fx$	Mean ($\bar{x}$)	Remark
ABP has helped my business to grow	5 (6.3)	65 (81.3)	2 (2.5)	8 (10.0)	227	2.84	High
The quantity of Rice I produce has increased	4 (5.0)	66 (82.5)	2 (2.5)	8 (10.0)	226	2.83	High
I make more money farming rice now than before	0 (0.0)	70 (87.5)	2 (2.5)	8 (10.0)	222	2.78	High
The money I make has improved our standard of living	0 (0.0)	70 (87.5)	2 (2.5)	8 (10.0)	222	2.78	High
We eat better food in my house now than before	0 (0.0)	70 (87.5)	2 (2.5)	8 (10.0)	222	2.78	High
We can afford and live in a better house now	6 (7.5)	6 (7.5)	38 (47.5)	30 (37.5)	148	1.85	Low
I am able to pay my children's school fees easily	26 (32.5)	36 (45.0)	5 (6.3)	13 (16.3)	235	2.94	High
Grand Mean						2.69	

Source: Field Survey, 2023 **Note:** SA=Strongly Agree, A=Agree, SDA=Strongly Disagree and D=Disagree **Decision mean=2.5; Figures in parenthesis are percentages**

Perceived Effectiveness of Anchor Borrowers' Programme on Rice Farmers' Livelihood

Table 3 is a result of the perceived effectiveness of ABP in the study area, result indicates that with a grand mean of 2.63 which is above the bench mark of 2.5, the beneficiaries perceived the programme to be effective in line with all the objectives of the programme, except in the area of provision of farm machines ($\bar{x} = 1.25$) and making it easy for farmers to work with other agricultural firms ($\bar{x} = 1.16$). All the other variables of effectiveness of the programme were rated above the benchmark mean of 2.5. This affirms that the programme was effective and met most of its mandate in the study. The result corroborates the work of Akinbile *et al* (2023), and Isah *et al* (2022) who also reported that the programme was effective in line with the programme objectives in their different studies.

Table 3: Effectiveness of Anchor Borrowers Programme

Perceived Effectiveness of ABP	SA 4	A 3	D 2	SDA 1	$\sum fx$	Mean ($\bar{x}$)	Remark
ABP gave me financial support through loans to grow my rice business	21 (26.3)	47 (58.8)	2 (2.5)	10 (12.5)	239	2.98	Positive
ABP provided me with improved rice seeds and seedlings to enhance my production	61 (76.3)	11 (13.8)	0 (0.0)	8 (10.0)	285	3.56	Positive
ABP provided farm inputs in kind and in cash to boost my productivity.	25 (31.3)	45 (56.3)	2 (2.5)	8 (10.0)	247	3.08	Positive
ABP Provided me with farm machines	1 (1.3)	0 (0.0)	17 (21.3)	62 (77.5)	100	1.25	Negative
ABP has stimulated increase in the quantity of rice I produce	20 (25.0)	49 (61.3)	2 (2.5)	9 (11.3)	240	3.00	Positive
ABP helped to connect me with marketers who bought my goods	21 (26.3)	47 (58.8)	2 (2.5)	10 (12.5)	239	2.98	Positive

ABP helped to connect me with processors, turned my rice paddy into finished products	25 (31.3)	45 (56.3)	2 (2.5)	8 (10.0)	247	3.08	Positive
ABP made it easy for me to work with other agricultural firms	3 (3.8)	2 (2.5)	0 (0.0)	75 (93.8)	93	1.16	Negative
Working with ABP has increased my income from rice sales	61 (76.3)	11 (13.8)	0 (0.0)	8 (10.0)	285	3.56	Positive
ABP has made me an employer of labour	49 (61.3)	21 (26.3)	2 (2.5)	8 (10.0)	271	3.39	Positive
Grand Mean						2.63	Positive

Source: Field Survey, 2023

Note: SA=Strongly Agree, A=Agree, SDA=Strongly Disagree and D=Disagree; Decision mean=2.5; Figures in parenthesis are percentages

Constraints Encountered by Beneficiaries in Accessing the Programme

The result presented in Table 4 is that of the constraints associated with accessing the programme by the beneficiaries, from the results a mean score of 3.0 was recorded implying the severity of the constraints studied. Furthermore, apart from the mean of 'poor output after intervention ($\bar{x} = 2.09$)' and 'No link to marketers ($\bar{x} = 2.04$)' other constraints listed were considered severe constraints to accessing the intervention by the farmers. Sambe, *et al* (2020), and Bello *et al* (2021) in their separate studies also reported similar constraints faced by Anchor Borrower Programme beneficiaries.

Table 4: Distribution of Respondents Based on Constraints in Accessing ABP in the State

Constraints	SA 4	A 3	DA 2	SDA 1	Σfx	Mean $\Sigma fx/n$	SD	Remark
Lack of adequate training	72 (90.0)	2 (2.5)	0 (0.0)	6 (7.5)	300	3.75	0.804	Severe
Lack of Proper Supervision	66 (82.5)	8 (10.0)	0 (0.0)	6 (7.5)	294	3.68	0.823	Severe
Untimely release of funds	65(81.3)	7 (8.8)	2 (2.5)	6 (7.5)	291	3.64	0.860	Severe
Untimely release of inputs	32 (40.0)	32(40.0)	10(12.5)	6(7.5)	250	3.13	0.905	Severe
Difficulty accessing loans	39(48.8)	33(41.3)	2 (2.5)	6 (7.5)	265	3.31	0.851	Severe
Unavailability of seed/seedling	13 (16.3)	37(46.3)	24(30.0)	6 (7.5)	217	2.71	0.829	Severe
Difficulty accessing farm inputs	14(17.5)	37(46.3)	23(28.8)	6 (7.5)	219	2.74	0.838	Severe
Poor output after intervention	4(5.0)	5 (6.3)	65(81.3)	6 (7.5)	167	2.09	0.578	Not Severe
No link to marketers	6 (7.5)	0(0.0)	65(81.3)	9(11.3)	163	2.04	0.645	Not Severe
No link with Processors	8 (10.0)	63(78.8)	3 (3.8)	6 (7.5)	233	2.91	0.658	Severe
Grand Mean						3.0		Severe

Source: Field Survey, 2023 **Note: SA=Strongly Agree, A=Agree, SDA=Strongly Disagree and D=Disagree; Decision mean=2.5; Figures in parenthesis are percentages**

Hypothesis Testing

The Pearson's Product Moment Correlation coefficient was used to determine the relationship between the constraints faced in accessing ABP and the effect of ABP on Rice Farmers Productivity in the study area. At 0.05 alpha levels, the calculated r-values of 0.396, 0.403, 0.309, 0.295 and 0.285 for constraints 1,2,3,5 and 8 respectively were greater than the tabulated r-value (0.217), which shows that there is a significant relationship between the constraints faced by the farmers and the effect of the programme on their productivity. The result implies that unless the challenges faced by the beneficiaries are addressed, the expected effect of the intervention on the productivity of the rice farmers may not be realized. According

to Balogun *et al* (2021), the constraints faced by the beneficiaries affected their productivity, which agrees with the result of this study. The finding is also in tandem with the work of Bello *et al* (2021)

Table 5: Test of significant relationship between the constraints faced in accessing ABP and the effect of ABP on Rice Farmers Productivity

	Pearson Correlation	Sig. (2-tailed)	n	r-tab (PPMC table	Decision
Effect on Productivity/Constraint 1	0.396**	0.000	80	0.217	H₀ rejected
Effect on Productivity /Constraint 2	0.403**	0.000	80	0.217	H₀ rejected
Effect on Productivity/Constraint 3	0.309**	0.005	80	0.217	H₀ rejected
Effect on Productivity/Constraint 4	0.179 ^{ns}	0.119	80	0.217	H₀ accepted
Effect on Productivity/Constraint 5	0.295**	0.000	80	0.217	H₀ rejected
Effect on Productivity/Constraint 6	-0.109 ^{ns}	0.336	80	0.217	H₀ accepted
Effect on Productivity/Constraint 7	0.183 ^{ns}	0.104	80	0.217	H₀ accepted
Effect on Productivity /Constraint 8	0.285**	0.010	80	0.217	H₀ rejected

p≤0.05 Constraints: 1 = Lack of adequate training; 2 = Lack of Proper Supervision; 3= Untimely release of funds; 4 = Untimely release of inputs; 5 = Difficulty accessing loans; 6= Unavailability of seed/seedling; 7 = Difficulty accessing farm inputs; 8 = No link to processors.

CONCLUSION AND RECOMMENDATIONS

The study therefore concluded that though the programme was rated high in its effectiveness, this could not translate into increased output in production of the rice farmers. Challenges such as lack of adequate training, lack of proper supervision, untimely release of funds, difficulty accessing machines, and loans and inability to link up with processors, affected the programme.

The study therefore recommends that for the anchor borrower programme and subsequent interventions to improve and be successful, the government should enhance monitoring, ensure timely and adequate input distribution, and fully implement all project components such as training and prompt fund disbursement. They should also encourage stronger supervision in order to ensure effective use of resources and attainment of intended goals.

The study also encourages farmers to form cooperatives and pull their resources together to access greater benefits. For instance, if they pull their land resources together, it might be easier to use machines

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Theme: Agricultural Extension for Food Security and Community Empowerment

**Assessment of Youths' Participation in Cocoa Production in Umuahia
Agricultural Zone, Abia State, Nigeria**

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ABSTRACT

The study assessed youths' participation in cocoa production in Umuahia Agricultural Zone, Abia State, Nigeria. Specifically, the study determined the level of participation of the respondents in cocoa production; assessed respondents' perception of the cocoa production; and ascertained the constraints that influence respondents' participation in cocoa production in the study area. A multistage sampling technique was used in the selection of 80 respondents for the study. Data for this study were obtained from primary sources, and analyzed using descriptive statistics, multiple regression analysis, and correlation. Results showed that the farmers' level of involvement in cocoa production had the grand mean of 3.64 which is a high level of involvement with the foremost activities like gathering pods ($\bar{x}=3.96$), planting ($\bar{x}=3.96$), processing ($\bar{x}=3.81$), and marketing ($\bar{x}=3.75$) was high. Although they encountered challenges like inadequate extension services ($\bar{x}=3.33$), inadequate trading ($\bar{x}=3.68$), lack of improved technologies ($\bar{x}=3.96$), and lack of insurance policy ($\bar{x}=3.43$), they perceived cocoa production as being lucrative with the potential of enhancing their income and welfare status. Marital status ($P<0.01$), education ($P<0.05$), farming experience ($P<0.01$), amount of credit ($P<0.05$), and cooperative membership ($P<0.10$) were the determinants of participation in cocoa production. There was a moderate positive correlation (0.5525^{**}) between the respondents' level of involvement in cocoa production and their perception of cocoa production. The study concluded that the youths participated highly in cocoa production. The study recommended that government and non-governmental organizations should develop and expand training programs that provide farmers with better knowledge about cocoa farming techniques, pest management, and market access. This could help address the challenges of inadequate training and extension services.

Keyword: Youths, Youth's Participation, Cocoa Production

INTRODUCTION

Agriculture remains an important sector of the economy and accounted for 42.1% Gross Domestic Product (GDP) in Nigeria and employed about 79% of the working population with about 80% of the country's poor working primarily in Agriculture (National Planning Commission, 2020). The need to diversify the productive base of the economy to reduce dependency on oil export and improve the agricultural sectors efficiency as well as intensify the growth potential of the private sector has placed cocoa enterprise as a topmost cash crop enterprise in Nigeria (Nkang, 2021).

Cocoa (*Theobroma Cacao*) is currently an important agricultural export crop in Nigeria with Nigeria producing about 5% of total world production (FAO, 2011). The contributions of cocoa to the nation's economic development are vast. In terms of foreign exchange earnings, no single agricultural export commodity has earned more than cocoa. A sizeable number of people are employed, both directly and indirectly in the cocoa sub-sector. In addition, it is an important source of raw materials, as well as a source

of revenue to the economy. In terms of foreign exchange earnings, no single agricultural export commodity has earned more than cocoa (Nkang, 2021).

According to Adesina (2022) Nigeria produces about 250,000 metric tonnes of cocoa. By this rating, Nigeria competed favourable with other front liners in cocoa industry like Ivory Coast, Indonesia and Ghana. Prior to the oil boom of the mid 70's, Cacao (*Theobroma Cacao*) was one of the highest foreign exchange earners in Nigeria and for a long time the crop has been generating substantial foreign earnings for the country (Onwumere and Alamba, 2022; Folayan *et al*, 2018).

Cocoa is used for drinks, candies, cosmetics, soap and pharmaceuticals. It is grown in fourteen states of Nigeria, which includes Abia, Akwa Ibom, Cross River, Delta, Edo, Ekiti, Ogun, Ondo, Osun, Oyo, Kogi, Kwara, Adamawa and Taraba States (FGN, 2019). Cocoa as a cash crop contributes to sustainable economic growth and development for both developed and less developed countries. The production of the commodity started in South America, but Africa as continent contributes the majority of cocoa beans to the world market.

The cocoa production in Nigeria is a source of livelihood to most farm households, especially, the youth who form the foundation of the future of agriculture in the country. Empirical data suggest that over four million people currently depend on the cocoa sector for employment in Nigeria (Nigeria Statistical Service [NSS], 2018). The importance of cocoa production in Nigeria economy cannot be overemphasized as the crop remains the leading export and foreign exchange earning of the country. Nigeria occupies fourth position as one of the largest producers of Cocoa in the world, after Ivory Coast, Indonesia and Ghana, and also takes third position as largest exporter, after Ivory Coast and Ghana. Oil boom discovery in 1960s made Nigeria to shift its investment attention from cocoa hereby leading to a major world output decline in production (Ndu, 2020).

Youths' participation in cocoa production constitutes an important segment of the society, and if given necessary support, their contributions cannot be undermined. Youths are an important and vital segment of human resources which not only today but in future will have to shoulder the responsibility for development including agriculture and rural sectors (Skuz, 2005). Okwoche *et al*. (2012) posited that one of the major setbacks of agricultural development programmes mostly in cocoa production is attributed to the inability of the Federal Government to integrate youths into the mainstream of the numerous agriculture development programmes implemented over the years. Nigeria needs a shift from the present mono product-based economy (petroleum product) to an economy that is diversified. There is need to join the modern economies of the world as envisioned in the Nigerian government vision 2020 and this may be realized if youths' engagement in agricultural development remains on relegated (Nduka, 2021).

The integration of youths into Cocoa production in Nigeria will be an important factor towards Cocoa sector and this will be a greater asset for the increased productivity of Cocoa. It is pertinent to say that youth have innovative behaviour, physical strength and fast rate of learning etc. However, the quest for white collar jobs among the youths, infrastructure deficit in the rural areas, and inconsistent government policies may have discouraged the youths from active participation in Cocoa farming.

Nduka, (2021) noted that there has still been low participation of youths in cocoa production. Also, attempts made by the Government, Non-Governmental Organizations (NGOs) and Private Institutions to encourage youths' participation in agriculture, the efforts have not reflected in the age distribution of the farming population. It is against this background, that the study sought to assess the level of participation of youths in cocoa production in Umuahia Agricultural zone of Abia State, Nigeria.

The specific objectives were to: identify cocoa production activities that the respondents participate in; determine the level of participation of the respondents in cocoa production; assess respondents' perception of the cocoa production; and ascertain constraints that influence youths' participation in cocoa production in the study area.

HYPOTHESIS

H₀₁: There is no significant relationship between the respondents' level of participation in cocoa production and their perception about cocoa production

METHODOLOGY

Study Area

This study was carried out in Umuahia Agricultural Zone in Abia State, Nigeria. Abia State lies between longitudes 7° 23' E and 8° 2' E East of the equator and latitudes 4° 47' N and 6° 12' N North of the Greenwich Meridian. The State is located East of Imo State and shares common boundaries with Anambra, Enugu and Ebonyi States in the North West and North East respectively. On the East and South East, it is bounded by Cross River and Akwa Ibom States and by Rivers State on the South. Abia State is made up of 17 local government areas and most of the people especially the rural dwellers are engaged mainly in subsistence farming. Abia State is one of the Cocoa producing states in Nigeria. The State is divided into three agricultural zones namely; Umuahia, Ohafia and Aba Agricultural Zones. Umuahia and Ohafia Agricultural Zones are the two major zones of Cocoa production in the state. According to Abia State Government (2019) Cocoa is majorly produced in Bende, Ikwuano, Umuahia North and some parts of Ukwu East and West. The state is blessed with favourable warm climate and sufficient moisture ideal for the growing of tree crops, root and tuber crops, cereals, vegetables, nuts and food crops including rice. The population of the study included all youths involved in cocoa production in Umuahia agricultural zone of Abia State.

Sampling Procedure

A multi-stage sampling technique was adopted in selecting the respondents for the study. In the first stage, two LGAs namely Umuahia North and Ikwuano LGAs were purposively selected from Umuahia agricultural zone in Abia state because of the presence of large number of young cocoa farmers in the areas. Then in the second stage, two autonomous community from each of the LGAs were selected while at the third stage, two villages from each of the communities were selected. Finally, at the fourth stage, ten youths that are cocoa farmers from each village were randomly selected making a sample size of 80 respondents for the study.

Data for this study were obtained from primary source. The primary source included the use of a structured questionnaire, interview which were administered to the respondents to get all the necessary data required for the study.

Method of Data Analysis

Objective 1: aimed at determining the level of participation of the respondents in cocoa production was realized using a 4-point rating scale of Always, Seldom, Sometimes and Never and were assigned scores of 4, 3, 2 and 1. The mean cut off point was 2.50, that is $4 + 3 + 2 + 1 = (10/2) = 2.50$ and any mean response below 2.50 was considered as activity with low level of involvement of youths. **Objective 2:** Which is to assess respondents' perception of the cocoa production was realized using A 4-point rating scale of Strongly Agree, Agree, Disagree and Strongly Disagree and were assigned scores of 4, 3, 2 and 1. The mean cut off point was 2.50, that is $4 + 3 + 2 + 1 = (10/2) = 2.50$, and any mean response below 2.50 was considered as negative perception while any mean response above 2.50 was considered as positive perception. **Objective 3:** Which is to ascertain the constraints that influence youths' participation in cocoa production was realized using a 4-point rating scale of Strongly Agree, Agree, Disagree and Strongly Disagree, and were assigned scores of 4, 3, 2 and 1. The mean cut off point was 2.50, that is $4 + 3 + 2 + 1 = (10/2) = 2.50$, and any mean response below 2.50 was considered as constraints faced by youths in getting involved in cocoa production.

HO₁ There is no significant relationship between the respondents' level of participation in cocoa production and their perception about cocoa production

This was analyzed using PPMC

The model is stated thus;

$$\text{PPMC}(r) = \frac{n\sum XY - (\sum X)(\sum Y)}{\sqrt{(n\sum X^2 - (\sum X)^2)(n\sum Y^2 - (\sum Y)^2)}}$$

Where;

r = correlation coefficient

Y = Perception about cocoa production (Mean)

X = Level of participation in cocoa production (Mean)

N = sample size of the youths.

The correlation coefficient will be further tested using this formula;

$$t = \frac{r \times \sqrt{n-2}}{t-r^2}$$

Where;

t = test of significance

r = correlation coefficient

n = sample size

RESULTS AND DISCUSSION

Level of Participation of the Youths in Cocoa Production

Level of participation of the youths in cocoa production are presented in Table 1

Table 1: Level of participation of the youths in cocoa production n = 80

Variables	Always (4)	Seldom (3)	Rarely (2)	Never (1)	Mean
Gathering of cocoa pods	78(312)	1(3)	2(4)	0(0)	3.96
Land Clearing	58(232)	12(36)	5(10)	5(5)	3.54
Planting	77(308)	3(9)	0(0)	0(0)	3.96
Weeding	44(176)	30(90)	2(4)	4(4)	3.43
Fertilizing	51(204)	29(87)	0(0)	0(0)	3.63
Spraying	50(200)	13(39)	10(20)	7(7)	3.33
Harvesting	47(188)	24(72)	5(10)	4(4)	3.43
Processing	69(278)	5(15)	6(12)	0(0)	3.81
Marketing	70(280)	3(9)	4(8)	3(3)	3.75
Grand mean = 3.64					

Source: Field Survey, 2024. Decision rule: Mean ≥ 2.5 = High level of participation, Mean < 2.5 = Low level of participation.

Results in Table 1 showed the level of participation of youths in various cocoa production activities in the study area. Activities such as gathering cocoa pods and planting received the highest mean scores of 3.96, indicating a high level of participation among youths. This consistent participation in key activities underscores the commitment of farmers to both the initial establishment of crops and the critical post-harvest processes, which are essential for ensuring quality and maximizing yields. Other activities like processing ($\bar{x} = 3.81$) and marketing ($\bar{x} = 3.75$) also show significant engagement, highlighting farmers' recognition of the importance of value addition and market access in the cocoa production chain. The grand $\bar{x}$ was 3.64, implying that the level of participation of youth in cocoa production was high in the study area. This study aligns with Adeloye *et al.* (2017) who studied the participation of youth in cocoa plantation in Ondo State, Nigeria and reported that the level of youth participation was high.

The Youths' Perception of the Cocoa Production Activities

The respondents' perceptions of the cocoa production activities are presented in Table 2

Table 2: The respondents' perception of the cocoa production activities n = 80

Technologies	SD (4)	A (3)	D (2)	SD (1)	Mean
Participation of the youths in cocoa production assist in family up keep	79 (316)	1(3)	0(0)	0(0)	3.98
Youths contribute so much to farm labour	77 (308)	2 (6)	1(2)	0(0)	3.95
Cocoa production activities are quite strenuous	15(60)	53 (159)	12 (24)	0(0)	3.03

Few youths participate in cocoa production	18 (72)	41(123)	21 (42)	0(0)	2.96
Youths' engagement in cocoa production helps to improve their general wellbeing	38 (152)	40 (120)	2(4)	0(0)	3.45
It helps youths to get extra income	75 (300)	3 (9)	1(2)	1(1)	3.90
It helps youths to be gainfully engaged in the community	76 (304)	2 (6)	1 (2)	1 (2)	3.93
Cocoa production activities are mainly for dropouts	0(0)	2(6)	35 (70)	43(43)	1.48
Cocoa production activities is not a good economic activity for youth	1(4)	0(0)	59 (118)	20(20)	1.78
Grand mean	3.16				

Source: Field Survey, 2024. Decision rule: Mean ≥ 2.5 = High perception, Mean < 2.5 = Low perception.

Results in Table 2 showed the respondents' perceptions of various aspects of cocoa production activities in the study area. The highest mean scores were recorded for statements indicating that youths contribute significantly to farm labor ($\bar{x}$ =3.95) and assist in family upkeep ($\bar{x}$ =3.98), both of which shows that the youth are aware of the benefits of their participation in cocoa farming as a means of enhancing their livelihoods. Additionally, respondents perceived cocoa production as a means for youths to earn extra income ($\bar{x}$ = 3.90) and to remain gainfully engaged in their communities ($\bar{x}$ = 3.93). The grand mean was 3.16, implying that the respondents had perception of cocoa production in meeting their welfare needs in the study area.

Constraints that Influence Youths' Participation in Cocoa Production

Constraints that influence youths' participation in cocoa production are presented in Table 3.

Table 3: Constraints that influence youths' participation in cocoa production n=80

Constraints	SA (4)	A (3)	D (2)	SD (1)	Mean
Inadequate extension service	26 (104)	54(162)	0(0)	0(0)	3.33
Inadequate training	55 (220)	25(75)	0(0)	0(0)	3.68
Lack of access to improved technologies	77 (308)	3 (9)	0(0)	0(0)	3.96
Lack of insurance policy	35 (140)	45 (135)	0(0)	0(0)	3.43
Grand mean	3.60				

Source: Field Survey, 2024. Decision rule: Mean ≥ 2.5 = Constraining factor, Mean < 2.5 = non-constraining factor.

Results in Table 3 outlined the constraints influencing youths' participation in cocoa production in the study area. Lack of access to improved technologies had the highest mean score of ($\bar{x}$ =3.96) indicating a significant constraining factor. Without access to innovative technologies, farmers may struggle to optimize their yields and compete effectively in the market. Additionally, inadequate training ($\bar{x}$ = 3.68) and inadequate extension service ($\bar{x}$ = 3.33) further emphasize the need for enhanced support and resources to empower farmers with the skills and knowledge necessary for successful cocoa production. Moreover, lack of insurance policy ($\bar{x}$ =3.43) is another critical factor that constrains farmers' participation. Without insurance, farmers are vulnerable to risks such as crop failure due to pests, diseases, or adverse weather conditions, which can significantly impact their livelihoods. The grand mean was 3.60, implying that they facing constraining facing in participating in cocoa production in the study area. This finding corroborates with Adeogun (2015) who studied participatory diagnostic survey of constraints to youth participation in cocoa production in Cross River State of Nigeria and reported that lack of access to improved technologies and input were the challenges faced by the respondents.

Correlation Result of the Relationship between Youths' Level of Participation in Cocoa Production and their Perception about Cocoa Production

Table 4: Correlation result of the relationship between youths' level of participation in cocoa production and their perception about cocoa production

	Respondents' level of participation in cocoa production	Their perception about cocoa production
Youths' level of participation in cocoa production	1.0000	
Youths' perception about cocoa production	0.5525***	1.0000

Source: Field Survey Data, 2024

Result in Table 4 shows a significant positive relationship between the respondents' level of participation in cocoa production and their perception about cocoa production with a coefficient of 0.5525. A coefficient of 0.5525 indicates a moderate to strong positive correlation between the respondents' level of participation in cocoa production and their perception about cocoa production. This correlation could be attributed to the fact that positive perceptions often lead to greater motivation and commitment to engage in farming activities. When farmers believe in the benefits and potential of cocoa production, they are likely to participate more actively, invest time and resources, and adopt best practices.

CONCLUSION AND RECOMMENDATIONS

Their level of involvement in cocoa production activities like gathering pods, land clearing, planting, weeding, fertilizing, spraying, harvesting, processing, and marketing was high. Although they countered challenges like inadequate extension services, inadequate trading, lack of improved technologies, and lack of insurance policy, they perceived cocoa production as being lucrative with the potential of enhancing their income and welfare status. There was a moderate positive correlation between the respondents' level of involvement in cocoa production and their perception of cocoa production.

Based on the findings of the research, the following policy recommendations were made:

Government and non-governmental organizations should develop and expand training programs that provide farmers with better knowledge about cocoa farming techniques, pest management, and market access. This could help address the challenges of inadequate training and extension services. The government should create initiatives to provide farmers with access to improved agricultural technologies and easier credit options. This would enable them to invest in better seeds and equipment, leading to higher productivity and income. Government and non-governmental organizations should encourage more farmers to join cooperatives and strengthen existing ones. Cooperatives can provide support, resources, and better market access, helping farmers work together to overcome challenges and increase their participation in cocoa production.

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**SOCIETY FOR COMMUNITY & COMMUNICATION DEVELOPMENT RESEARCH
CONFERENCE PROCEEDINGS**



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Theme: Agricultural Extension for Food Security and Community Empowerment

Effect of Anchor Borrowers' Programme on the Annual Income of Rice Farmers in Aninri Local Government Area, Enugu State, Nigeria

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ABSTRACT

This study examined the effect of the Anchor Borrowers' Programme (ABP) on the annual income of rice farmers in Aninri Local Government Area (LGA) of Enugu State, Nigeria. The specific objectives were to identify ABP activities extended to them, and ascertain their annual income. A multistage sampling technique was employed to select 120 rice farmers across selected villages. Data were analyzed using descriptive statistics and Pearson correlation. Findings revealed high participation in training (90%), input supply (75%), extension services (80%), and farming equipment (78.33%), but limited access to credit (50%), water pumps (24.17%), and market linkages (31.67%). However, the Pearson correlation analysis showed no significant relationship between ABP participation and farmers' annual income ($r = 0.054$; $p = 0.425$), indicating that the programme has not significantly improved farmers' income in the study area. The study concludes that while the ABP has provided valuable support services, its financial impact remains limited. It recommends expanding credit access, improving market linkages, and strengthening irrigation infrastructure to enhance programme effectiveness.

Keywords: Anchor Borrowers' Programme (ABP), Rice farmers, Credits, Participation

INTRODUCTION

The Anchor Borrowers' Programme (ABP), launched by the Central Bank of Nigeria in 2015 under the Buhari administration, was designed to provide loans (in kind and cash) to smallholder farmers, including rice farmers, in order to boost agricultural production and reduce food importation (CBN, 2016; Akinwale, 2021). According to Okoroh *et al.* (2021), participating farmers gain access to credit facilities to purchase farm inputs, hire labour, and expand their production scale. This progression from subsistence to commercial farming results in increased income and improved living standards.

Through the ABP, rice farmers receive quality inputs such as improved seeds and fertilizers, and benefit from mechanized services like ploughing and harrowing, which are often provided as part of the loan package (Okoroh *et al.*, 2021). Furthermore, farmers are trained on how to access loans, manage accounts, and adopt good agricultural practices. This systematic support enhances productivity, market access, and profitability. By 2022, over 4.8 million farmers had benefited financially from the programme, with more than 5.2 million hectares of land cultivated nationwide, including rice farms (Mojeed, 2022; Akinfenwa, 2022). The programme's focus on rice as a priority crop, alongside government efforts to reduce rice importation, has created an enabling environment for higher local rice output and better income for rice farmers (Oba *et al.*, 2021; Mahmud *et al.*, 2022).

In Nigeria, agriculture employs nearly 75% of the population, yet the sector receives only about 1% of formal bank lending, limiting productivity, innovation, and income growth among smallholder farmers (Ahmed & Mesfin, 2017). These farmers, who play a vital role in national food production—especially

rice—often lack access to credit facilities, improved inputs, and mechanization needed to increase yields and income (IFC, 2014).

To bridge this gap, the Federal Government launched the Anchor Borrowers' Programme (ABP) in 2015 through the Central Bank of Nigeria (CBN), with the goal of linking smallholder farmers to finance, inputs, and structured markets (CBN, 2016). The programme targets staple crops, particularly rice, and provides loans (in kind and cash), extension services, and access to quality inputs to help farmers increase their productivity and income levels (Akinwale, 2021; Okoroh et al., 2021).

According to Okoroh et al. (2021), rice farmers enrolled in ABP receive farm inputs, mechanized services like ploughing and harrowing, and are educated on how to access and manage loans through partner banks. Upon harvest, farmers supply their produce to designated anchors (agro-processors), who pay them directly, ensuring both market access and cash returns. These interventions are expected to increase annual income by transitioning farmers from subsistence to commercial production.

In Enugu State, the CBN committed to supporting 20,000 rice farmers under the ABP during both the rainy and dry seasons (Nigerian Tribune, 2017). However, the actual impact of this initiative on the income levels of rice farmers in Aninri Local Government Area is not well-documented. While prior studies have evaluated the ABP's impact on agricultural output and credit access in broader contexts (Salisu *et al.*, 2022; Akighir *et al.*, 2021), there is a noticeable gap in research on how the programme specifically affects the annual income of rice farmers in Aninri LGA.

This study, therefore, seeks to examine the effect of the Anchor Borrowers' Programme (ABP) on the annual income of rice farmers in Aninri LGA, Enugu State. The specific objectives are

To identify the ABP activities extended to rice farmers in the study area.

To ascertain the annual income of the ABP rice farmers in the study area.

HYPOTHESIS

H0: There is no significant relationship between the ABP programmes and the annual income of rice farmers in Aninri LGA Enugu State.

METHODOLOGY

The study was conducted in Aninri Local Government Area (LGA) of Enugu State, located in the Southeast geopolitical zone of Nigeria. Geographically, Aninri lies between Latitude 4° and 5° North and Longitude 6° and 7° East of the Greenwich Meridian. The LGA spans an area of approximately 364 square kilometers and is characterized by a tropical climate with two distinct seasons: a rainy season and a dry season, with the latter occasionally marked by harmattan (Nwaobiala & Ogbonna, 2014).

Aninri LGA receives an annual rainfall ranging from 1000mm to 1400mm, with temperatures fluctuating between 28°C and 34°C, and an average temperature of 28.5°C. The relative humidity is estimated at 62%, creating a favourable environment for agricultural activities, particularly rice cultivation, which is a key crop under the Anchor Borrowers' Programme (Nwaobiala & Ogbonna, 2014).

The population of Aninri was estimated at 154,239 in the 2006 national census; however, recent projections placed the population at approximately 97,865 (Manpower, 2019). The area is predominantly inhabited by the Igbo ethnic group, and the major languages spoken are Igbo and English. The dominant religion is Christianity, although a small proportion of the population still practices traditional beliefs.

Aninri LGA comprises several towns and villages including Oduma, Nenwe, Ndeaboh, Mpu, and Okpanku. The area is well known for its agricultural heritage, with widespread cultivation of crops such as yam, cassava, cocoyam, melon, pumpkin, and oil palm. Agriculture is the primary economic activity, making it a suitable location for assessing the impact of agricultural interventions such as the Anchor Borrowers' Programme. Commerce also plays an important role in the local economy, with key markets like Afor Okpanku and Oduma Central serving as hubs for agricultural produce and other goods (Manpower, 2019; Propertypro, 2019).

The population of this study consisted of rice farmers who benefited from the Anchor Borrowers' Programme (ABP) in Aninri LGA, Enugu State. A multistage sampling technique was used in selecting the

sample size. At the first stage, three communities were purposively selected based on their participation in ABP. At the second stage, two villages were randomly chosen from each community. Finally, twenty (20) ABP rice farmers were selected from each village, resulting in a total sample of 120 respondents. Data were analyzed using descriptive and inferential statistics. Objectives 1, was realized using frequency and percentage, objective 2 was realized using mean and the hypothesis was tested using the Pearson's correlation coefficient.

RESULTS AND DISCUSSION

ABP activities received by the ABP rice farmer in Aninri LGA Enugu State

Table 1 shows the findings from the study Distribution of rice farmers according to the ABP activities received by the ABP rice farmers in Aninri LGA Enugu state. The result showed that very high proportion of farmers (90%) received training, while 80% benefitted from extension services. This indicates that the programme prioritized knowledge transfer and skill acquisition, which are critical for improving farmers' technical efficiency and adoption of modern farming practices.

The result also showed that a substantial percentage of farmers accessed input supply (75%) and farming equipment (78.33%), showing that the programme provided moderate support in terms of production resources. Advisory services were also fairly provided to 61.67% of the farmers, which complements the training and extension activities. On the other hand, access to financial resources was relatively weak. Only 50% of the farmers received credit facilities and fertilizer, while 68.33% benefitted from running capital. This implies that a significant number of farmers still face financial constraints that could hinder their ability to expand production or fully utilize the training and equipment received.

Table 1: Distribution of rice farmers according to the ABP activities received by the ABP rice farmers in Aninri LGA Enugu state

S/N	Activities	Yes		No	
		Frequency	Percentage (%)	Frequency	Percentage (%)
1	Training	108	90.00	12	10.00
2.	Advisory services	74	61.67	46	38.33
3.	Input supply	90	75.00	30	25.00
4.	Farming equipment	94	78.33	26	21.67
5.	ABP credit facilities	60	50.00	60	50.00
6.	Fertilizer	61	50.83	59	49.17
7.	Extension services	96	80.00	24	20.00
8.	Water pumping machines	29	24.17	91	75.83
9.	Provide linkages between smallholder farmers (SHFs) and reputable companies (anchors)	38	31.67	82	68.33
10.	Provision of running capital	82	68.33	38	31.67

Source: Field Survey, 2024

Annual income of the ABP rice farmers in the study area.

The result in table 4.2 indicates that the average annual rice output for the rice farmers participating in the Anchor Borrowers Program (ABP) in Aninri LGA, Enugu State, is 130.6 kg. This figure provides an insight into the productivity level of these farmers within the given period.. An average output of 130.6 kg suggests that the rice farmers in this area may be engaging in small-scale production, possibly due to limited access to resources such as quality inputs, adequate extension services, or mechanized farming tools. The relatively modest output might also point to challenges related to land availability, farming techniques, or adverse climatic conditions affecting yields. For a large-scale program like ABP, this output figure may highlight the need for further support, such as improved access to high-yielding rice varieties, better irrigation systems, or more effective training programs that can enhance farmers' productivity and help them

maximize their land's potential. This further symbolizes that ABP program did not have a significant impact on the annual output of the farmers.

Hypotheses Testing

There is no significant relationship between the ABP programmes and the annual income of rice farmers in Aninri LGA Enugu state.

The analysis of the relationship between participation in the Anchor Borrowers' Programme (ABP) and the annual income of rice farmers in Aninri LGA, Enugu State, shows a statistically non-significant result. The Pearson correlation coefficient ($r = 0.054$) with a p-value of 0.425 exceeds the 0.05 significance threshold, indicating no meaningful correlation between ABP participation and income level.

This suggests that despite the intended benefits of the ABP—such as access to credit, inputs, and training—the programme has not significantly improved the income of participating rice farmers in the study area. Possible reasons for this outcome may include implementation inefficiencies, market access limitations, climatic factors, or low adoption of improved practices.

The findings underscore the need to re-evaluate the structure and delivery mechanisms of the ABP, with particular attention to addressing external constraints that may be impeding its impact on farmers' financial outcomes.

Table 2: A correlation results of the significant relationship between the extended programs and perceived role of ABF programme in poverty alleviation among rice farm

		ABP PROGRAMS	MEAN PERCIEVED EFFECT
ABP PROGRAMS	Pearson Correlation	1	.179*
	Sig. (2-tailed)		.150
	N	120	120
PERCIEVED EFFECT	Pearson Correlation	.179*	1
	Sig. (2-tailed)	.150	
	N	120	120

*. Correlation is significant at the 0.05 level (2-tailed).

CONCLUSION

This study examined the effect of the Anchor Borrowers' Programme (ABP) on rice farmers' annual income in Aninri LGA, Enugu State, with a focus on their socio-economic characteristics, participation in ABP activities, and annual income levels. Findings revealed that the majority of rice farmers were actively involved in key ABP activities such as training, input supply, extension services, and equipment provision, indicating a fair level of programme implementation in the area.

However, despite these interventions, the statistical analysis showed no significant relationship between participation in the ABP and the annual income of rice farmers. The Pearson correlation coefficient ($r = 0.054$, $p = 0.425$) confirms that ABP participation did not translate into measurable income increases for beneficiaries.

This suggests that while the programme has successfully delivered several forms of support, its impact on income generation remains limited, likely due to factors such as uneven access to credit, poor infrastructure (e.g., water pumping machines), and weak market linkages. The study, therefore, concludes that enhancing the effectiveness of ABP requires a more holistic and inclusive approach that addresses both production and post-harvest challenges faced by smallholder rice farmers.

RECOMMENDATIONS

From the findings of this research, this study hereby recommends the following:

1. Strengthen farmers' access to financial support (credit, fertilizer, and running capital) and ensure timely disbursement to enable them scale up production.
2. Improve irrigation facilities by providing water pumping machines and other infrastructure to reduce dependence on rain-fed farming.

3. Enhance market linkages with reputable companies to ensure stable demand, better prices, and sustainability of rice farming under the ABP.

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12 – 14 Aug. @ Michael Okpara University of Agriculture, Umudike, Abia State
Theme: Agricultural Extension for Food Security and Community Empowerment

**The Scope of Internet Accessibility as A Tool for Learning among
Agricultural Undergraduate Students at Michael Okpara University of
Agriculture, Umudike, Abia State, Nigeria**

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ABSTRACT

The study evaluated the scope of internet accessibility as a tool for learning among agricultural undergraduate students at Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria. It specifically identified the rate at which the undergraduate students access relevant agricultural information on various agricultural disciplines and assess the militating constraints of assessing the internet. A stratified random sampling technique used in dividing the population into strata and Taro Yamme's Formula selected a sample size of 400 respondents. Data were collected using a well-structured questionnaire and were analyzed with both descriptive and inferential statistics. Major findings revealed that majority of the respondents access relevant information more on animal breeding genetics ($\bar{x}$ 3.01) and the major factor militating access is high cost of data ($\bar{x}$ 3.09). Pearson's Product Moment correlation coefficient revealed that there is no significant relationship between the students' access to internet facilities and their extent of use of internet as a learning medium at 5% level of significance. The study concludes that animal breeding is the discipline most B Agric. Students access relevant information and high cost of data are major constraints to accessing the internet. The study recommends that the institution should create awareness on the availability of WIFI within the school to enable students access the internet and provide education for digital literacy for the students on campus.

Keywords: Internet, Accessibility, Data, Learning Medium, Information

INTRODUCTION

The Internet serves as a global network connecting computers across different geographical locations, facilitating the exchange of information and resources through protocols like HTTP and email services (Bolu-Steve, Oyeyemi, and Amali 2015). It's essentially a network of networks enabling users to retrieve information and communicate with others globally (Sharma and Mohanty, 2020).

In technical terms, the Internet is a complex system of interconnected computer networks allowing for the exchange of data (Radovan, 2018). This "network of networks" encompasses diverse technological solutions, including web communication, email, online chat, video communication, file sharing, and online gaming (Radovan, 2018).

Today, the Internet has become an indispensable tool for communication, learning, and entertainment, profoundly impacting various aspects of modern life (Radovan, 2018). Its significance in education is particularly noteworthy, with tertiary institutions in Nigeria heavily investing in Internet infrastructure to enhance teaching and learning practices (Apuke and Iyendo, 2018). For undergraduates, the Internet plays a crucial role in academic pursuits, offering access to a wealth of information and materials for learning

(Adeyemi, 2019). It enables students to conduct research, complete assignments, make presentations, and prepare for examinations (Adeyemi, 2019). Additionally, the Internet fosters critical thinking, creativity, collaboration, and problem-solving skills among undergraduates (Dryli and Kinnaman, 2014). Overall, the Internet enhances accessibility to education, improves curriculum quality, and boosts academic productivity in universities (Adeya and Oyelaran-Oyeyinka, 2013). Its pervasive influence underscores its importance as a fundamental resource for educational and professional development.

The internet serves as a rich repository of information that proves highly beneficial to students, providing access to research materials and educational content that can significantly enhance their understanding of their coursework, particularly in fields like agriculture. Undergraduate students utilize the internet extensively for various purposes, such as staying updated on current events related to their areas of interest, engaging in social media interactions, completing assignments, and conducting research. In the context of this study, the focus lies on the extent to which B.Agric students utilize the internet as a tool for learning and deepening their comprehension of agricultural concepts. This highlights the importance of internet accessibility among undergraduate students, as it directly impacts their ability to leverage online resources for academic enrichment and skill development within their chosen field of study. This study was therefore conducted with the primary aim of evaluating the scope of internet accessibility as a tool for learning among agricultural undergraduate students at Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria. The specific objectives are to;

- i. identify the rate of access to relevant agricultural information on various agricultural disciplines and;
- ii. assess the constraint militating internet access by B.Agric students of MOUAAU.

HYPOTHESIS

H₀₁ There is no significant relationship between student's access to internet facilities and their extent of use of internet as a learning medium among B.Agric students of Michael Okpara University of Agriculture, Umudike (MOUAAU).

METHODOLOGY

The study took place at Michael Okpara University of Agriculture (MOUAAU) in Umudike, located within Ikwuano Local Government Area of Abia State (Ebube, Miracle, Onyinye, Blessing, 2023). MOUAAU's geographical coordinates are approximately latitude 5°4'01" and 6°04'1" north, and longitude 7°1'01" and 7°34'1" east, situated within the tropical climate zone characterized by distinct wet and dry seasons. The rainy period spans from March to October, while the dry season occurs from November to February. Meteorological data indicates an average daily rainfall of 146.5 mm and a relative humidity of 80%, with mean daily temperatures ranging from 21.9°C to 31.5°C (Ebube *et al.*, 2023). The university comprises twelve colleges, with this study focusing specifically on five agricultural colleges: the College of Agricultural Economics, Rural Sociology, and Extension (CAERSE); the College of Animal Science and Animal Production (CASAP); the College of Crop and Soil Sciences (CCSS); and the College of Natural Resources and Environmental Management (CNREM).

The study population included all final-year students and those in their third year at Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria. Stratified random sampling was employed, dividing the population into four strata: Stratum 1 comprised the College of Agricultural Economics, Rural Sociology and Extension (CAERSE), Stratum 2 included the College of Animal Science and Animal Production (CASAP), Stratum 3 consisted of the College of Natural Resources and Environmental Management (CNREM), and Stratum 4 encompassed the College of Crop and Soil Sciences (CCSS). To determine the sample size for the quantitative survey, Taro Yame's formula was utilized. This formula is suitable when the population is known but it is impractical to distribute questionnaires to every individual within the population. Therefore, the total number of students was used to calculate the sample size according to Taro Yame's formula as follows:

$$n = \frac{N}{1+N(e)^2}$$

n= Sample Size

N= Total Population of the study

e= Level of error i.e. 0.05

Table 1: Sample size of 500 level and 300 level students

College	300 level Population (N)	500 level Population (N)
College of Agricultural Extension, Rural Sociology and Extension (CAERSE)	156	89
College of Animal Science and Animal Production (CASAP)	124	78
College of Crop and Soil Sciences (CCSS)	133	88
College of Natural Resources and Environmental Management (CNREM)	214	123
Grand Total of 300 and 500 level population	1005	
Sample Size	400	
Sampling fraction (0.40)	300level: 250	500 level: 150

The sample size for the population of B. Agric students at Michael Okpara University of Agriculture, Umudike, Abia State, was determined using Taro Yamane's formula. According to Wikipedia (2021), the sampling fraction refers to the ratio of the sample size to the population size, or in the context of stratified sampling, the ratio of the sample size to the size of the stratum. A sampling fraction of 0.40 was utilized to determine the sample sizes for both 300 level students (250) and 500 level students (150).

Data analysis employed descriptive and inferential statistics. Objectives 1 and 2 were achieved through the use of means, and hypotheses were tested using Pearson's Product Moment correlation coefficient. The model is as follows:

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

Where,

r – Correlation effects

Y- access to internet facilities

X – extent of internet usage

n- sample size

RESULTS AND DISCUSSION

The rate at which B.Agric students access relevant information on the internet

Table 2 shows the result of the rate at which B.Agric students access relevant information on their various disciplines in agriculture. B.Agric students' access information more in animal breeding genetics ($\bar{x}$ 3.01) compared to other disciplines listed on the table. It suggests that students show a stronger inclination or interest in seeking out information related to animal breeding genetics compared to other areas within agriculture. This could reflect a particular interest, relevance, or perceived importance of this discipline among the students.

Table 2: Distribution of agricultural discipline on the rate of access to relevant information by the B.Agric students

Agricultural discipline	Always 4	Most times 3	Some times 2	Never 1	Total	Mean
Agricultural extension services	52(208)	57(171)	166(332)	131(131)	842	2.08
Agricultural marketing	32(128)	51(153)	174(348)	147(147)	776	1.92
Agricultural meteorology	22(88)	50(150)	170(340)	162(162)	404	1.00
Agricultural Policy Analyst	22(88)	54(162)	152(304)	178(178)	732	1.81
Agronomical practices	40(160)	76(228)	281(562)	111(111)	1061	2.63
Animal Health services	44(176)	101(303)	170(340)	117(117)	766	1.90
Animal breeding and genetics	42(168)	88(264)	330(660)	124(124)	1216	3.01
Business strategies in agriculture	58(232)	76(228)	154(308)	116(116)	884	2.19
Crop production and production practices	58(232)	88(294)	152(304)	106(116)	936	2.32
Essential storage facilities in agriculture	42(168)	62(186)	194(388)	106(106)	848	2.10
Farm mechanization	42(168)	78(234)	166(332)	118(118)	852	2.11
Fishery management	38(152)	66(198)	162(324)	140(140)	814	2.01
Fodder production	16(64)	96(288)	140(320)	142(172)	844	1.90
Forestry	26(104)	52(156)	142(284)	142(142)	686	1.70
Honey production and processing	18(72)	80(240)	170(340)	128(128)	780	1.93
Horticultural practices	24(96)	60(180)	196(392)	124(124)	792	1.96
Soil Survey and land use planning	26(104)	60(180)	158(316)	140(140)	740	1.83

Field Survey data, 2022.

Decision rule: A midpoint was derived as the acceptances mean = 2.5, which states that any mean score greater than 2.5, the response agrees with the objective but anything lesser than 2.5 the response disagrees with the objective.

Constraints Militating Internet Accessibility by B-Agric Students

The result shows that high cost of data ($\bar{x}3.09$) is one of the major factors that militates B.Agric students' access to the internet. With the cost of data being a substantial concern, students may face limitations in accessing educational materials, conducting research, and engaging in online learning activities essential for their academic success. This finding underscores the importance of addressing affordability issues surrounding internet access to ensure equitable opportunities for students to leverage digital resources in their studies.

The result also shows that lack of computer skill ($\bar{x}2.45$) is not a major factor that militate internet access, this result agrees with the findings from Mohammed, Muhammad and Tahiru (2017) research which also agree that poor computer skill is not a major factor that militate student from accessing the internet because only (8%) of the population lack computer skills

Table 3: Distribution of the factors militating internet accessibility B.Agric students

Items	Most severe 4	Very severe 3	Severe 2	Not severe 1	Total	Mean
High cost of data	158(632)	156(468)	68(136)	14(14)	1,250	3.09
Poor network	118(472)	166(498)	91(182)	35(35)	1,187	2.94
High cost of ICT device	150(600)	160(480)	82(164)	14(14)	1,258	3.11
Lack of computer skills	80(320)	96(288)	148(296)	84(84)	988	2.45

Field Survey data, 2022.

Decision rule: A midpoint was derived as the acceptances mean = 2.5, which states that any mean score greater than 2.5, the response agrees with the objective but anything lesser than 2.5 the response disagrees with the objective.

Hypothesis

There is no significant relationship between student's access to internet facilities and their extent of use of internet as a learning medium among B.Agric students of Michael Okpara University of Agriculture, Umudike (MOUUAU).

The Pearson's Product Moment correlation coefficient was used to determine the relationship between the student's access to internet facilities and their extent of use of internet as a learning medium. At 0.05 alpha level, the calculated r-value of 0.033 which was less than the tabulated r-value (0.195), shows that there is no significant relationship between the students, access to internet facilities and their extent of use of internet as a learning medium. Therefore, the null hypothesis which states that there is no significant relationship between B.Agric students' access to internet facilities and their extent of use of internet as a learning medium is accepted.

Table 3: Test of significant correlation between the student's access to internet facilities and their extent of use of internet as a learning medium

Access to Internet/Level of use of internet	Pearson Correlation(r-cal)	Sig. (2-tailed)	n	df	r-tab (PPMC table)	Decision
Internet/Level of use of internet	0.033 ^{ns}	0.488	444	442	0.195	H₀ accepted

Field Survey data, 2022.

p≤0.05 ns = not significant

CONCLUSION

In conclusion, the findings of this study shed light on several important aspects regarding B.Agric students' access to internet resources and their utilization for learning purposes. Firstly, it was observed that students display a pronounced interest in accessing information related to animal breeding genetics, indicating a particular affinity or perceived importance of this discipline within agriculture. However, the study also identified the high cost of data as a significant barrier to students' internet access, potentially limiting their ability to engage with online educational materials essential for academic success. Notably, lack of computer skills was found to be less influential in impeding internet access among students, aligning with previous research. Furthermore, the analysis revealed no significant correlation between students' access to internet facilities and their extent of use of the internet for learning purposes, underscoring the need for further exploration of factors influencing internet usage patterns among B.Agric students. These findings emphasize the importance of addressing affordability issues surrounding internet access and highlight the complex interplay of factors impacting students' utilization of digital resources in agricultural education.

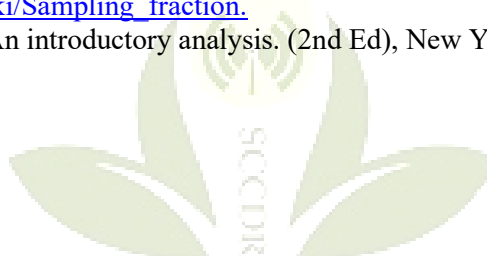
RECOMMENDATIONS

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

1. **Create awareness on availability of data within the school:** Michael Okpara University students have access to the university's Wi-Fi upon payment of their school fees. Therefore, efforts should be made to raise awareness throughout the campus to encourage more students to utilize the internet through the Wi-Fi provided by the university.
2. **Enhance Digital Literacy Programs:** While lack of computer skills may not be a major impediment to internet access among students, it is still essential to provide opportunities for enhancing digital literacy. Educational institutions should consider implementing comprehensive digital literacy programs to equip students with the necessary skills to navigate online learning platforms effectively, utilize digital resources for academic purposes, and critically evaluate information obtained from the internet. This can empower students to make the most of available online resources and enhance their academic success in agricultural education.

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**SOCIETY FOR COMMUNITY & COMMUNICATION DEVELOPMENT RESEARCH
CONFERENCE PROCEEDINGS**



4th Biennial Conference, 2025

12 – 14 Aug. @ Michael Okpara University of Agriculture, Umudike, Abia State

Theme: Agricultural Extension for Food Security and Community Empowerment

**Analysis of Garri Wholesale Marketing in Bende Local Government
Area, Abia State, Nigeria**

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ABSTRACT

The study analyzed garri wholesale marketing in Bende Local Government Area, Abia State, Nigeria. Specifically, the study determined the cost, returns and marketing efficiency of garri wholesale marketing in the study area; estimated the determinants of net returns of garri wholesale marketers in the study area and identified the challenges of garri wholesale marketing in the study area. The study population comprised of all garri wholesale marketers in Bende Local Government Area, Abia State. The sample size of this study was 60 respondents, selected using a multistage sampling procedure. Data for the study were obtained using a structured questionnaire and were analysed with means, frequencies, percentages, cost and returns, marketing efficiency and multiple regression models. Results showed that the marketers recorded net returns of ₦208,818.93, implying that wholesale garri marketing is lucrative with the potential for higher net returns and should be taken as a source of livelihood. Age ($p < 0.05$), household size ($p < 0.05$), marketing experience ($p < 0.01$), transport cost ($p < 0.01$), and cooperative membership determined the net returns of the marketers. All (100%) of the respondents identified high transportation costs, high purchase costs, and limited access to finance as critical challenges in their operations. The study recommended that the government implement transport subsidies (Government transport services) for wholesale garri marketers to cushion the effect of high transport costs on their net returns.

Keywords: Marketing channels, net return, variable cost, fixed cost, marketing efficiency, challenges

INTRODUCTION

Garri is a staple food item widely consumed in Nigeria, Ghana, Benin, Togo, and other West African countries (Obekpa *et al.*, 2022). It forms the base of many traditional meals and can be enjoyed in different ways. In Nigeria, garri is typically eaten with soups, stews, or sauces after being soaked in water to create a dough-like consistency (Ettah and others, 2020). It is high in vitamins, minerals, weighs between 360 and 400 kcal, has 0–1 gram of fat, 1-2 grams of dietary fiber, and 1-3 grams of protein. Garri is a product with enormous marketing potentials in Nigeria.

There is a sizable market for garri marketers in Nigeria because of its steady demand across different demographic groups and geographical areas (Morris *et al.*, 2022). Garri marketing could be described as the set of activities that involves in the buying, selling, distribution and promotion of garri, aimed at ensuring that the product moves from the producer to the final consumer (Ebewore and Eldore, 2015). Retailers and wholesalers are largely responsible for garri marketing in Nigeria, which calls for value addition, brand development, a diverse consumer base, efficient distribution routes, and the use of both traditional and digital tactics.

Wholesaler are intermediaries that buys garri in bulk straight from processors, facilitating the movement of the product from the processors to regional markets, acting as a middleman between garri producers and retailers (Okechalu *et al.*, 2022). They create distribution networks and supply chains to reach supermarkets, retailers, and other large purchasers. Depending on the size of their business, wholesale garri marketers in Bende Local government Area sell to both domestic and regional markets. For their marketing operations and procedures to run smoothly and generate profits, garri wholesalers need an efficient marketing system (Azubuike, 2023).

Agbebi and Adetuwo (2018) stated that a marketing system is considered efficient if it maximizes the ratio of marketing input to output or provides customers with satisfactory, reasonably priced services. It ensures high product standard, processing methods, and returns on investment. Efficient marketing system helps wholesalers to understand consumer preferences, demand patterns, and pricing dynamics (Isitor *et al.*, 2016). Furthermore, efficient wholesale garri marketing depends on fundamental market infrastructures including storage, transportation, and packaging facilities, as the implementation of appropriate storage and preservation methods can increase product quality and satisfaction (Ke'gah and Ndjouenkeu, 2023).

Nonetheless, the Nigerian garri wholesale marketing system face many challenges such as ineffective transportation infrastructure that prevents wholesalers from operating optimally. Due to poor roads, ineffective facilities, and clogged highways, garri wholesalers in Bende Local Government Area, Abia state, incur high transportation costs (Azubuike, 2023). Inadequate storage facilities are another problem facing wholesale garri sellers. Garri is susceptible to pests, heat, and dampness; however, insufficient storage facilities might reduce the quality and profit of the marketers.

There is a noticeable research gap on wholesale-on-wholesale garri marketing in Bende Local Government Area, despite the fact that numerous studies in Abia State have looked at garri value chain. For example, like Azubuike (2023) studied risk management practices by garri producers in Bende Local Government Area of Abia State, Nigeria; Onwukwe & Udokure (2021) analyzed enterprise combination and net profit of garri marketers in Ikwuano Local Government Area, Abia State, Nigeria. However, none of these studies have analyzed garri wholesale marketing in Bende Local Government Area, Abia State, Nigeria. This study sought to filled this research gap. The specific objectives of the study were to:

- i. determined the cost, returns and marketing efficiency of garri wholesale marketing;
- ii. estimated the determinants of net returns of the marketers;
- iii. and identified the challenges of garri wholesale marketing in the study area.

METHODOLOGY

Study Area

The study was conducted in Bende Local Government Area of Abia State, Nigeria. Bende Local Government Area lies on latitude: 5° 33' 31.46" N of Equator and Longitude: 7° 38' 0.92" E of Greenwich meridian. The Local Government Area has a population of 52,300 (Bende Local Government Area profile, 2016). The LGA is bounded in the North by Cross River State, Afikpo and Ohazara LGAs of Ebonyi State, in the West by Isukwuato, in the East by Ohafia and Arochukwu LGAs, in the South -West Umuahia North and South LGAs; in the South -South by Ikwuano LGA. The LGA is made up of eleven communities, these include Ozuitem, Ugwueke, Okporoenyi, Itumbuzo, Umuju-ezechi, Umu-menyi, Igbere, Item, Alaye, Nkpa and Uzuakoli. Agriculture is the major occupation of the people in the local government area. The people produce food crops like rice, maize, cassava, plantain, banana also small ruminant animals are reared.

Sampling Technique

The study population comprised all garri wholesale marketers in Bende L.G.A, Abia State. The sample size of this study was 60 respondents. In the selection of 60 respondents, multistage sampling procedures were used. In the first stage, three communities namely; Bende District, Ugwueke and Uzuakoli were purposively selected for the reason of large markets for garri marketing. In the second stage, two (2) markets were randomly selected from each of the selected communities given a total of six (6) markets for the study

(Afia Eke market, Orié Ugba market, Ebem market, Item market, Alayi market and Bende market) In the final stage, ten (10) garri wholesale marketers were randomly selected from the six (6) markets, making it sixty (60) respondents.

Data Analysis

Data for the study were obtained from primary source through the use of structured questionnaire.

Objective i was analyzed with budgetary approach as follows:

$$NR = TR - TC \dots\dots\dots 1$$

$$TR = P \times Q \dots\dots\dots 2$$

$$TC = TVC + TFC \dots\dots\dots 3$$

Where:

TR = Total Revenue,

TVC = Total Variable Cost,

TFC = Total Fixed Cost,

TC = Total Cost

NR= Net Return

Q = Quantity (kg)

P = Price (₦)

Marketing efficiency was realized using marketing efficiency ratio. The formula is specified as follows:

$$M. E = \frac{\text{Value added by marketing (Net profit)}}{\text{Total marketing cost}} \times 100 \dots\dots\dots 4$$

Where:

M. E = Marketing efficiency

Objective ii was analyzed with OLS multiple regression model.

The multiple regression model is specified implicitly thus:

$$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10}, X_{11}) \dots\dots\dots 5$$

Y = Net returns (₦)

X₁ = Age (Years)

X₂ = Marital status (Married=1, others=0)

X₃ = Marketing experience (Number of years spent in garri marketing)

X₄ = Household size (No of household members)

X₅ = Level of Education (No of years spent in school)

X₆ = Transportation cost (₦)

X₇ = Storage cost (₦)

X₈ = Purchase cost (₦)

X₉ = Cost of loading/offloading (₦)

X₁₀ = Selling price (₦)

X₁₁ = Market union membership (Yes=1, no=0)

β₀ = Intercept

β₁- β₁₁ = Parameter estimate

Objective iii was analyzed with descriptive statistical tools such as frequency, means and percentages.

RESULTS AND DISCUSSION

Cost, returns and marketing efficiency of garri wholesale marketing

Cost, returns and marketing efficiency of garri wholesale marketing are shown in Table 1.

Table 1: The distribution of the respondents according to cost, returns and marketing efficiency of garri wholesale marketing

Items	Amount (₦)	%
Total Monthly Revenue	466,666.69	
Average quantity sold (kg)	7	
Average selling price per kg	66,666.67	
Variable cost (₦)		
Average purchase cost	235,000.00	91.14
Transportation cost	5,020.00	1.95
Market charges	2,728.33	1.06
Storage cost	3,548.33	1.38
Total Variable Cost (TVC)	246,296.66	95.52
Fixed cost (₦)		
Rent	6,478.33	2.51
Depreciation on assets	5,072.77	1.97
Total Fixed Cost (TFC) (₦)	11,551.10	4.48
Total cost (TVC+TFC) (₦)	257,847.76	100
Net Income (TR-TC)	208,818.93	
Marketing efficiency (%)	100.00	

Source: Field Survey, 2025

Results in Table 1 show that the respondents' total revenue was ₦466,666.69, their total costs was ₦257,847.76, and their net income was ₦208,818.93. This implies that wholesale garri marketing is profitable, has the potential to increase net income, and ought to be considered a means of livelihood. This finding is in tandem with Zakariya *et al.* (2019), who reported that wholesale garri marketing in Ankpa LGA of Kogi State was profitable.

Results also showed that the respondents were efficient with efficiency value of 100%. This implies that they have achieved the highest possible return on their operating expenses by successfully turning their investments into earnings. This also means that their price policies, distribution plans, and general market strategy are set up to satisfy customer demand while controlling expenses. This result is in line with that of Isitor, Babalola, and Abegunde (2019), who found that garri marketing in Kwara State was profitable and efficient.

Determinants of net returns of garri wholesale marketers in the study area

Determinants of net returns of garri wholesale marketers are presented in Table 2

Table 2: Determinants of net returns of garri wholesale marketers in the study area

Variable	+Linear	Exponential	Semi-log	Double log
Constant	-13.85 (-1.53)	1.36 (1.32)	-761.81 (-10.32) ***	-4.54 (-8.46) ***
Age	0.23 (2.05) **	0.03 (0.52)	30.02 (1.44)	0.23 (1.58)
Marital status	1.12 (0.67)	-0.02 (-1.37)	17.94 (2.14) **	0.05 (0.82)
Education	-0.36 (-0.91)	-0.06 (-1.51)	6.10 (0.65)	-0.01 (-0.28)
Household size	0.38 (2.44) **	0.06 (3.64) ***	-1.01 (-0.29)	0.01 (0.72)
Marketing experience	0.65 (3.49) ***	0.08 (4.01) ***	-18.95 (0.68)	0.50 (0.68)

Market union membership	0.05 (3.57) ***	0.04 (-2.39) **	-11.29 (-2.57) **	-0.07 (-2.31) **
Purchase price	-2.30 (-1.57)	-0.04 (-0.83)	-0.36 (-0.05)	-0.09 (-1.61)
Transport cost	-0.01 (-26.65) ***	9.92 (22.52) ***	114.52 (18.37) ***	0.98 (21.77) ***
Cost of Loading/Offloading	-0.01 (-0.76)	-6.80 (-0.03)	25.55 (2.36) ***	0.02 (0.32)
Selling price	-0.34 (-0.18)	-0.08 (-0.42)	-3.85 (-0.39)	-0.03 (-0.48)
Storage cost	0.06 (0.75)	0.08 (0.87)	9.63 (0.59)	0.12 (1.01)
R²	0.9585	0.9391	0.9087	0.9345
Adjusted R²	0.9479	0.9236	0.8854	0.9177
F- statistic	90.46***	60.41***	39.00***	55.84***
No. of respondents	60	60	60	60

Source: Field survey, 2025, ***, **, and * represents 1%, 5% and 10% levels of significance, Figures in parenthesis are t-ratio.

Results of the determinants of net returns of garri wholesale marketers in the study area are presented in Table 2. The linear functional form was chosen as the lead equation and it shows that the value of the coefficient of multiple determinations (R^2) was 0.9585. This implies that 95.85% of the variations in the net returns of the respondents were explained by the regressors included in the model. The F-value of 90.46 was significant at 1% level, presaging the significance of the entire model. Age ($p < 0.05$), household size ($p < 0.05$), market union membership ($p < 0.01$) and transport cost ($p < 0.01$) were the determinants of net returns of the marketers.

The coefficient of age (0.23) was statistically significant at 5% level and positively related to the net returns of the respondents, implying that as the marketers grow older, their net returns also tend to increase. This trend may be attributed to several factors, including the accumulation of experience, enhanced skills, and better decision-making capabilities that often come with age. Older marketers are likely to have developed valuable relationships within the market, allowing them to negotiate better prices and access more lucrative opportunities. This finding contradicts with Aturamu *et al.* (2021) who analysed of profitability and market outlets of garri marketers in Ondo State, Nigeria and reported that age influenced the net returns of the marketers negatively.

The coefficient of household size (0.38) was statistically at 5% level and positively related to the net returns of wholesale garri marketers. This implies that as the number of individuals in a household increases, the net returns for these wholesale garri marketers also tend to rise. A larger household may mean more hands available to assist in the business, leading to increased net returns. Family members can contribute to tasks such as transporting goods, managing sales, and handling customer interactions, which can ultimately enhance the overall performance of the business. This finding aligns with Nwajei *et al.* (2017), who examined the factors affecting income of garri marketers in Imo State and reported that household size increased the net income of the marketers.

The coefficient of marketing experience (0.65) was statistically significant at 1% level and positively related to the net returns of the respondents. This finding suggests that as the marketing experience of the wholesalers increases, their net returns also tend to rise significantly. Greater experience in the market allowed the respondents to develop essential skills, such as effective negotiation, pricing strategies, and customer relationship management, which are crucial for maximizing profitability. More so, their familiarity with market trends and consumer preferences enables them to make informed decisions that can lead to higher returns. This finding is in line with Oluwatusin (2017), who assessed economic of gari marketing in Osun State Nigeria and reported that experience influenced net income positively.

The coefficient of transport cost (-0.01) was statistically significant at 1% level and negatively related to the net returns of the respondents. This suggests that as transport costs increase, the net returns for wholesale

garri marketers tend to decline. Higher transportation expenses can significantly erode profit margins, making it more challenging for marketers to maintain profitability in their operations. As costs associated with moving goods from one location to another rise, it directly impacts the overall financial performance of the business, leaving less income available after expenses. This finding is in tandem with Nwajei *et al.* (2017), who reported a negative relationship between transport cost and net income of garri marketers in Imo State.

The coefficient of cooperative membership (0.05) was statistically significant at 1% significant level and positively related to the net returns of the respondents. This implies that being a member of a cooperative significantly contributes to the net returns of wholesale garri marketers. Cooperative membership often provides access to collective resources, shared knowledge, and enhanced bargaining power, which can lead to higher net returns. Marketers who are part of cooperatives can benefit from lower purchasing costs, joint marketing efforts, and support in managing operational challenges, all of which can enhance their financial performance. This finding is in tandem with Onwukwe, and Udokure (2024) who assessed enterprise combination and net profit of garri marketers in Ikwuano Local Government Area, Abia State, Nigeria, and reported that cooperative membership influenced the net income of the marketers positively.

Challenges of garri wholesale marketing in the study area

Challenges of garri wholesale marketing in the study area shown in Table 3

Table 3: Challenges of garri wholesale marketing in the study area

Variables	Frequency*	%	Rank
Price fluctuation	44	73.33	4 th
High cost of transportation	60	100	1 st
High purchase cost	60	100	1 st
Storage issues	36	60.00	5 th
Limited access to finance	60	100	1 st
High market charges	46	76.67	3 rd
Low patronage	59	98.33	2 nd
Under-developed market	46	76.67	3 rd

Source: Field survey, 2025 *Multiple responses recorded

Results in Table 3 showed that all (100%) of the marketers identified high transportation costs, high purchase costs, and limited access to finance as the most pressing issues. High transportation costs increase operational expenses, thereby reducing net margins and limiting the ability of marketers to compete effectively. This aligns with the findings of Obekpa *et al.* (2022), who also reported high transportation costs as a major constraint in garri marketing in Kaduna State. Similarly, high purchase costs suggest that wholesalers acquire garri from producers at elevated prices, which limits their flexibility in pricing to attract customers while still maintaining profitability. Limited access to finance further compounds these challenges by restricting marketers' capacity to expand their operations, invest in bulk purchases, or adopt efficiency-enhancing measures. Other notable constraints with high prevalence include low patronage (98.33%), high market charges (76.67%), under-developed market infrastructure (76.67%), price fluctuations (73.33%), and storage issues (60%). Low patronage may be linked to reduced consumer purchasing power or competition from other food products, directly impacting sales volume and income.

CONCLUSION

Wholesale garri marketing is profitable and efficient in the study area. Net income was influenced by age, experience, household size, transport cost and cooperative membership. Despite of the positive income earned by the marketers, the enterprise was hindered by several challenges, notably the burden of high transportation and purchase costs, unpredictable price fluctuations that affect market stability, and limited access to affordable financing, which constrains business expansion and resilience against market shocks.

RECOMMENDATIONS

1. In order to reduce transportation costs and ensure smooth movement of garri from producers to consumers, marketers should collaborate to pool resources for road maintenance or jointly arrange affordable transport services.
2. Cooperatives and microfinance banks should offer garri marketers soft loans and credit facilities to help them expand their businesses and effectively manage price fluctuations, as limited access to finance negatively influenced their net income.
3. Cooperative membership showed a positive influence on net income of the marketers, so efforts should be made by garri marketers to form/join cooperatives in order to benefit from bulk purchasing, collective bargaining, and training that can improve their profit margins and marketing abilities.

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**SOCIETY FOR COMMUNITY & COMMUNICATION DEVELOPMENT RESEARCH
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4th Biennial Conference, 2025

12 – 14 Aug. @ Michael Okpara University of Agriculture, Umudike, Abia State
Theme: Agricultural Extension for Food Security and Community Empowerment

**Effect of Adoption of Improved Cassava Technologies on the
Livelihood of Women Farmers in Anambra State, Nigeria**

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ABSTRACT

This study assessed the effect of adoption of improved cassava technologies on the livelihood of women farmers in Anambra State, Nigeria. Specifically, the study determined the level of adoption of improved cassava technologies; determined the extent to which the technologies positively impacted on the livelihood of women farmers in the study area; assessed the level of farm income before and after the adoption of the technologies by women farmers and to identify constraints to adoption. A purposive and multistage random sampling procedure was used to select a sample of 50 cassava women farmers. Data were collected using structured questionnaire and was analyzed using frequency, percentage, count rating and z-test. The level of adoption of cassava technologies was high with a grand mean of ($\bar{x} = 2.39$) which is higher than the mean cut off of 2.0. The adoption had positive effect on the livelihood of the women mostly on paying of children school fees, good health and nutrition, increased availability of food, and income generation. The study concluded that majority of the women farmers willingly adopted the improved technologies and it has increased their farm income levels and livelihood to an extent. It is highly recommended that, the women farmers should be encouraged by providing timely information on improved technologies, availability of the stem and provision of incentives to enable them enhance their level of adoption and greatly improve their livelihoods.

Keywords: Adoption, Effect, Cassava, Women Farmers, Nigeria

INTRODUCTION

Cassava (*Manihot esculenta* Crantz) remains a vital crop in Nigeria's agricultural sector. It is the most important root crop grown in Nigeria and its potential to fight hunger and food insecurity is documented (NRCRI, 2023). However, today cassava has become a very scarce and expensive product to get in Nigeria. Recognizing the importance of cassava, research institutes have developed improved technologies to enhance yield and address food insecurity. The main solution to this problem is adoption of improved cassava varieties and production technologies by the farmers (Amadi *et al.*, 2020). In order to relieve farmers from this problem of poor yield in cassava, IITA, Ibadan and NRCRI, Umudike collaborated to developed many hybrid cassava varieties through selective breeding, capable of adapting to a wider range of ecological conditions and farming systems (IITA, 2017; Abdoulaye, 2015). These improved varieties have high yielding capacity per unit land area. They tolerate major diseases and pests of cassava (NRCRI, 2020). They also have low cyanide content, high starch, high gari index and are early maturing and bulking, stay green, drought tolerant, yellow root, protein and vitamin (NRCRI, 2020). Some of the selected improved cassava technologies studied are: TME 419, Hope, Farmer's Pride, Poundable, Pro Vitamin A Cassava and Value-added products (bread, cake, chin-chin, doughnut, and biscuits among others).

Women dominate agricultural production in Nigeria. Women play important roles in the home economic life of society and their contributions to agricultural output should never be undervalued (Amadi *et al.*,

2020). About 70% of women are very much involved into agricultural practices especially in the area of cassava production. In Nigeria, women are very much involved into cassava production, processing and marketing activities (Amadi *et al.*, 2018). Women play a central role in cassava farming, handling tasks such as land preparation, weeding, harvesting, transportation, processing, and marketing. Their involvement provides additional income opportunities and strengthens household food security (Onwusiribe *et al.*, 2022). Progressively, the need to find out the level of adoption, extent the adopted crops has positively impacted on the livelihood of the women cultivars came up. Given the increasing adoption of improved cassava varieties, there is a need to evaluate the extent to which these technologies have influenced the livelihood of women farmers. Therefore, this study determined the level of adoption of improved cassava technologies; determined the extent to which the technologies positively impacted on the livelihood of women farmers in the study area; assessed the level of farm income before and after the adoption of the technologies by women farmers and identified constraints to adoption.

METHODOLOGY

The study was conducted in Anambra State, Nigeria. A multistage sampling procedure was used in selecting the sample for this study. In the first stage one agricultural zone (Anambra) was purposively selected. This is because improved cassava technologies have been massively disseminated and cultivated in those areas. The second stage involved the selection of two (2) blocks (Anyamelu and Oyi) from the agricultural zone. The third stage involved the random sampling of one (1) circle from each block, totaling two (2) circles altogether. Twenty-five (25) women cassava farmers were randomly selected from the list of the farmers in the area, making it a total number of 50 women cassava farmers for the study. Data were collected using structured questionnaires and was analyzed using descriptive such as frequencies, percentages; mean count of 3 point (the points were adopted and still using = 3, adopted and stopped = 2, never adopted = 1). In using the 3point rating type, a mid-point was obtained by adding 3, 2 and 1 which gave 6 and when divided by 3 gave a mean score of 2.0. For the purpose of decision, any mean score response above the upper limit was adjusted to indicate high and moderate adoption, while any mean score responses lower than the upper limit was viewed as low adoption of cassava technologies). More so, mean count of 5point likert scale was also used (the points were: very much = 5, much = 4, moderate = 3, low = 2, very low = 1). In using the 5point rating scale, a mid-point was obtained by adding 5, 4, 3, 2 and 1 which gave 15 and when divided by 5 gave a mean score of 3.0. For the purpose of decision making, any mean score response above the upper limit was adjusted to indicate much impact, while any mean score responses lower than the upper limit was viewed as low impact of adoption of cassava technologies), respectively, and z-test.

The models specification for Z-test is thus;

$$Z = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$

Where z = calculated value of difference between means

$\bar{x}$ = Mean income of women farmers in naira before adopting the technologies

$\bar{x}$ = Mean income of women farmers in naira after adopting the technologies

n_1 = Sample size of respondents before adopting the technologies

n_2 = Sample size of respondents after adopting the technologies

σ_1^2 = Standard deviation of respondents before adopting the technologies

σ_2^2 = Standard deviation of respondents after adopting the technologies.

RESULTS AND DISCUSSION

Level of adoption of improved cassava technologies

Table 1 shows the mean scores distribution of the level of adoption of cassava technologies in the study area. The overall level of adoption of cassava technologies by the women farmers in Anambra was high with a grand mean of ($\bar{x}$ = 2.39) which is greater than the decision mean cut-off of 2.0 with TMS 419, game

changer and farmer's pride having the highest mean adoption score of ($\bar{x}$ =2.86), ($\bar{x}$ =2.7) and ($\bar{x}$ =2.68) respectively. The implication of the results is that adopters adopted the technologies because of its impact on their livelihood. This finding is in accordance with the report of Abdoulaye *et al*, (2014) in Amadi *et al*, (2020) who stated that several factors could drive the adoption process.

Table 1: Level of adoption of improved cassava technologies by women farmers

Cassava Technologies	Mean	Std.	Remark
TME 419	2.86	.0572142	High
Hope	2.64	.0937213	High
Farmer's Pride	2.68	.0779325	High
Game changer	2.7	.0820652	High
Yellow root cassava	2.62	.0942857	High
Cassava flour	2.56	.0954474	Moderate
Value-added products (bread, chin-chin, cake, etc.)	2.58	.1033717	Moderate
Grand mean	2.6		High

Source: field survey, 2024

2.6 and above – High adoption; 2.00 -2.59 – Moderate; below 2.00 – Low adoption.

Extent to which cassava technologies positively effect on the livelihood of women farmers in Anambra state, Nigeria

Table 2 shows that majority of the selected improved cassava technologies had positive effect on the livelihood of the women farmers in Anambra, mostly TMS 419, game changer, farmers pride and yellow root cassava, especially in the areas of increased availability of food, income generation, paying children school fees, among others, with a grand mean of 4.03 which is greater than the decision mean cut off of 3.00. The result shows that TMS 419, game changer and farmer's pride majorly had positive effect on the livelihood of the women farmers. The implication is that high adoption of improved varieties brings about improvement in the livelihood of adopters. This finding agrees with the report of Ironkwe *et al.*, (2012) in Amadi *et al.*, (2024) that farmers adopt those technologies that have high impact on their socio-economic status.

Table 2: Distribution of the women according to the extent the cassava technologies positively impacted on their livelihood

Variables	Mean	Std.	Remarks
Good health & nutrition	3.96	.077746	Much
Wedging of poverty	3.99	.0658971	Much
Income Generation(money)	4.18	.0743728	Very much
Acquired new property (kitchen equipment)	3.93	.0912926	Much
Employment for household	3.53	.10096	Much
Increased availability of food	4.84	.054532	Very much
Paying of children school fees	4.05	.0687184	Very much
Increased cassava farmland	3.84	.0800505	Much
Financial empowerment	3.93	.0728288	Much
Grand mean	4.03		Very much

Source: field survey data, 2024;

4.0 and above -very much; 3.5 -3.99 – much; 3.0 – 3.49 - moderate, 2.99 – 2.5 - low; 2.49 and below - very low.

Z-test showing the difference in income of cassava technologies in Anambra State

Table 3 shows that Z-test statistic shows significant difference ($P < 0.01$) in income of cassava women farmers before and after adoption of cassava technologies in Anambra State, Nigeria. From the result, mean income before adoption of improved cassava technologies was ₦119, 840.00, while mean income after adoption of improved cassava technologies was 275, 500.00. There was cassava income difference of ₦155,

660.00 with z-test value of (4.6731***) at 1% significant level. The findings of this study is in line with Onwusiribe *et al.* (2022) that adoption of improved crop varieties increased farmers income which in turn improves the capacity to adopt other agricultural innovations as they have the necessary capital to start the innovation.

Table 3: Z-test showing the difference in farm income of women farmers before and after adopting cassava technologies in Anambra State, Nigeria

Variable	Individual Mean	Mean Difference	Standard Err.	Z-Value	Sig
Income before adopting cassava technologies	119, 840.00	155, 660.00	13793.12	4.6731 ***	0.000
Income after adopting cassava technologies	275, 500.00		30319.47		

Field survey data, 2024

Constraints to the adoption of cassava technologies

The results revealed that almost all the possible constraints investigated in the study were serious constraints to adoption of cassava technologies by women farmers. In Anambra, insecurity, high cost of labour, lack of credit facility, inadequate information, and high cost of planting materials were the most serious constraints to adoption of improved cassava technologies by the women farmers. The implication is that these factors are more or less retrogressive to the total adoption goal of improved technologies. This finding is in line with Onyeneke *et al.*, (2018) who reported that reality of new hybrid varieties and its improved farming system, sometimes introduces certain difficulties for smallholder farmers to adopt due to inadequate fund and credit facilities.

Table 4: Constraints to the adoption of cassava technologies

Variables	Frequency	Percentage	Rank
Unavailability of cassava varieties	27	54.00	5 th
High cost of planting materials	30	60.00	4 th
Marketing problems	15	30.00	7 th
High cost of labour	35	70.00	2 nd
Lack of credit facility	31	62.00	3 rd
Inadequate information	30	60.00	4 th
Inadequate knowledge on value addition products	26	52.00	6 th
Insecurity	38	76.00	1 st
Total	50	100.00	

Source: Field Survey data, 2024 multiple responses

CONCLUSION AND RECOMMENDATIONS

In conclusion, the study recorded high level of adoption of cassava technologies among women farmers in the study area. Technology adoption increased their farm income and had positive effect on their livelihood. The study also concluded that high adoption of improved cassava technologies brings about improvement in the livelihood of adopters, especially in the area of increased availability of food, income generation. paying of children school fees, among others. It is therefore, recommended that the women should be encouraged to continue with the technologies by creating more awareness, dissemination of new technologies and conducting training on value-addition of the technologies for the women farmers to further boost adoption, enhance the quality and productivity of cassava as well enhance the livelihood of the women farmers.

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Food Stability and Access of Rural Women in On-Farm and Off-Farm Activities in South East, Nigeria

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ABSTRACT

The study assessed food stability and access of rural women involved in on-farm and off-farm activities in South East, Nigeria. The study specifically examined the food stability and access of the respondents, and the incomes of respondents involved in on-farm and off-farm activities. A multistage random sampling technique was used to select a sample size of three Hundred and sixty (360) respondents from three (3) states in the South East Nigeria. Data collection was done with copies of the questionnaire and analyzed using both descriptive and inferential statistics such as Z-test. Major findings showed that the women involved in on-farm activities earned lower income than their counterparts in off-farm activities as those involved in cereal cropping (87.2%) earned ₦1500/month and while those involved in petty trading (50.60%) earned ≤ ₦12,600/month. The level of Food access in the area was low with a grand mean of 1.7 which meant food was not accessible in the study area. Measuring food stability, a grand mean score of 2.8 was realized, indicating that food was stable in the study area. The Z-test was significant at 5%, indicating that there was a significant difference in the income obtained from off-farm and on-farm activities. The study recommended that non-governmental organizations, farm groups and individuals should invest in rural infrastructure like storage facilities as this will help the rural women to store their perishable food items and thus improve food stability and access.

Keywords: food, food access, food stability, Income, on-farm activities, off-farm activities,

INTRODUCTION

Food is a substance that provides the body with essential nutrients, energy, promote growth and sustain vital processes (FAO, IFAD, WFP and WHO 2023). It nourishes and supports the human existence and so to have a healthy life, we must observe the rules guarding food intake (Thomas, 2023). Rural women undertake many on-farm and off-farm activities to essentially support the necessary food needs of the family.

Women often pursue several on-farm and off-farm activities in a bid to maintain their food stability and access. To be food secure, a population, household or individual must have access to adequate food at all times. They should not risk losing access to food as a consequence of sudden shocks (e.g. an economic or climatic crisis) or cyclical events (e.g. seasonal food insecurity) (Quniton, Jenkins and Olasehinde-R, 2024). In this study, food access is described as the various sources of food available to the respondents while food stability examined terms such as occurrence of shocks, lean periods and how respondents coped during lean periods in the study area. FAO (2024) described food access by individuals to include having adequate resources to cater for their food needs at the household level.

On-farm activities are said to be all farming activities or all activities done in the farm while off-farm activities included all activities done outside the farm to support the waiting periods inherent in the farming world. For this study, this included, cereal cropping, roots and tuber farming, vegetable/plantain farming, poultry farming, provision of labour services, goat/sheep farming and snail/snailery farming. Off-farm activities for this study included tailoring, weaving of hair/salon, petty trading, restaurant, hawking of food items/snack, sell of beans balls/yam/potatoes and babysitting the elderly and children.

It has become obvious that women engage in on-farm and off-farm activities to sustain their families and mostly to achieve food security. Today, the issue of food security has become paramount as most organization and government seek lasting solution to reduce the pangs of hunger and food insecurity. The quest for easy money-making strategies and the greatly sort white collar jobs had led to the abandonment of the hoes, machet and so farm work has been made obsolete. In return, hunger, poverty and frustration has become the companion of man in the now. Presently, agriculture is taken as a seasonal occupation except for a few areas that practice irrigation and agriculture (Wani *et al* 2024). FAO (2024) has given four examples of what makes a nation food insecure, they as follow:

- a) When the food source has greatly reduced and there isn't efficient way to replace it.
- b) High incidence of malnutrition that is not related to health factor for some parts of the year.
- c) Unsustainable food base.
- d) When people's livelihood has become very unstable, thereby discouraging lives.

GRFC (2024) suggested that in the recent times, there has been an occurrence of food crisis in the nation due to unimproved food production and the incessant attack of herdsmen/kidnapping around Nigeria rural farm families; hence, the urgent need for livelihood assistance which would include empowering women and securing their dwelling places as this would guarantee food access and stability (Beriso, G. 2023).

PROBLEM STATEMENT

The quest to have sufficient and nutritious food supply for the farm family at all times and to ensure that the household doesn't stand a risk to loose access to food as a result of immediate shocks has necessitated this study. Inherent in the study also is the issue of low sales experienced from agricultural products. However, the role women play has become obvious. Such roles as home managers, food producers/processors, preservers of agro-diversity and their roles and more, make them indispensable in the quest to achieve food security. Rural women have diversified into on-farm and off-farm activities just to get more income to support family needs and hence improve food stability and access at the household level in the South East, Nigeria.

OBJECTIVES OF THE STUDY

The broad objective of the study is to evaluate food stability and access of rural women in on-farm and off-farm activities in South East Nigeria. The study had the following specific objectives to; (i.) examine the food stability of the respondents; (ii)examine the food access of the respondents; (iii) determine the income of respondents in on-farm activities; (iv.) determine the income of respondents in off-farm activities.

H0: There is no significant difference in income obtained from on-farm and off farm activities in the study area.

METHODOLOGY

Study Area

The study area was the south east, Nigeria. The south east is located within latitude 5°N to 6°N of the equator and longitude 6 °E to 8 °E of the Greenwich meridian (NPC, 2006). The south east of Nigeria is made up of Abia, Imo, Anambra, Ebonyi and Enugu states. It has two peculiar seasons which are dry seasons which occurs between November and February and wet seasons which occurs between March and September. The total land mass of this zone is 10,952,400 hectares with a population of 16,381,729 people

as at NPC (2006) with an estimated annual growth of 3% growth per annum, the population of the South East will be 17,944,478 by the end of 2030.

Sample and Sampling Procedure

The multi-stage sampling method was adopted for the study. In the first stage, purposive sampling technique was used to select rural women in on-farm and off-farm activities in 3 States, out of 5 States in the South East Nigeria. At the second stage, random sampling technique was used to select 2 (two) geographical zones in the 3 states; giving a total of 12 (twelve) Local Government Areas.

At the 3rd stage, stratified random sampling technique was used to select two rural communities each from the 12 local government areas in the 3 States. This gave a total of 24 communities. Finally, random sampling techniques were used to select 15 (fifteen) rural women from each of the 2 communities from the two geographical zones each in the 3 states in the study the study area. This gave a total of 360 respondents.

Method of Data Collection

Primary Data was collected for the study through a well-structured questionnaire.

Method of Data Analysis

Objectives i and ii were realized using the mean of the food security indicators to ascertain food stability and access of these rural women. Basically, a three-point rating scale of Always = 3, Sometimes = 2, Never = 1 were used to realize the benchmark for decision making. A benchmark of 2.0 was obtained for the individual tables of the food security indications.

Objectives iii and iv were realized using frequency and percentages to describe the respondents' income from on-farm and off farm activities.

HYPOTHESIS

H₀₁: There is no significant difference in income obtained from on-farm and off farm activities in the study area. Z-test was used to test this hypothesis.

$$Z_{cal} = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{S^1 X_1 + S^2 X_2}}$$

Where

$\bar{X}$ = Sample mean of income from on-farm activities

$\bar{X}$ = Sample mean of off-farm activities

$S^1 \bar{X}_1$ = Variance of on-farm activities

$S^2 \bar{X}_2$ = Variance of off farm activities

n_1 = sampled number for on-farm.

n_2 = sampled number for off-farm

RESULTS AND DISCUSSIONS

Food Stability of the Respondents

Table 1: Distribution of respondents according to Food Stability

Variables	ABIA		IMO		EBONYI		SOUTH EAST
	X	SD	X	SD	X	SD	X
Occurrences of shock at home	4.4	1.4	4.3	1.6	4.2	1.4	4.3
Lean period (periods of lack of food)	1.6	0.9	1.7	0.6	1.5	0.5	1.6
Affordable square meals/day	2.3	0.6	1.9	0.6	2.0	0.6	2.1
Coping during lean periods	3.3	0.7	3.2	0.8	3.2	1.0	3.2
Grand mean							2.8

Source; Field Survey, 2019

The result from Table 1 showed that the occurrence of shocks in the home was very high with a mean score of 4.3. These shocks included loss of jobs, conflicts and loss of productive resources. The focus group discussion showed that the highest of these occurrences was the loss of productive resources due to conflicts (individual conflicts and herdsman-villagers clashes). This finding agreed with Quinton, Jenkins and Olasenhinde-W, (2024) who observed that limited economic capacities, environmental and physical shocks have hindered most Nigerians in the rural areas to adequately feed themselves. The results also showed a mean of 1.6 which meant that the peak season for lack of food was during the planting seasons wherein food becomes scarce. This finding agrees with Anazia (2023) who observed that during planting seasons, rural people experience slight scarcity of food and hike in food prices, thus rural people engage in several activities such as trading, palm wine tapping and traditional dancing to support themselves financially. The focus group discussion also supported the hike in food prices/scarcity of food during planting seasons. The result also showed a very poor mean score of 2.1 for number of square meals that can be afforded by the rural households. This meant that households in the study area had one to two square meals per day. This could be as a result of an adaptation to food scarcity which has tilted families to resolve to taking meals once or twice a day. This finding agrees with Magwegwe, Zingwenva and Zenda (2024) who insisted that ruralites adapt to the following as coping strategies during food scarcity periods; eating once a day, buying inexpensive food materials, letting children eat first and buying food on credit among others. The focus group conducted in the study area revealed that feeding patterns of one to two meals has become a custom due to the occupational pattern of ruralites which allows them to eat at mid-day in the farm and then in the evening when they return from the hectic days work. Lean periods for the study described periods which rural households cannot comfortably afford cash for meals or brief periods of lack of cash. The result showed a moderate mean score of 3.2. This suggested that rural households sometimes don't have enough cash to cater for their meals, so they resort to borrow from relative/friends or ask for cash assistance from their children who are income earners. Kenny (2024) observed that due to low income, rural households resort to dietary changes and rationing of diets as strategies utilized during lean periods. The focus group discussion conducted in the area revealed that most under-aged children or teenagers have been forced into becoming income earners. This suggested a case of child labour. UNICEF and ILO (2025) views child labour as a violation of human rights which deprives children of their childhood potentials dignity, leading to physical and mental travail and other hazardous work which can likely jeopardize their health and safety.

Food Access of Respondents

Table2: Distribution of respondents according to Food Access

Sources of food available to respondents	ABIA		IMO		EBONYI		SOUTHEAST
	X	SD	X	SD	X	SD	X
Credit	1.2	0.5	1.3	0.5	1.5	0.7	1.3
Market	2.7	0.5	2.6	0.6	2.3	0.7	2.5
Gift and food aid	1.7	0.6	1.3	0.5	1.6	0.5	1.5
Exchange by barter	1.2	0.4	1.2	0.4	1.3	0.5	1.2
Wild fruits and hunting	1.5	0.6	1.4	0.6	1.7	0.7	1.5
Going on low cost for children because of insufficient funds	2.0	0.5	1.9	0.4	2.0	-0.6	1.9
Grand mean							1.7

Source; Field Survey, 2019

Food Access of Respondents

Table 2 examined sources of food available to the respondents which for this study was seen as the access to food. Food access in the study area was low with a grand mean score of 1.7. This could be as a result of inadequate storage facilities. Ogunwado (2024) insisted that lack of storage facilities hampers food access in rural Nigeria. Access to food by credit was low with a mean score of 1.3. This indicated that the respondents didn't depend on credit schemes to source money to purchase their food. Simba et al., (2023) insisted that the issue of collateral hampered the women's access to credit facilities. Access to food through

the market facility had a high mean of 2.5. This showed that majority of the respondents utilized the market facility for purchasing food items that they couldn't produce from the farm. This finding agrees with NIQ (2024) who opined that the market facility was majorly the easily patronized food source as fresh food were easily sourced because of its convenience and sustainability. The result also showed that sourcing of food from gifts/food aid had a very low mean score of 1.5. This indicated that food was not majorly sourced from gifts/food aid. Though the focus group discussion revealed that food was generally shared on days the community had elaborate celebrations such as new year festivals and e.t.c. This disagreed with the finding mentioned above, that most poor ruralites depend on gifts /food aids to combat the surge of hunger in our remote areas. With a relative low mean of 2.0, the results further showed that the respondents go for low-cost food materials to feed their children because they were running low on cash at home. It meant that low-cost food was readily available and affordable in the remote areas studied. The focus group discussion conducted in the area also affirmed the above fact. The results also showed a low mean of 1.2 with regards to sourcing of food through trade by barter. This indicated that the study area scarcely considered trade by barter as a major source of food. This finding agreed with Scholz (2024) who opined that this mode of sourcing for food was an ancient means of food exchange. The study also showed that with a relative low mean score of 2.0, respondents went for low-cost food alternatives to feed children because they were running out of cash. This meant that low-cost food was readily available in the study area. The focus group conducted in the area affirmed this finding.

Determinants of On-Farm Income Activities of the Respondents

Table 3: Distribution of respondents by On-Farm Income Activities

n = 360

Variables	Abia	Imo	Ebonyi	South East
Income from On-farm activities (N)				
Cereal cropping				
0-1500	98 (81.6)	109(90.8)	107(89.2)	314 (87.2)
1600-3100	20(16.7)	6(5.0)	12(10)	38(10.6)
3200-4700	2(1.6)	2(1.7)	1(0.8)	5(1.4)
4800-6300	0	3(1.7)	0	3(0.8)
Roots and Tuber cropping				
0-1500	49(40.8)	57(47.5)	66(55)	172(47.8)
1600-3100	44(36.7)	57(47.5)	49(40.8)	150(41.7)
3200-4700	8(6.7)	3(2.5)	5(4.2)	16(12.4)
4800-6300	17(14.2)	0	0	17(4.7)
6400-7900	2(1.8)	1(0.8)	0	3(0.8)
8000-9500	0	2(1.8)	0	2(0.6)
Vegetables and plantation farming				
0-1500	62(51.6)	70(58.3)	73(60.8)	205(56.9)
1600-3100	50(41.7)	44(36.7)	43(35.8)	137(38.1)
3200-4700	7(5.8)	3(2.5)	4(3.3)	14(3.9)
4800-6300	1(0.8)	3(2.5)	0	4(1.1)
Poultry Farming				
0-1500	94(78.3)	94(78.3)	94(78.3)	282(73.8)
1600-3100	7(5.8)	9(7.5)	10(8.3)	26(7.2)
3200-4700	7(5.8)	3(2.5)	4(3.3)	14(3.9)
4800-6300	1(0.8)	7(5.8)	7(5.8)	15(4.2)
6400-7900	1(0.8)	6(5.0)	1(0.8)	8(2.2)
8000-9500	2(1.8)	0	3(2.5)	5(1.4)
9600-11000	2(1.8)	1(0.8)	1(0.8)	4(1.1)
11100-12500	3(2.5)	0	0	3(0.8)
>12600	3(2.5)	0	0	3(0.8)
Labour services in farms				
0-1500	113(94.2)	111(92.4)	106(88.3)	330(91.7)

1600-3100	3(2.5)	6(5.0)	10(8.3)	19(5.3)
3200-4700	2(1.7)	3(2.5)	1(0.8)	6(1.7)
4800-6300	1(0.8)	0	1(0.8)	4(1.1)
6400-7900	0(0.8)	2(0.8)	1(0.8)	2(0.6)
8000-9500	1	1(0.8)	1(0.8)	2(0.6)
9600-11000	1(0.8)	0	0	0
Goat/sheep production				
0-1500	115(95.8)	117(97.5)	117(97.5)	349(96.9)
1600-3100	2(1.7)	1(0.8)	0	3(0.8)
3200-4700	0	1(0.8)	0	1(0.3)
4800-6300	1(0.8)	0	0	1(0.3)
6400-7900	0	0	0	0
8000-9500	0	0	1(0.8)	1(0.3)
9600-11000	1(0.8)	1(0.8)	2(1.7)	4(1.1)
11100-12500	0	0	0	0
>12600	1(0.8)	0	0	1(0.3)
Snailry/snail picking				
0-1500	120(100)	117(97.5)	118(98.3)	355(98.6)
1600-3100	0	1(0.8)	1(0.8)	2(0.6)
3200-4700	0	0	0	0
4800-6300	1(0.8)	2(1.7)	1(0.8)	3(0.8)

Source: Field Survey, 2019

** The figures in parenthesis are percentages, the ones outside are frequencies.

* All the class intervals are measured in Naira.

Determinants of On-Farm Income Activities of the Respondents

Table 3 describes on-farm income activities of respondents. The on-farm activities included cereal cropping, roots/tuber cropping, vegetable/plantation cropping, poultry farming, provision of labour services on the farm, goat/sheep production, Snailry/snail picking. Table 3 described the on-farm activities.

For cereal cropping in Table 3, the result showed that 87.2% of the respondents' income fell between 0-~~N~~1500 per month while 0.6% had ~~N~~1600-~~N~~3100, 5% had ~~N~~3200-~~N~~4700 and 0.8% had ~~N~~4800-~~N~~6300 per month. This indicated that income made from sales were low generally. This could be attributed to the poor road network into these remote areas and the activities of middlemen. For Tuber/plantation cropping, 47.8% had 0-1500 per month, 41.7% made ~~N~~1600-~~N~~3100 per month, 12.4% made ~~N~~3200-~~N~~4700, 4.7% made ~~N~~4800-~~N~~6300 per month, 0.8% made ~~N~~6400-~~N~~7900 and 0.65% made ~~N~~8000-~~N~~9500. This also showed that income made here too was low though very few of them managed to make up to a range of ~~N~~3100-~~N~~9500 monthly. This increment was rarely seen on combined market days where varied villages convened in a central market area to carry out their market activities. This finding is consistent with of Jacob, Adam and Fausat (2023) who insisted that productivity of rural women in cassava farming results to low income due to delayed technical support of extension services, high transportation fares, non-design of female friendly tools for hydraulic pressing and ease of operation. For vegetable/plantation farming, 56.9% of the respondents made 0-~~N~~1500, 38.1% of them made ~~N~~1600-~~N~~3100, 3.9% of them made ~~N~~3200-~~N~~4700 and 1.1% of them made ~~N~~4800-~~N~~6300 per month. Sales here too was low. The focus group discussion conducted in the area affirmed that low income accompanies agricultural produce due to the pressure of large household size on household resource which limits resource mobilization. For poultry farming, 73.8% of the respondents made income between 0-~~N~~1500, 7.2% of them made ~~N~~1600-~~N~~3100, 3.9% of them made ~~N~~3200-~~N~~4700, 4.2% of them made ~~N~~4800-~~N~~6300, 2.2% made ~~N~~6400-~~N~~7900, 1.4% of them made ~~N~~8000-~~N~~9500, 1.1% of them made ~~N~~9600-~~N~~11,000 and 1.65% made ~~N~~11,100 and up to >~~N~~12600. This implies that most of the respondents were into poultry farming but yet the made low sales too. This is consistent with Ekwe *et al* (2024) insisted that due to the free range of raising poultry in the rural areas, it is often attributed with low profitability as a result of high incidence of Newcastle diseases and other mortality factors, this, makes the business less attractive. For provision of labour, 91.7% of the respondents made 0-~~N~~1500, 5.35% of them made ~~N~~1600-~~N~~3100, 1.7% of them made ~~N~~3200-~~N~~4700, 1.1% of them made

~~₦4800-₦6300~~, and 1.2% made above ~~₦6400~~. This indicated that the venture was not patronized more often. The focus group discussion conducted in the area opined that that this venture was often done by the farm owners but when given out was more to the poorest of households who are given peanut pay/ very little pay in the rural areas of Nigeria. For goat/sheep production, 96.9% of respondents made 0-~~₦1500~~, while 3.1% made between ~~₦1600~~ and more than ~~₦12600~~. This indicated that women were not into goat/sheep farming. This was because it was more attributed to the male folk. The few women seen in the farm were more of meat sellers than the core-goat farmers. This also implied a gender restriction to the full participation of women in the said farm. This finding agrees with Kariuki *et al* (2022) opined that the venture has been termed ‘gender conducive’ for males than the women because of the gender-economic norm that such venture was dominated by the men but when reconsidered can be entry point for the women folk. For Snailry/snail picking, 98.6% of the respondents made 0-~~₦1500~~, 0.65 made ~~₦1600-₦3100~~, 0.8% of them made ~~₦4600-₦6300~~. This indicated that most respondents were not into Snailry/snail picking. These findings generally show that sales made from agricultural products were low in the study area due to poor road network, increased activities of middlemen and inadequate storage facilities. These were also confirmed by the focus group discussion made in the study area.

Table 4: Distribution of respondents by Off-Farm Income Activities **n = 360**

Variables	Abia	Imo	Ebonyi	South East
Income from Off-farm activities (₦)				
Sewing of clothes				
0-1500	89 (74.2)	103(85.8)	102(85)	293(81.2)
1600-3100	4(3.3)	10(8.3)	8(6.7)	22(18.3)
3200-4700	4(3.3)	4(3.3)	4(3.3)	12(3.3)
4800-6300	8(6.7)	1(0.8)	3(2.5)	12(3.3)
6400-7900	6(5)	0	1(0.8)	7(1.9)
8000-9500	2(1.7)	1(0.8)	2(1.7)	5(1.4)
8600-11000	2(1.7)	1(0.8)	0	3(0.8)
11100-12500	2(1.7)	0	0	2(0.6)
>12600	3(2.5)	0	0	3(0.8)
Weaving of air/salon				
0-1500	102(85)	98(81.7)	107(89.2)	307(85.3)
1600-3100	4(3.3)	17(14.2)	8(6.7)	29(8.1)
3200-4700	4(3.3)	2(1.7)	3(2.5)	9(2.5)
4800-6300	3(2.5)	2(1.7)	2(1.7)	7(1.9)
6400-7900	3(2.5)	0	0	3(0.8)
8000-9500	2(1.7)	1(0.8)	0	3(0.8)
9600-11000	0	0	0	0
11100-12500	0	0	0	0
>12600	2(1.7)	0	0	2(0.6)
Petty trading				
0-1500	53(44.2)	62(51.7)	63(55.5)	178(49.4)
1600-3100	42(35)	27(22.5)	20(16.7)	89(24.7)
3200-4700	8(6.7)	13(10.3)	13(10.8)	34(9.4)
4800-6300	13(10.8)	13(10.8)	12(10)	38(10.6)
6400—7900	4	3(2.5)	4(3.3)	11(3.1)
8000-9500	0	0	2(1.7)	2(0.6)
9600-11000	0	1(0.8)	3(2.5)	4(1.1)
11100-12500	0	1(0.8)	3(2.5)	4(1.1)
Restaurant				
0-1500	40(33.3)	30(25)	35(29.2)	105(29.2)
1600-3100	27(22.5)	59(49.2)	40(33.3)	124(34.4)
3200-4700	17(14.2)	3(2.5)	10(3.3)	30(2.2)
4800-6300	11(9.2)	17(14.2)	17(14.2)	45(12.5)
6400-7900	14(11.6)	6(5.0)	10(8.3)	30(8.3)

8000-9500	5(4.2)	0	3(2.5)	8(2.2)
9600-11000	2(1.7)	1(0.8)	1(0.8)	4(1.1)
11100-12500	3(2.5)	5(4.2)	4(3.3)	9.8(2.5)
>12600	3(2.5)	1(0.8)	0	8(2.2)
Total	120	120	120	
Hawking of food items				
0-1500	113(94.2)	91(71.8)	93(77.5)	297(82.5)
1600-3100	6(5)	12(10)	10(8.3)	28(7.8)
3200-4700	1(1.7)	12(10)	2(1.7)	15(4.2)
4800-6300	0	4(3.3)	14(11.7)	8(2.2)
6400-7900	0	1(0.8)	0	1(0.3)
8000-9500	0	0	0	0
9600-11000	0	0	1(0.8)	1(0.3)
Sell of beans ball/potatoes/yam				
0-1500	103(85.8)	100(83.8)	100(83.3)	303(84.2)
1600-3100	4(3.3)	10(8.8)	10(8.8)	24(6.7)
3200-4700	1(0.8)	7(5.8)	3(2.5)	11(3.1)
4800-6300	6(5)	3(2.5)	5(4.2)	14(3.9)
6400-7900	3(2.5)	-	1(0.8)	4(1.1)
8000-9500	0	-	1(0.8)	1(0.3)
9600-11000	2(1.7)	-	-	2(0.6)
>12500	1(0.8)	-	-	1(0.3)
Baby-sitting the elderly/children				
0-1500	77(64.2)	64(53.3)	70(58.3)	211(58.6)
1600-3100	39(32.5)	11(9.2)	20(16.7)	70(19.4)
3200-4700	1(0.8)	5(4.2)	5(4.2)	11(3.1)
4800-6300	1(0.8)	28(28.3)	12(10)	47(13.1)
6400-7900	-	5(4.2)	9(7.5)	14(3.9)
8000-9500	-	1(0.8)	4(2.5)	5(1.4)
9600-11000	2(1.7)	-	-	2(0.5)

Field survey, 2019

**** the figures in parenthesis are percentages, the ones outside are frequencies.**

*** all the class intervals are measured in naira.**

Determinants of Off-Farm Income Activities of the Respondents

The off-farm activities included sewing, weaving of hair/salon, petty trading, restaurant, hawking of food items/snacks, selling of beans balls, potatoes/yam and baby-sitting children and the elderly. This was represented in table 4 below.

From Table 4, about 81.2% of the respondents had income between 0-~~N~~1500 from sewing of cloths. About 18.3% of them made ~~N~~1600-~~N~~3100, 3.3% of them made ~~N~~3200-and ~~N~~6300, 1.9% of them made ~~N~~6400 - ~~N~~7900, 1.4% of them made ~~N~~8000 -~~N~~9500, 0.8% of them made ~~N~~9600-~~N~~11000 and ~~N~~12600 respectively and 0.6% of them made ~~N~~11,100-~~N~~12500. This indicates that a low patronage to the sewing profession. This finding agrees with Omoghie *et al* (2022) who observed that sewing in the rural area was an age long livelihood activity that has persisted in the rural economies with interest of women from resource poor households which required minimal demands in the course of acquiring the skill.

For weaving of hair, 85.3% of the respondents made 0-~~N~~1500, 8.1% of them made ~~N~~1600-~~N~~3200, 2.5% of them made ~~N~~3200-~~N~~4700, 1.9% of them made ~~N~~4800-~~N~~6300, 0.8% of them made ~~N~~6800-~~N~~7900 and ~~N~~8000-~~N~~9500 respectively and 0.6% of them made ~~N~~12600. This also implied that this off-farm activity received low patronage. The focus group discussion confirmed the issue of low patronage in the aforementioned venture. The hair stylists consulted complained that most of their customers refused to pay for services rendered while the rest were owing them. This has dwindled the running of salons in the rural areas and this makes the business less attractive. Pierotti, Freidson-R and Olayiwola (2022) opined that women in agriculture engage in some off-farm activities wherein they only manage to break-even during festive periods of the year like Christmas. This finding agrees with Mukaila, Falola, and Akanbi (2021) who

insisted that most rural women in rural ventures get a very small monthly income from their returns with majority who have large family sizes. This is a mismatch between income and household size.

For petty trading, the result showed that 49.4% of the respondents made 0-~~₦1500~~, 24.7% of them made ~~₦1600-₦3100~~, 9.4% made ~~₦3200-₦4700~~, 10.6% made ~~₦4800-₦6300~~, 3.1% of them made ~~₦6400-₦7900~~, 0.6% of them made ~~₦8000-₦9500~~, 1.1% of them made ~~₦9600-₦11000~~ and ~~>₦12,500~~ respectively. This indicated that petty trading was majorly the off-farm activity done by the respondents in the study area. Popoola *et al* (2023) insisted that rural households produced some of the foodstuff and sold them at the market place in the study area.

For running of restaurant, 78.1% of the respondents made 0-~~₦1500~~, 8.9% of them made ~~₦1600-₦3100~~, 1.9% of them made ~~₦3200-₦4700~~, 5.6% made ~~₦4800-₦6300~~, 2.2% of them made ~~₦6400-₦7900~~, 2.5% of them made ~~₦8000-₦9500~~ and 0.6% made ~~₦9600-₦11000~~. This indicated a poor income base of the respondents due to low patronage. The focus group discussion on the running of restaurants affirmed the above finding. This finding agrees with Islam *et al* (2022) who opined that the running of business ventures in the rural areas of Nigeria could be unproductive due to low income yields and poverty prevalent in these the rural regions.

For hawking of food items/snacks, the result showed that 82.5% of the respondents made 0-~~₦1500~~, 7.8% of them made ~~₦1600-₦3100~~, 1.7% of them made ~~₦3200-₦4700~~, 11.7% of them made ~~₦4800-₦6300~~, 0.4% of them made ~~₦9600-₦11000~~. This indicated that majority of the respondents managed to make up to ~~₦1500~~. This implied that hawking of items was not efficiently patronized in the study area. This was also affirmed by the focus group discussion. This may be attributed to the low cash flow in the rural areas. This finding agrees with Peng (2022) who observed that Nigerian rural households engaged in farming majorly for consumption and not necessarily for earning cash giving rise to low-income flow in the rural economy. For selling of beans balls/potatoes /yam, the result showed that 83.3% of the respondents made 0-~~₦1500~~ per month, 8.3% of them made ~~₦1600-₦3100~~, 2.5% of them made ~~₦3200-₦4700~~, 4.2% of them made ~~₦4800-₦6300~~, 0.8% of them made ~~₦6400-₦7900~~ and ~~₦8000-₦9500~~ respectively. This showed that income from sales of this venture was very low in the study area. Nkamigbo and Isibor (2021) insisted that there has been an increased marketing of sweet potatoes due to increased consumer/ marketing awareness of its economic, nutritional and medicinal values and as the startup capital for this business venture is also small. Though, the focus group discussion conducted in the study area confirmed that much sales was not made in the aforesaid venture in the rural area because of low income of residents and lack of zeal by residents to patronize this venture.

For baby-sitting of children and the elderly, 58.3% of the respondents made 0-~~₦1500~~, 16.7% of them made ~~₦1600-₦3100~~, 4.2% of them made ~~₦3200-₦4700~~, 10% of them made ~~₦4800-₦6300~~, 3.9% of them made ~~₦6400-₦7900~~, 1.4% of them made ~~₦8000-₦9500~~ and 0.5% of them made ~~₦9600-₦11000~~. This indicated that this venture was not popular in the study area, hence, it was not patronized more often in the study area. This was because the families took care of their elderly within their homes. The focus group discussion conducted in the area insisted that, babysitting of children and the elderly in the rural area is not yet a common business in the rural area. Ezulike, Shiyu and Chiu (2024) opined that the aging portion seems ignored in policy development and implementation. Odude (2023) insisted that the care of the aging population has been carried out by the traditional family and other informal support systems but there are no publicly funded social system for them.

Testing of Hypothesis

H0: There is no significant difference in income obtained from on-farm and off-farm activities in the study area.

Table 5. Z-test on significant difference in income obtained from on-farm and off-farm activities in the study area.

	Z-tab	Z-cal	X	Std. dev	Std. error	Df	Decision
Off-farm		38.708	936.255	458.930	24.18774		Reject the null and
On-farm	2.05	28.087	776.0516	524.244	27.63017	359	accept the alternative.

Field survey, 2019 Z-test was significant at 1%, Ho1 was rejected at 5%

Table 5 observed a significant level (p) at 1%. The Z-test showed that the Z calculated is 38.708 and 28.087 which is greater than the Z—tabulated (2.05) at 359 degree of freedom. This means that there is a statistically significant difference in income from on-farm and off-farm activities in the study area. Thus, the null hypothesis which states that there is no significant difference in income obtained from on-farm and off-farm activities in the study area was therefore rejected. The study concluded that there is significant difference in income obtained from on-farm and off-farm activities in the study area.

CONCLUSION

From the findings of the study, the following conclusions were made; The study concluded that involvement of rural women in on-farm and off-farm activities supported their household food stability and access. Rural women had low sales from their agricultural products due to poor road networks, activities of middlemen, inadequate storage facilities and also experienced shocks as result of loss of productive resources. Furthermore, that off-farm activities contributed more to household income than on-farm activities in the study area.

RECOMMENDATIONS

Based on the findings, the following recommendations were made; non-governmental organizations, farm groups and individuals should invest in rural infrastructure/ local security measures e.g storage facilities as this will help the rural women to store their perishable food items, soothe loss of productive resources and thus improve food stability and access. Government should create policies to regularize the activities of middlemen and also construct feeder roads networks into these remote areas. Government and other stakeholders such as Non-Governmental Organizations and Community-Based Organizations should team up to offer grants to rural women in on-farm and off-farm activities as this will help women to diversify their on-farm and off-farm activities as well as augment the low income gotten from the sale of agricultural products. Government should conduct effective programmes on value addition of goat/sheep/Snailry ventures for rural women which will help reduce shocks at the household level.

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Effect of Use of Integrated Pest Management Practice (IPM) on Yield of Rice in Abia State, Nigeria.

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ABSTRACT

The study assessed the effect of use of Integrated Pest Management (IPM) practice on yield of rice in Abia State, Nigeria. The specific objectives of the study include to; ascertain farmers' awareness of IPM, determine the level of utilization of IPM practice by the respondents and estimate the yield of rice farmers after the use of IPM. The hypothesis states that use of IPM practice has no significant effect on the yield of rice in the study area. A multi-stage sampling technique was used to select 120 respondents from Abia States, Nigeria. Questionnaire and interview schedule were used for data collection, and data collected were analyzed using descriptive and inferential statistics such as frequency count, percentages, mean scores and regression model. The results showed that most (67.5%) of the farmers were aware of IPM practice. The estimated yield of rice farmers was low (1,229.19kg/ha) before they started using IPM but became high (3,067.08kg/ha) after the use of IPM practice. The grand mean score ($\bar{x} = 3.11$) showed that there is high utilization of IPM in Abia State. The null hypothesis result was rejected since the farmers' use of IPM had significant effect on yield of rice at 1% probability level. The study, therefore, concludes that the use of IPM practice had a positive effect on yield of rice in Abia State, Nigeria. It, therefore, recommends that, farm shows/exhibition programmes should be organized by agricultural agencies and cooperatives to enable rice farmers showcase their high yields from IPM practice and encourage more farmers to utilize IPM practice.

Keywords: Effect, Utilization, Integrated Pest Management Practice and Yield.

INTRODUCTION

Nigeria is endowed with favorable environment for cereal cultivation. Cereals are the major dietary energy suppliers which provide significant amount of protein, minerals (potassium and calcium), vitamins (Vitamins A and C). They are consumed in a variety of forms, including pastes, noodles, cakes, breads, drinks etc. The bran, husk, plant parts and other residues (after processing) are useful as animal feeds and in the culture of micro-organisms, while wax syrup and gum extracted from cereals are used for industrial purposes. Major cereals produced in Nigeria are rice, sorghum, maize, and millet.

Rice (*Oriza sativa*) is a very important food crop globally. Virtually all the rice growing ecologies (the upland irrigated, inland valley swamp, deep water floating and tidal mangrove swamp) abound in Nigeria. Rice consumption is accelerating rapidly in Nigeria owing to urbanization, easy cooking, and storage (Uga, Sugimoto, Ogawa, Rane and Ishitani, 2013). According to Basorun (2013), rice is highly revered in many rural areas to the extent that it is prepared mostly on Sundays and local market days, though, it is now assuming a regular daily meal nowadays. Sustainability is, therefore, paramount in rice production for the nation to fill the gap required for the increasing population. Unfortunately, the production of this all-

important food crop is gradually reducing and consequently, there is increase in price beyond the reach of many Nigerians (Ajala and Gana, 2015).

Research has shown that Africa faces great challenges in the production of cereal crops of which rice is among the largest (Macauley and Ramadjita, 2015). This is against the backdrop that cereal forms the highest percentage of calorie intake in the national diet of 22 countries of the world, sixteen of which are domiciled in Africa (Blein, 2013). These challenges in Abia State, where agricultural activities are predominant, includes harsh climatic factors and the prevalence of pest infestation. IITA (2019) indicated that climate-induced cereal production is associated with certain constraints which include heat, drought stress and emerging invasive insect pests and diseases. The common pests of cereal crops in Nigeria, according to Harrison, Thierfelder, Baudron, Chinwada, Midega, Schaffner and VandenBerg (2019), include termites, stem borer, weevils, armyworm, birds, grasshopper, butterfly, etc. As a result of the above constraints, cereal crops yield in Africa is generally low (Edmeades, Trevisan, Prasanna, and Campos, 2017). The negative influence of pest invasion on food/nutrition security has been made worse due to insufficient resistant/tolerant varieties, poor control measures and management of pests (Harrison, *et al.*, 2019).

Currently, researchers are working on immediate and long-term solutions to these problems, and the available control strategies include use of pesticides, cultural practices, use of natural enemies, the use of resistance variety, and Integrated Pest Management (IPM) strategy.

Most farmers rely on synthetic pesticides because intensive synthetic pesticides can support rice productivity by reducing yield losses caused by pests but on the other hand, the persistent overuse of chemicals has resulted in a number of adverse environmental impacts such as, outbreak of secondary pests, decreasing of beneficial insects and the accumulation of toxins in the food webs (Arora, Mukherji, Kumar and Tanwar, 2014).

Research and extension are advising farmers to use Integrated Pest Management (IPM) to manage cereal crop pests because it is targeted at minimizing chemical damage to humans and the environment, while targeting effective pest control (Day, Phil, Melanie, Tim. & Anne, 2017). According to Kabir and Rainis, (2015), Integrated Pest Management (IPM) is a combined use of chemical, cultural, biological and mechanical methods to control pest in a farm. This technique has been developed by Farmers Field School (FFS) and it is an effective, environmentally-sound approach to pest management, with the aim of also protecting the air, water and soil resources, while meeting specific production objectives (National Pesticides information Centre in USA, 2015).

A study of IPM on Lepidopteran pest in rice, carried out by Babendreier, Hou, Tang, Zhang, Vongsabouth, Win, Kang, Peng, Song, Annamalai, Horgan (2020), reported that pest had been a major problem in rice farms in Asia but the implementation of the IPM strategy reduced the infestation of pest, resulting to higher rice yields. More so, Muck (2015) noted in his study that by the practice of IPM, pest problem in Nigeria can be reasonably mitigated in a sustainable manner which may eventually reflect on the crop yield.

The paper therefore assessed the effect of use of Integrated Pest Management (IPM) practice on yield of rice in Abia State with the following objectives, to;

- i. ascertain farmers' awareness of IPM
- ii. determine the level of utilization of IPM practice by the respondents
- iii. estimate the yield of rice farmers after the use of IPM.

METHODOLOGY

The study was carried out in the Abia State, Nigeria. The State is one of the prominent South-Eastern States Region in Nigeria. The State whose capital is Umuahia, was carved out from Imo State on 27th day of August, 1991. According to Abia State Government (ABSG) (2015), it is geographically located on approximately latitude 5°25'N and longitude 7°30'E. Abia "God's own State" as it is fondly called, is popular for Commerce, Industry and Agriculture. The State, which has 17 Local Government Council areas occupies a land area of 5,834 km². The State has boundary on the West with Imo and Anambra States, on the North with Enugu State, on the North-East with Ebonyi State, on the East with Cross River State, on the South-East with Akwa Ibom State, and on the South with Rivers State. Its major commercial nerve is

Aba, which is located south of the State. Aba is known for its strategic location having industrial and commercial potentials with notable industries known for textile manufacturing, footwear and leather production, pharmaceuticals, soap, plastics, cement, and cosmetics. Notwithstanding the industrial potentials of the State, the manufacturing sector accounts for 2% of the Gross Domestic Product (GDP), while Agriculture which is the most prominent sector in the State accounts for about 70% of the State's economic activity (Hoiberg, 2010).

A multi-stage sampling technique was employed in selecting 120 (one hundred and twenty) respondents for the study. In the first stage, two agricultural zones were randomly selected from the three agricultural zones of the State namely; Umuahia and Ohafia agricultural zones. Secondly, two blocks were randomly selected from each of the agricultural zones making a total of four blocks namely; Umuahia North and Ikwuano (Umuahia zone), Bende and Isuikwuato (Ohafia zone). Thirdly, three circles were randomly selected from each of the blocks to give a total of twelve (12) circles namely; Umu-ezike, Ubani and Ajata (Umuahia North), Ibere-Itunta, Nkalunta and Obuoro (Ikwuano), Akoli-Imenyi, Izuakoli and Nkpa (Bende), Ahaba-Imenyi, Acha and Ovim (Isuikwuato). Finally, ten (10) rice farmers were randomly selected from each the circles to give a total of one hundred and twenty respondents which constituted the study sample. Data for this study were obtained through questionnaire/structured interview and the data obtained were analysed using descriptive statistical tools and tested using simple Regression Model. The function of the model is express thus;

$$Y = f(x) + e_i$$

$$Y = a + b_0 + b_1x + e_i$$

Where;

Y = Yield of rice in the study area (Kg/ha)

a = Regression coefficient

b₀ = Regression constant

x = IPM practice

e_i = Error term

RESULTS AND DISCUSSION

Awareness of IPM Practices

Data on the awareness of farmers about IPM practices in the study area is presented in Table 1

Table 1: Distribution of respondents according to their awareness about IPM practices

IPM Practices	Frequency	Percentage
Chemical Method:		
Application of Attacke (inorganic pesticide)	81	67.5
Best (inorganic pesticide)	98	81.7
D-D Force (inorganic pesticide)	112	93.3
Sniper (inorganic pesticide)	77	64.2
Cultural Method:		
Spraying of Wood ash	111	92.5
Grinded chilli pepper	115	95.8
Neem leaves	76	63.3
Intercropping	66	55.0
Adjusting planting time	102	85.0
Biological Method:		
Planting resistance varieties (Faro 44/IR 36)	109	90.8
Natural enemies/Predators	115	95.8
Application of Tetratichus (biopesticide)	120	100.0
AG-Zyme (biopesticide)	98	81.7
Mechanical/Physical Method:		
Use of Scarecrow	87	72.5

Carbide guns/catapult	67	55.8
Trap	113	94.2
Net	12	10.0
Hand picking/Crushing	41	34.2
Combination of Methods above	81	67.5

Source: Field Survey, 2023

***Multiple responses recorded**

Result in Table 1 shows that majority (67.5%) of the farmers in the study area were aware of combination of different methods to control pest. This is an indication that farmers in the study area were aware of Integrated Pest Management (IPM) practices as a means of pest management. The finding is in agreement with Umeh and Ekwenyene (2017) who noted that farmers in South-East are aware of farm innovations that will improve their farm yield and add value to their outputs.

Level of Utilization of IPM Practices

Data on the utilization level of IPM practices in the study area is shown in Table 2

Table 2: Distribution of respondents according to their level of utilization of IPM practices n = 120

IPM Practices	$\sum f(x)$	$\bar{x}$
Chemical Method:		
Application of Attack (inorganic pesticide)	446	3.72
Best (inorganic pesticide)	439	3.66
D-D Force (inorganic pesticide)	469	3.91
Snipper (inorganic pesticide)	455	3.79
Mean		3.77
Cultural Method:		
Spraying of Wood ash	274	2.28
Grinded chili pepper	263	2.19
Neem leaves	468	3.90
Intercropping	444	3.70
Adjusting planting time	442	3.68
Mean		3.15
Biological Method:		
Planting resistance varieties (Faro44/IR36)	374	3.12
Natural enemies/Predators	460	3.83
Application of Tetratichus (biopesticide)	267	2.23
AG-Zyme (biopesticide)	363	3.01
Mean		3.05
Mechanical/Physical Method:		
Use of Scarecrow	365	3.04
Carbide guns/catapult	447	2.73
Trap	387	3.23
Net	193	2.02
Hand picking/Crushing	156	1.62
Mean		2.54
Combination of Methods above	405	3.38
Total mean		59.04
Grand mean	3.11	

Source: Field Survey, 2023

Keys: Always = 4, Often = 3, Occasionally = 2, Never = 1

Decision: $\bar{x} > 2.5$ implies high level of utilization $\bar{x} \leq 2.5$ implies low level of utilization

Figures in $\sum f(x)$ (sum) are nominal Likert values multiplied by frequencies

Result in Table 2 shows farmers' utilization level of IPM practices on a four-point rating scale in Abia State. Finding reveals that utilization of chemical method had a mean score ($\bar{x}=3.77$) while cultural and biological methods had mean scores ($\bar{x}=3.15$ and 3.05) respectively but mechanical/physical method had a mean score ($\bar{x}=2.54$). More so, the combination of different methods had a mean score ($\bar{x}=3.38$). This implies that the use of chemical, cultural and biological methods were high while the utilization of mechanical/physical method was low. But the use of IPM (combination of more than one method) was high in the study area. Further finding reveals that the utilization of IPM practices had a grand mean score ($\bar{x}=3.11$). This implies that the utilization level of IPM practice in Abia States is high. The high utilization level may be attributed to their awareness about the usefulness of IPM. The finding is in agreement with Nwaobiala (2018) who posited that utilization level of agronomic practices that boost production is high in South-East. The result also agrees with Odoemelum, Onuekwusi and Alocha (2016) who asserted that farmers will be ready to utilize agricultural innovations, especially when they are aware of its existence and usefulness.

Yield Estimate of Rice Farmers before and after the Adoption of IPM

Data on the estimated yield of rice farmers before and after the adoption of IPM practices in the study area is presented in Table 3.

Table 3: Distribution of respondents according to yield estimate before and after the use of IPM

Rice output before IPM use (n = 120)	Rice output after IPM use (n = 120)	
	Quantity (Kg/ha)	Sales (Naira)
Rice grains	841.67	505,000
Rice bran	387.50	7750
Total	1229.19	512750

Field Survey, 2023

The result in Table 3 shows that the estimated mean yield of rice before the use of IPM in Abia State was 1,229.19kg/ha. (grain + bran). This implies that yield of rice was low before the use of IPM. This low yield can be attributed to the effect of pest which might have adapted to the continuous use of traditional pest control measures. The result is in consonance with Kamai, N, Omoigui, L.O, Yamara A. Y and Ekeleme F (2020) who asserts that most rice farmers rely on traditional technologies which accounts for the low yield that ranges between 1,000-3,000kg/ha, as against the standard average yield range between 3,000-6,000kg/ha. Furthermore, the result in the table indicates that the estimated mean yield score of rice after the use of IPM in Abia State was 3,115kg/ha (grain + bran). This implies that yield of rice was high after the use of IPM in the study area. This high yield can be attributed to the effect of IPM which might have addressed the concern of pest that hitherto affected the growth and yield of rice crop in the farmers' farms. The result agrees with Agbarevo and Okringbo (2020) who noted that the effective use of agricultural technologies and agronomic practices will increase farm yield and farmers' income.

Hypotheses Testing

H0: Use of IPM practice has no significant effect on the yield of rice in the study area

Table 4: Simple linear regression influence of use of IPM on yield of rice in the study area.

Parameters	Coefficient	Standard error	t-value
Constant	219.323	0.610	6.953***
Use of IPM	0.227	0.148	2.952**
R-square	0.637		
R-adjusted	0.585		
F-ratio	11.679***		

Source: Computed from Field Survey Data 2023

** = significant at 5% and *** = significant at 1%

Table 4 shows that the R-square value was 0.637 indicating that about 63.7% of the variation in the dependent (yield of rice) was accounted for, while others were due to error. The coefficient of use of IPM practice was statistically significant at 1% probability level and positively related. The result implied that an increase use of IPM practice will lead to a corresponding increase in yield of rice farmers in the study area. The hypothesis which stated that use of IPM practice have no significant effect on the yield of rice in the study area was, therefore, rejected at 5% level F probability and concluded otherwise.

CONCLUSION AND RECOMMENDATIONS

Based on the findings of the study, it is concluded that the use of IPM practice by farmers in Abia State, Nigeria had a positive effect on yield of rice, because the yield of rice farmers in the study area increased after the use of IPM practices compared to the yield before the use of IPM practice. Agricultural agencies and cooperatives should continually organize farm show/exhibition programmes where farmers' yields from IPM practice can be showcased, as that will encourage more farmers to adopt IPM practice and enjoy high yield like others. More so, farmers from all parts of South-East should endeavor to effectively utilize IPM practices since it has been found to increase yield which will lead to increase income and food availability in the Region and Nigeria in general.

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**Knowledge and Attitude of Artisanal Fishermen towards Malaria
Prevention in Fishing Communities in Eket Agricultural Zone, Akwa
Ibom State, Nigeria**

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ABSTRACT

The study assessed artisanal fishermen's knowledge and attitude towards malaria prevention in Eket agricultural zone of Akwa Ibom State. Primary data used were derived from structured questionnaire. Multi-stage sampling procedure was used to select 120 fishermen. Data were analyzed using descriptive statistics (percentages and likert scale) and logistic regression analysis. Results showed that artisanal fishing is dominated by men of active age of 41.66%, married (65.83%) and literate (76.67%) with an average household of 5 persons and fishing experience of 13 years. Respondents had an average monthly income of ₦38,000 but majority had no access to credit. Result further revealed that majority of the respondents had knowledge about the disease as parasitic/bacterial/ disease ($X=3.2/X=3.0$), most of them ($X=3.1$) had fever and bitter tongue as symptoms which can be prevented by traditionally by burning scent leaves before sleep. Their most relevant treatment method included the use of herbs. Home treatment, vaccination, protection of doors and windows with nets were some attitudinal preventive measures used. Membership of cooperative societies, level of education, fishing experience, household size, and income from fishing were the determinants of knowledge of prevention; whereas determinants of attitudinal preventive measures were marital status, membership of cooperative societies, level of education, fishing experience, age of fishermen, household size and income from fishing from the logit model used. The study recommended educational interventions, encouragement to form cooperative societies as requisites to increase knowledge level of fishermen on malaria prevention.

Keywords: Knowledge, Attitude, Artisanal fishermen, malaria, Fishing Communities.

INTRODUCTION

Fisheries play an important role in providing food, income and employment in many developing countries including Nigeria. This sub-sector's monetary yield offers significant contributions to assuage poverty and food insecurity especially for the rural people through: dietary protein intake of fish; revenue to those on a job and through generation of revenues from exports (Nkeme, Frank and Okon 2020). Most households in these coastal areas are convoluted in fishery-related occupations (Organization for Economic Co-operation and Development (OECD), 2001). Be that as it may, these communities lack physical infrastructures and access to other rudimentary amenities of life (Olago *et al.* 2007; Iwasaki *et al.* 2009; Marine Resources Assessment Group (MRAG), 2011). This is because emerging economies like Nigeria, rural and coastal dwellers are contingent upon climate-sensitive livelihoods such as fishing, agriculture, and forestry. They are worst affected at slightest disease outbreaks and most endangered by malaria because of availability of potential breeding grounds.

The impact of malaria on the fisheries sub-sector of agriculture cannot be over emphasized. Fishing societies are at high danger, aiding as possible “hotspots” for speedy breeding of the carried species and spread of the parasites due to availability of stagnant water and at times pitiable aseptic practices within them, thus menacing employments, upsetting value chains, global trade, and posing risks to fish supply chains (Food and Agricultural Organization (FAO, 2019). According to Sallu *et al.* (2010) it is the amalgamation of bio-physical and socio-economic dynamics that characterize the susceptibility of natural resource-based livelihood systems, and fishery is one of them. Its effect has been projected to have significant global consequences on all sectors of the economy and the most vulnerable is the agricultural sector. This is because food sequence is a complex web that consists of primary producers, middlemen down to the consumers.

Fishing is a high-risk business because of the fugitive nature of the resource, the intimidating milieu of the seas, perishability of the product (MRAG 2011) and transitive nature of the fisher-folks. Due to the fact that malaria lives with us in the tropic and the symptoms are very familiar, there has been a mirage of misperception and misinterpretation on the disease, its modus operandi on infection and the essential safety measures. Equally challenging is the enormous parody and deception on social media on malaria and the skepticism on potency of most discovered vaccines and ACT treatment drugs. Moreover, facts on malaria and prescriptions by experts are received with great doubt by them because fishermen see the disease as one that has come to stay.

The fishing populations are exceedingly exposed to mutually health-associated, socio-economic and institutional vagaries customarily because of their great reliance on natural means (Priyadarshi, 2019). This makes the fishers most vulnerable. Therefore, empathy on folks’ vulnerabilities, enacting achievable policies of mediations (Heck, 2020), and providing choices for amelioration needs a question on their self-evaluation. It should be noted that poor knowledge of any disease condition may lead to poor practice. Therefore, it is crucially important to comprehend their familiarity, responses, loyalty to, and receipt of malaria control procedures that impact on their everyday lives.

According to Woodhead, *et al* (2018) in natural resource-dependent societies like fishing, notwithstanding the significance of health, there is a complete paucity of health information disturbing the folks. If ordinary health issues of fishers have questions, worst will be the case of an endemic condition. Conditions emanating from malaria endemic situation are bound to compromise agricultural productions, nutritional and health statuses of all affected agricultural communities in a country. This is so because the comb for facts in fishing economies is very arduous, ambiguous, multifaceted, and asymmetrical. This is the fundamental knowledge of lifecycle in the fishing economy according to Carnaje, (2018). The characteristic of the fishing economy replicates the key challenge of not harmonizing choices but defining their challenges. Therefore, facts exploration is the bedrock in any fishing economy (Carnaje, 2018). This according to her is exacerbated by the fact that information in these economies of especially unindustrialized nations is underprivileged, rare, mal-distributed, incompetently connected but strongly treasured.

The artisanal fishermen in Eket Agricultural Zone of Akwa Ibom State are not an exception. Their economy is not only ignorant but vulnerable and gullible. Therefore, most secular and health information and enlightenment campaigns will exclude them. Poor and mal-distributed information especially on a disease fondly referred to as “common” will stall its early-stage detection and treatment, and malaria is one of such diseases. There have been legions of reports about knowledge, attitudes, and practices relating to malaria and its control in Nigeria and indeed Africa. Abasiattai, Etukumamana, and Umoiyoho (2009) did it in Uyo, Adeneye, Jegede, Mafe and Nwokocha (2007) did it in Ogun, Chukwurah, Idowu, Adeneye, Aina, Agomo and Otubanjo (2016) did it in Lagos while Vundule and Mharakurwa, (1996) did it in Zimbabwe. Their reports establish fallacies regarding malaria disease and that its prevention strategies are second-rated (Vundule and Mharakurwa, (1996). This has created a gap which this research seeks to fill. Therefore, examining the vulnerability of fishing populations will help in recognizing and describing judicious arrangements to be made in order to fight the adverse effects of malaria, and will help in efficacious execution of numerous health robust policies by creating consciousness, extenuation, and alteration choices. The specific objectives were to: (i) describe the socio-economic characteristics of the artisanal fishermen

in the study area: (ii) assess the knowledge level of artisanal fishermen on the prevention of malaria in the study area, (iii) assess the attitude of artisanal fishermen toward the adoption of malaria preventive measures, (iv) estimate determinants of artisanal fishermen's knowledge on adoption of malaria preventive measures (v) estimate determinants of attitude of artisanal fishermen on adoption of malaria preventive measures.

RESEARCH METHODOLOGY

Study Area

The study was carried out in Eket Agricultural Zone of Akwa Ibom State, Nigeria. It is one of the six agricultural zones in Akwa Ibom State. Eket Agricultural Zone houses seven (7) Local Government Areas (LGAs). It is located in the coastal part of the state, lying between latitudes 4°32'N and 5°33'N, and longitudes 7°25'E and 8°25'E, with Coordinates 05°00'N 07°50'E. The zone enjoys a tropical humid climate with two climatic seasons, the rainy season and the dry season. The annual precipitation ranges from 2000 - 3000mm per annum. It has an estimated population of well over 260,000 according to updated 2.50% annual growth rate as at 2019 (National Population Commission, (NPC), 2007). The people of the zone are predominantly fishers, farmers and traders. Fishery activities are the cheapest, easiest source of food, income and employment opportunities for many artisanal fishers in the coastal rural communities within the zone.

Sampling Procedure: The study adopted a multi-stage sampling procedure. The first stage involved the purposive selection of Eket Agricultural Zone because that is where intensive artisanal fishing is carried out. The second stage involved the purposive selection of three (3) Local Government Areas from where intensive fishing is practiced. The third stage involved the random selection of two fishing communities from each of the selected Local Government Areas, making a total of six (6) fishing communities. The fourth stage involved the random selection of twenty (20) fishermen from each of the already selected fishing communities using a list of fishermen that have registered with fishermen unions in the respective fishing communities. A total of 120 respondents were selected and used for the study.

Method of data analyses: Both descriptive and inferential statistics were used for analysis.

Objective 1: The socio-economic characteristics of the artisanal fishermen were analysed using descriptive statistic such as percentage distribution and mean.

Objectives 2 and 3: A 4-point likert scale was used with bench mark of 2.50 for these objectives.

Objectives 4 and 5: These objectives were analysed using logistic regression model. The hidden form of the model is stated thus: $Y = \ln (P_i/1-P_i) = \beta_0 + \beta_1 X_1 + \dots + \beta_n X_n + e_i$

Where Y is a dichotomous dependent variable which takes the value of 1 if the fisherman is highly informed in malaria prevention measures; i.e. (p_i (Y=1) and 0 if he/she possesses low knowledge P_i (Y=0), β_0 = intercepts, $\beta_1 \dots \beta_n$ = regression coefficients, X_i = the independent variables (i= 1,2, 3,...n), e = the error term. The explicit form is stated as follows: $Y = \ln (P_i/1-P_i) = \beta_0 + \beta_1 \text{ AGE} + \dots + \beta_9 \text{ COM} + U$.

Where Y = knowledge (attitude) index of fishermen (1 if highly knowledgeable (or possesses a positive attitude), 0 if he/she possesses a low knowledge (attitude).

Left-censored observations: 0 (Knowledge (attitude) index ≤ 0)

Right-censored observations: 2 (Knowledge (attitude) index ≥ 1)

AGE = Age of fishermen (years), MAS = Marital Status (married 1, others = 0), GEN = Gender (Male = 1, Female 0), HHS = Household size (Number of persons), EDU = Educational level of fishermen (years of Education), MOI = Monthly Income of Fishermen (Naira), EXC = Extension contact (number of times of extension visits), FIX = Fishing experience (years), COM = Cooperative Membership (YES = 1, NO = 0), U = Stochastic error term.

RESULTS AND DISCUSSION

Socio-economic characteristics of respondents

According to Table 1, the gender distribution shows that 87.50% of them were male. This is a clear indication that fishing activities is mostly practiced by the male gender in these coastal areas. Same findings were reported by Frank, Okonkwo, Obot and Asogwa (2019). They opined that more males than females were involved in fishing activities.

The age result reveals that 41.66% of the respondents were within the age bracket of 31-40 years, 34.16% indicating that a good number of adults in their active age were involved in fishing. Similar findings were reported by Frank, *et al.*; (2019) and Nkeme, (2020). Majority (65.83%) of them were married with children. This finding corroborates George *et al.*, (2021). They reported that most artisanal fishers were married people with ultimate aim of making ends meet and catering for their children.

As regards educational status, the result showed that majority of the respondents 76.6% of the respondents had completed various level of formal education. It implies that majority of the respondents were lettered. This result is in line with Frank and Umoh (2019), who stated that over 70% of their respondents had formal education. The household size mean value was about 5 persons. In the study area, 60.00% of the respondents had fishing experience of between 11-20 years fishing experience. This is in line with Frank and Umoh (2019), and it implies that artisanal fishing activities are dominated by experienced fishermen. Bulk of the artisanal fishers (77.50%) earned monthly income of between N30,000 - N40,000 from other occupational sources. This result is in line with Frank, *et. al.*; (2019) findings of artisanal fishermen in Akwa Ibom. They reported that most fishers had other income-yielding ventures. In terms of access to credit, the result further revealed that 85.83% had no access to credit. This is corroborated by Frank and Umoh (2019), (2015) and Dimelu *et al.* (2020) who asserted that artisanal fishers lack access to credit except through their cooperatives and local contributions.

Table 1: Distribution of respondents based on socio-economic characteristics **n = 120**

Socio-Economic Variables	Percentage (Frequency)	Mean
Gender		
Male	87.50% (105)	
Female	12.50% (15)	
Age		
20-30	6.66% (8)	
31-40	41.66% (50)	
41-50	34.16% (41)	
51-60	17.50% (21)	
Marital Status		
Single	10.00% (12)	2.39
Married	65.83% (79)	
Divorced	9.16% (11)	
Widower	15.00% (18)	
Educational Status		
No formal education	23.33% (28)	2.17
Primary education	45.00% (54)	
Secondary education	25.00 (30)	
Tertiary education	6.66% (8)	
Household Size		
5-Jan	35.00% (42)	4.88
10-Jun	65.00% (78)	
Fishing Experience		
1-10 years	23.33% (28)	13.97
11-20 years	60.00% (72)	
21-30 years	17.50% (21)	
30 years & above	7.50% (9)	
Income from other source		
< 30,000	15.00% (18)	
30,000-40,000	77.50% (63)	

41,000-50,000	26.66% (32)	
> 50,000	5.83% (7)	
Access To Credit		
Yes	14.16% (17)	1.33
No	85.84% (103)	

Source: Field survey, 2024.

Knowledge Level of Artisanal Fishermen on Malaria Prevention

The distribution of artisanal fishermen, based on their knowledge of the cause of malaria showed that most of the respondents were aware of what causes malaria - mosquito bites. This may be credited to majority of the respondents being lettered as can be seen from the socio-economic characteristics. This is in line with Vundule and Mharakurwa, (1996) who re-counted that the respondents were knowledgeable of the disease. On the degree of seriousness of the disease as envisaged by the respondents, they responded that the disease was a very common disease though, serious and at times very serious. This might not be unconnected with the fact that the tropic is a malaria-endemic area which makes it a very common disease and the seriousness could stem from the lost man-hours when one is down with the disease or the restlessness associated with it when any household member is down with it. This is corroborated by Chukwurah, Idowu, Adeneye, Agomo and Otubanjo (2016). They reported that the disease was a common but serious one and the degree of severity can be graded based on the parasite load.

When knowledge on signs of malaria attack was analyzed, the respondents reported that body pain, yellowish eyes, vomiting and fever were relevant signs of the disease while headache, loss of appetite and bitter tongue were very relevant signs of attack. These signs though may be misleading in terms of essential vitamins deficiencies and indication of other organs malfunctioning. This is in line with Chukwurah, *et al.* (2016) report who reported that fever and headache were symptoms of the disease.

Knowledge of prevention of the disease attack shows that the respondents knew about some malaria preventive methods. They agreed that prevention of the presence of mosquitos and burning of scent leaves before sleep time were very relevant preventive methods. This is a fall out of their knowledge of malaria taught in schools while that of burning of scent leaves has been the traditional method of preventing the causative agents and has been proven to be potent. Prevention of breeding grounds, checking stagnant water reservoirs and making use of mosquito nets were other preventive methods relevant to the respondents. This is still a manifestation of their knowledge of the viable breeding grounds of the mosquitos. However, prevention of the presence of flies, checking contaminated water, spraying rooms with insecticides every night and taking of malaria drugs every month were not relevant preventive methods by the respondents. The last two may be because of the costs involved.

Knowledge on treatments showed that consultation of a traditional medicine man was relevant, consultation of patent medicine dealers and use of herbs/roots were very relevant methods of treatment to the respondents. This may not be unconnected with the ease and accessibility of the methods as most of the malaria drugs have developed resistance against some strands of it. Consultation with the medical doctor and medical diagnostic analysis were not relevant methods perhaps because of the costs and time involved.

Table 2: Respondents Responses to Knowledge Questions on Malaria Prevention

Knowledge about Malaria					Total	WS	Mean	Infer
Knowledge on Type of Disease								
Parasitic disease	69	12	19	20	120	370	3.083	VR
Viral disease	40	16	23	41	120	295	2.458	NR
Natural phenomenon	46	14	30	30	120	316	2.633	R
Bacterial disease	70	16	22	12	120	384	3.200	VR
Knowledge on malaria Cause								
Caused by mosquito bite	74	19	18	9	120	398	3.316	VR
Caused by contaminated water	21	26	51	22	120	286	2.383	NR
Caused by contaminated air	25	33	24	38	120	285	2.375	NR

Caused by flies	22	30	24	34	110	260	2.363	NR
Knowledge on Degree of Seriousness								
Very serious illness	64	22	31	3	120	387	3.225	VR
Serious illness	60	33	17	10	120	383	3.191	VR
Common illness	57	31	21	11	120	374	3.116	VR
Knowledge of malaria Symptoms								
Body pains	41	32	35	12	120	342	2.850	R
Yellow eyes	46	21	30	23	120	330	2.750	R
Headache	57	27	20	16	120	365	3.041	VR
Lack of appetite	27	32	31	30	120	296	2.466	VR
Fever	60	22	15	23	120	359	2.991	R
Vomiting	42	26	25	27	120	323	2.691	R
Bitter tongue	70	19	10	21	120	378	3.150	VR
Knowledge on prevention								
Prevent the presence of Mosquito	60	20	26	16	122	368	3.016	VR
Prevent breeding grounds	48	19	28	25	120	330	2.750	R
Check stagnant water reservoir	40	26	23	31	120	315	2.625	R
Prevent the presence of flies	38	14	21	47	120	283	2.358	NR
Check contaminated water	24	25	32	39	120	274	2.283	NR
Make use of Mosquito nets	48	20	26	26	120	330	2.750	R
Spray room with insecticides every night	27	19	39	35	120	278	2.316	NR
Take malaria drugs every month	30	24	25	41	120	283	2.358	NR
Burn scent leaves every night before sleep	51	42	10	17	120	367	3.058	VR
Knowledge of Treatment								
Consult the Medical Doctor	27	24	24	35	110	263	2.390	NR
Consult the Trado Doctor	57	20	25	18	120	356	2.966	R
Visit the pharmacist	36	21	24	39	120	294	2.450	NR
Patronize the pattern medicine dealer	62	21	27	10	120	375	3.125	VR
Use the known herbs/roots	54	32	17	7	110	353	3.209	VR
Go for diagnostic test	20	25	55	20	120	285	2.375	NR

Note: < 2.50 = Not Relevant, 2.51 - 3.00 = Relevant, 3.01 – 3.50 = Very Relevant, 3.51 – 4.0 = Highly Relevant. (NR (1) = Not Relevant, R (2) = Relevant, VR (3) = Very Relevant, HR (4) = Highly Relevant)

Source: Field Survey data, 2024.

Artisanal fishermen's attitude towards Malaria prevention in the study area

The result shows that voluntary subsection of oneself to malaria vaccination for prevention any time and day, preference of herbs/roots treatment to ACT drugs if infected and preference of mosquito coils to net usage were relevant malaria prevention strategies by the attitudinal judgment of the artisanal fishermen. This agrees with Chukwurah, *et. al.* (2016) report that most respondents preferred herbs treatment of the disease. Preference for treatment at home rather than at health centers, fixing of house windows and doors with mosquito nets and preference for treatment of malaria with tablets rather than injections were very relevant (VR) attitudinal malaria prevention strategies.

Variables	1	2	3	4	W S	Mea n	Infe r
1. Attendance of a seminar on Malaria in and around my neighborhood?	3 7	2 7	2 4	3 2	29 1	2.42 5	NR
2. Adherence to Malaria prevention as displayed on any flyer.	3 0	3 5	3 9	1 6	28 1	2.34 1	NR
3. Immediate report of any malaria infected person(s) to health authorities.	3 1	3 0	3 2	2 7	29 5	2.45 8	NR
4. Voluntary subsection of oneself to Malaria vaccination for prevention any time and day.					41 2	2.57 5	R

	4	2	4	4			
	1	8	9	2			
5. Compulsory subjection of family member with symptom to health authorities.	3	2	3	2	29	2.43	
	4	4	8	4	2	3	NR
6. For Malaria infection, I prefer treated at home rather than go to health centre.	2	1	1	7	37	3.14	
	1	2	6	1	7	1	VR
7. I will adhere to lockdown if imposed on cause of malaria infestation.	3	3	3	2	28	2.34	
	6	0	1	3	1	1	NR
8. The use mosquito net in the family house for night sleep.	4	3	2	2	26	2.24	
	1	3	2	4	9	1	NR
9. I will oblige prevention of my house windows and doors with nets.	2	1	2	5	35		
	5	2	5	8	6	2.9	VR
10. Voluntary and regular disposal of stagnant water containers.	2	1	3	5	36		
	0	4	2	4	0	3.0	VR
11. Infected with malaria, I will rather prefer herbs/root treatment to ACT drugs	2	2	2	5	35		
	2	1	1	6	1	2.9	R
12. For prevention, I will prefer mosquito coil to net usage.	2	2	4	2			
	3	9	1	1	31		
					2	2.6	R
13. For treatment, I will prefer malaria tablets to injections	1	3	2	5	35	2.91	
	5	1	3	1	0	6	VR

Note: < 2.50 = Not Relevant, 2.51 - 3.00 = Relevant, 3.01 – 3.50 = Very Relevant, 3.51 – 4.0 = Highly Relevant. (NR (1) = Not Relevant, R (2) = Relevant, VR (3) = Very Relevant, HR (4) = Highly Relevant)

Source: Field Survey data, 2024

Determinants of artisanal fishermen's knowledge of malaria prevention

The estimated logit model for the determinants showed that the log likelihood ratio and log likelihood ratio (232.02) were all significant at 1% showing that the specified model jointly and adequately explained the variation in the knowledge of fishermen in the prevention of malaria. The constant term was significant showing the goodness of fit of the estimated model. Result showed that estimated coefficient of membership of cooperative society, level of education, fishing experience, household size and income were positive and significant at 1% and 10% level of probability. This denotes that increasing these variables will increase malaria prevention knowledge of fishermen and vice versa. The positive sign for education is expected because educated fishermen are expected to be more knowledgeable in relevant information sources and hence apt to learn and utilize. They can easily read and understand malaria preventive information printed on flyers and other electronic media more than their uneducated counterparts. This aligns with the findings of Lee *et al.* (2021) in South Korea. The positive significant relationship for membership of cooperative society is expected since majority of the fishermen were male. More male fishermen than the female ones have enough time after each fishing day to sit out and interact with friends and may access malaria-related information. This finding aligns with those of Lee *et al.* (2021) who reported a positive association among membership of cooperatives and high level of knowledge in South Korea. The positive sign for fishing experience is also in order because age experience is associated with knowledge and wisdom. This is possible because they may have overtime, been familiar with diverse health information sources which they can leverage on to access malaria preventive information hence, are expected to be highly knowledgeable.

Equally, the positive coefficient of house hold members was expected because each person has different ways of reacting to diseases and track record of each person's treatment is bound to increase the head of household experience on the disease prevention. The positive coefficient of income from fishing indicates that wealthy fishermen are likely to access orthodox medical services when sick than their less privileged counterparts.

Table 4: Estimated Logit Model for the Determinants of Fishermen Level of Knowledge

Variable	Coefficient	Standard error	Z-value
Constant	12.53854	0.486886	11.71***
Gender	0.205608	0.251492	1.796
Marital Status	0.548688	2.592030	0.1420
Cooperative Membership	6.206e-08	5.351e-08	3.18***
Level of education	0.059832	0.011753	3.25***
Fishing experience	0.183116	0.136737	1.752*
Age of a fisherman	0.005582	0.004481	0.7523
Household size	4.550e-05	1.222e-05	2.513***
Income of fishermen	0.102906	0.12306	11.043***
Diagnostic tests			
Wald chi ²			= 73.26***
Pseudo R ²			= 0.074
Log likelihood			= 232.02***

***, ** and * denotes significant at 1%, 5%, and 10% levels, respectively.

Source: Field survey data, 2024.

Determinants of artisanal fishermen attitude on malaria prevention

The result of estimated logit model for the fishermen socio-economic characteristics on the fishermen attitude gave a constant ratio estimated Wald chi² of 91.02, and Log likelihood ratio (226.021). They were all significant showing the goodness of fit of the estimated model. The coefficient for marital status, membership of cooperative society, level of education, fishing experience, age of fishermen, household size and income from fishing were positive and significantly related to attitude while gender had a positive relationship but was statistically not significant. The positive status of marital status was expected because marriage was for procreation and having children in an endemic area like Nigeria is bound to engender attitudinal change in the treatment of malaria. Membership of cooperative society equally is social capital because interaction of members is likely to influence attitudinal changes both in health and secular issues. The positive coefficient for age, membership of cooperatives is expected since age is synonymous with experience and association is synonymous to influence. Chukwurah, *et. al.* (2016) reported that age was a key predictor of women attitude towards condoning self-resilience and adoption of measures for better health in Vietnam. The positive relationship of education is justified because education as a social capital tool and continuous access to such diverse information is capable of provoking a change of attitude among such group of fishermen. This is consistent with those of Chukwurah, *et. al.* (2016). Therefore, increase in fishing experience is likely to influence attitude unlike a novice who is coming to the fishing environment for the first time. Household size and income from fishing are as explained in the knowledge situation above.

Table 5: Estimated Logit Model for the Determinants of Fishermen Attitude

Variable	Coefficient	Standard error	Z-value
Constant			10.248
		58	0.215 13.457**
		47	*
Gender		0.4723	0.251 3.1245
		61	492
Marital Status		0.6875	4.845 4.257**
		90	236

Cooperative Membership	4.0124 54	2.782 410	5.586**
Level of education	0.0725 98	0.045 782	5.783**
Fishing experience	0.2457 81	0.457 882	4.2568*
Age of a fisherman	0.0145 78	0.102 021	8.1245**
Household size	8.0124 47	3.214 547	5.237***
Income of fishermen	0.3147 591	0.358 792	8.258**
Diagnostic tests			
Wald chi ²			= 91.02***
Pseudo R ²			= 0.081
Log likelihood			= 226.021* **

***, ** and * denotes significant at 1%, 5%, and 10% levels, respectively.

Source: field survey data, 2024.

CONCLUSION:

The research concluded that the majority of artisanal fishermen had good knowledge that malaria is a parasitic bacterium, sustained by mosquito bites and were of the opinion that it was a serious but a common disease. They also knew the signs to include fever, headache, and loss of appetite with bitter tongues, amongst others. Their knowledge on prevention were checking of breeding grounds, checking stagnant water reservoirs and making use of mosquito nets. Knowledge on treatments hinged on consultation with traditional medicine men, consultation with patent medicine dealers and use of herbs/roots. Equally, the artisanal fishermen had positive attitude in terms of preference for treatment at home rather than go to health centres, obligation for fixing of house windows and doors with mosquito nets and preference for treatment of malaria with tablets rather than injections were very relevant (VR) attitudinal malaria treatment strategies. The study revealed that the positive and statistically significant knowledge level of the fishermen on malaria was influenced by membership of cooperative societies, level of education, fishing experience, household size and income from fishing while their attitudinal influence was premised upon marital status, membership of cooperative societies, level of education, fishing experience, age of fishermen, household size and income from fishing.

RECOMMENDATIONS

Based on the findings of this study, knowledge level of the fishermen on malaria was influenced by membership of cooperative societies, level of education and fishing experience. It is recommended that the fishers be encourage to belong to organisations for progressive interactions since both knowledge and attitude on malaria were influenced by membership of cooperatives. Relevant authorities should intensify the creation of awareness programs at all strata of education for knowledge and attitudinal influence on malaria. This is because education and experience had influence on knowledge and attitude of fishers on malaria and majority of them were lettered. This will greatly assist in both the diagnostic and therapeutic management of the disease.

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**Perceptions and Practice of ICT for Instruction Delivery among
Agricultural Science Lecturers in Tertiary Institutions in Imo State,
Nigeria**

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ABSTRACT

The study assessed the perceptions and practices of ICT for instruction delivery among agricultural science lecturers in tertiary institutions in Imo State, Nigeria. The study ascertained areas of ICT practiced, assessed the knowledge level of ICT practiced, and identified the challenges to the application of ICT by lecturers in tertiary institutions of Imo State. A multi-stage sampling procedure was used to select 192 respondents. Data were collected using a structured questionnaire and analyzed using descriptive and inferential statistics (T-test). The study revealed that the major areas of ICT used by lecturers in teaching were Microsoft Word (78.6%), Internet services (59.9%), data projectors (66.7%), microphones and audio amplifiers (93.2%). With a grand mean of 3.34, it was also observed that the knowledge level of agricultural lecturers in ICT application was high in Microsoft Word and the internet, but low in PowerPoint. The most significant challenges limiting agricultural lecturers' effective practice of ICT application, with a grand mean score of 3.96, were the lack of available ICT training centers to update their knowledge, an overly busy schedule, poor information dissemination methods, and lack of internet access. In conclusion, the use of ICT application software has not been well integrated into the teaching and learning process among agricultural lecturers. The study, therefore, recommends training and retraining of Imo State tertiary institution staff. Also, ICT must be fully integrated into instruction delivery by all agricultural science lecturers.

Keywords: *ICT, perceptions, practices, and lecturers.*

INTRODUCTION

Information and Communication Technology (ICT) has transformed the way information is created, distributed, and retrieved throughout the world. According to Nwachukwu (2014), ICT has led to an information revolution, which has changed communication and knowledge transmission, and this has in recent times massively impacted learning especially in tertiary institutions. ICT is now an important driver in different areas such as education, governance, business and the society at large, making knowledge available to more people quickly and cheaply. ICT includes a wide variety of tools and applications ranging from radios and televisions to computers, smartphones, satellites, and digital applications such as the use of video conferencing and distance education (Sara, 2010).

In Nigeria, as in many other developing countries, the last fifteen years have shown phenomenal increase in the perception and practice of ICT by citizens, and this has led to a significant impact on various sectors such as health, education, agriculture, governance, and transportation (Jimoh et al., 2012).

Gbenga (2006) stated that ICT enhances the learning process by combining text, data elements, vocal and visual components to support interactive, dynamic teaching methods in the educational environment. It

assists students to learn on a self-pace and interactive mode and access educational materials at any time and place. With virtual classrooms and digital content, collaboration can now be conducted in real time between students and lecturers, transforming learning to become more learner-centred (Castro & Alemán, 2011). E-learning improves students' collaboration, communication, and resource sharing between lecturer and students, and still combines traditional and digital learning methods.

Despite the widely recognized potentials of ICT to enhance teaching and learning, especially in a practical and dynamic field like agricultural science, its effective integration within tertiary institutions remains a significant challenge. The successful implementation of ICT for instructional delivery is not solely dependent on the availability of technology, but also on the perceptions and practices of the lecturers who are expected to use these tools. Specifically, in agricultural science departments, where there's a critical need to bridge theoretical knowledge with practical, real-world applications, ICT tools such as simulation software, virtual field trips, and online learning platforms could be transformative. However, it is unclear to what extent lecturers in this discipline have embraced these technologies. This research, therefore, seeks to address this gap by exploring the perception and practice of agricultural science lecturers regarding ICT for instruction delivery, with a view to identifying the key factors that hinder its effective adoption.

OBJECTIVES OF THE STUDY

The broad objective of the study was to assess the perception of ICT for instruction delivery among agricultural science lecturers in tertiary institutions in Imo State, Nigeria. The specific objectives were to;

- i. ascertain areas of ICT application practiced by agricultural science lecturers in teaching,
- ii. assess the level of knowledge of ICT application practice among agricultural science lecturers, and;
- iii. ascertain the challenges to the practice of ICT applications among agricultural science lecturers in the study area.

METHODOLOGY

Table 1: Sample distribution of respondents

S/N	Tertiary Institution	Departments	No of Lecturers	Sample Size
1	Federal University of Technology Owerri, FUTO)	Animal Sc. Tech.	15	51
		Agric Extension	19	
		Agric Economics	17	
2	Imo State University (IMSU)	Crop Science	12	42
		Animal Science	17	
		Agric Extension	13	
3	Alvan Ikoku College of Education (AICOE).	Agric Extension	10	35
		Agric Economics	11	
		Crop Science	14	
4	Federal Polytechnic Nekede	Agric Engineering	12	40
		Fishery Technology	19	
		Agric Technology	09	
5	Imo Polytechnic, Umuagwo	Agric Technology	09	24
		Forestry	10	
		Agric. Engineering	05	
TOTAL				192

Sample and Sampling Procedure

Multi-stage purposive sampling technique was adopted. The first stage of sampling is a purposive selection of five (5) tertiary institutions in Imo State. These institutions were accredited and had Faculty/Colleges of Agriculture. In the second stage, three (3) Departments from the Agriculture Faculty/College, were randomly selected from each of the five (5) tertiary institutions in Imo State, resulting in a total of fifteen (15) Departments. The list of academic staff was obtained from each Head of Department, and the entire staff of each of these departments was used. The sample size was 192.

Method of Data Analysis

For objective one: the ascertained areas of ICT practiced by the lecturers in teaching was analyzed using descriptive statistics such as frequencies, percentages and mean scores. Objectives two assessed the level of knowledge of ICT practice among agricultural science lecturers, and challenges to the practice of ICT applications among agricultural science lecturers in the study area was analyzed using likert-type scale format. To determine the mean likert level, $X_s = \sum x \cdot \sum s$ of each item was computed by multiplying the frequency of each respondent pattern with its appropriate nominal value and dividing the sum with the number of respondents to the items.

This can be summarized with the equation below;

$$X_s = \sum fn/N$$

Where X_s = mean score

$\sum$ = summation

F = frequency

n = likert nominal scale

N = number of respondents

$$X_s = 1+2+3+4+5/5 = 15/5 = 3.0$$

RESULTS AND DISCUSSION

Areas of ICT application practiced by agricultural science lecturers for teaching in Imo State

The pooled result in Table 2 showed that 78.6%, 59.9%, 66.7% and 93.2% of the agricultural science lecturers in tertiary institutions in Imo State averred that the major areas of ICT they practiced in teaching were Microsoft Word processing software, Internet services, Data projector and microphone and audio amplifier, respectively. This result implies that the practice of ICT in teaching among agricultural science lecturers in tertiary institutions in Imo State is poor. The practice with Microsoft Excel, PowerPoint, statistical packages such as STATA, Eview, GenStat, SPSS, Minitab, and smart boards in teaching seems to be a challenge among agricultural science lecturers in tertiary institutions in Imo State.

The finding of the study agrees with the view of Owuagboke and Singh (2016) that there are poor areas of practice of ICT application in instructional delivery among academic staff, suggesting that academic staff should embrace innovative techniques by a favourable disposition towards them which will help boost classroom implementation of such innovation. The finding of the study is also consistent with the findings of Onasanya, Shehu, Oduwaye and Shehu (2010), Yusuf and Balogun (2011), Umeh and Okonkwo (2014) and Onwuagboke, Singh and Onwuagboke (2014) who noted that the areas of ICT application in teaching is poor among academic staff due to lack of experience in the practice of different areas of ICT application in instructional delivery.

Table 2: Percentage distribution of areas of ICT applications practiced by the agricultural science lecturers in teaching in Imo State

S/N	Areas of ICT applications used in teaching	*FUTO (n=51)	*ALVAN (n = 35)	*IMSU (n=42)	*IMOPOLY (n = 24)	*FEDPOLY (n = 40)	*Pooled (n = 192)
1.	Microsoft Word	90.2	71.4	73.8	66.7	82.5	78.6
2.	Microsoft Excel	47.1	25.7	33.3	29.2	20.0	32.3
3.	PowerPoint	58.8	31.4	47.6	29.2	20.0	39.6
4.	STATA	9.8	5.7	-	4.2	10.0	6.3
5.	Eview	9.8	11.4	-	4.2	10.0	7.3
6.	Genstat	9.8	5.7	-	4.2	10.0	6.3
7.	SPSS	9.8	8.6	4.8	4.2	10.0	7.8

8.	Minitab	3.9	2.9	-	-	2.5	2.1
9.	Internet services	70.6	48.6	54.8	41.7	72.5	59.9
10.	Data projector	54.9	85.7	54.8	58.3	82.5	66.7
11.	Smart boards	29.4	22.9	14.3	-	0	15.1
12.	Microphone and audio amplifier	96.1	88.6	90.5	87.5	100.0	93.2

Source: Field survey data (2018) * multiple responses recorded.

Levels of knowledge of ICT practice among agricultural science lecturers in Imo State

The group mean score in Table 3, shows that ALVAN lecturers had better knowledge in the use of Microsoft word software and PowerPoint software, although FUTO scored highest (3.54) in the use of the Internet. The grand mean score was higher than the benchmark score of 3.0. By the Grand mean score of 3.34, it shows that the knowledge level of agricultural science lecturers regarding the practice of ICT for instruction delivery is high. This is further evidence by the fact that the group mean score for the knowledge of Microsoft word is high, and that of Internet is high although their knowledge of practice of Powerpoint is low, being below the benchmark score. The finding of the study agrees with the view of Gberevbie (2014) that most academic lecturers have basic knowledge in the practice of Microsoft word software but lack depth knowledge in the practice of other Microsoft office applications like Excel and PowerPoint. The finding of this study also agrees with the view of Egunjobi (2009) that Microsoft Word application is the first Microsoft office application any individuals is exposed in learning computer applications and this give them more opportunity to know the application more than other computer applications. The results of this study are also in line with Usun (2003) and (Kashif, 2012) and coincide with remarkable consistencies. In both studies, lecturers agreed strongly that the knowledge of the internet is essential for students and they feel comfortable in using the internet.

Table 3: Mean score responses of the level of knowledge in the practice of Microsoft Word processing software, PowerPoint, and the internet among agricultural science lecturers in tertiary institutions in Imo State

S/N	KNOWLEDGE OF ICT	FUTO (n=51)	ALVAN (n=35)	IMSU (n=42)	IMOPOLY (n=24)	FEDPOLY (n=40)	Pooled (n=192)	Decision
	Microsoft Word Application							
1	Format text e.g. size	4.00	4.05	4.62	4.15	4.20	4.20	VK
2	Spell check a document	3.96	3.41	3.06	3.21	3.16	3.36	FK
3	Copy and paste elsewhere	3.08	4.13	3.18	3.23	3.28	3.38	FK
4	Proper use of undo tool	3.14	3.29	3.24	3.29	3.24	3.24	FK
5	Customize toolbar	4.75	4.8	4.75	4.9	4.95	4.83	VK
6	Set margins & page breaks	4.69	4.74	4.79	4.84	4.89	4.79	VK
7	Create numbers & bullets	4.64	4.69	4.74	4.89	4.84	4.76	VK
8	Set headers and footers	4.03	4.08	4.13	4.18	4.22	4.13	VK
	Group mean	3.44	4.15	4.06	4.09	4.10	3.97	K

PowerPoint Application								
1	Delete slides	2.70	3.00	2.95	2.90	2.85	2.88	PK
2	Duplicate slides	2.92	2.87	2.82	2.78	2.74	2.83	PK
3	Inserting bullets	2.99	2.94	2.89	2.84	2.79	2.89	PK
4	Create a new slide	2.95	2.90	2.85	2.80	2.75	2.85	PK
5	Start a slide show	2.56	2.66	2.61	2.56	2.51	2.58	PK
6	Add an image or table	2.87	2.82	2.77	2.72	2.67	2.77	PK
7	Formatting a slide	2.61	2.56	2.51	2.56	2.51	2.55	PK
8	Operate a projector	2.75	3.05	3.00	2.95	2.90	2.93	PK
	Group mean	2.79	2.85	2.80	2.76	2.72	2.78	PK
The Internet								
1	Know how to use google	4.22	4.43	4.18	4.05	3.45	4.07	K
2	Navigate a website	3.54	3.23	3.30	3.00	3.44	3.30	FK
3	Create and send an e-mail	3.88	3.44	3.54	3.09	3.10	3.41	FK
4	Reply or forward an e-mail	3.88	3.47	3.49	3.12	3.17	3.43	FK
5	Attach a document and send	3.67	3.21	3.86	2.99	3.82	3.51	K
6	Know how to sort e-mails	3.11	2.93	2.55	2.99	3.01	2.92	PK
7	Create a new outlook folder	3.14	3.51	3.18	2.44	3.09	3.07	FK
8	Uploading lecture notes	2.90	2.88	3.23	2.90	3.01	2.98	PK
	Group mean	3.54	3.39	3.42	2.70	3.26	3.26	FK
	Grand mean score	3.26	3.46	3.43	3.18	3.36	3.34	FK

Source: Field survey data (2018)

Challenges to practice of ICT among agricultural science lecturers

The result of the pooled mean response of respondents shown in Table 4 shows that the respondents accepted all the fourteen (14) statements bordering on the challenges to the practice of ICT applications among lecturers in Imo State. The grand mean response of the respondents was 3.96. Lecturers in FUTO, having the highest score of 4.06 were more challenged in using ICT applications. This implies that the respondents were challenged in all the listed ways as regards using ICT applications in the study area. Therefore, efforts geared at enhancing the practice of ICT application among agricultural science lecturers must focus on these areas.

Table 4: Mean score responses on the challenges to the practice of ICT applications among lecturers in Imo State

S/N	Challenges to the Pract of ICT Applications	FUTO (n=51)	ALVAN (n=35)	IMSU (n=42)	IMOPOLY (n=24)	FEDPOLY (n=40)	Pooled (n=192)	Decision
1	Non-availability of ICT training centres to update ICT knowledge	4.41	4.36	4.31	4.26	4.21	4.31	Accepted
2	Inadequate ICT facilities like computer electronic board in the faculty	3.87	3.82	3.77	3.72	3.67	3.77	Accepted
3	High cost of ICT equipment	4.03	3.98	3.93	3.88	3.83	3.93	Accepted
4	Incessant power failure	3.99	3.94	3.89	3.84	3.79	3.89	Accepted
5	Lack of internet access	4.16	4.11	4.06	4.01	3.96	4.06	Accepted
6	Poor Internet connectivity	3.81	3.76	3.71	3.66	3.61	3.71	Accepted
7	Too busy schedule	4.23	4.18	4.13	4.08	4.03	4.13	Accepted
8	Lack of awareness/Training on the use of various analytical software e.g. SPSS, STATA etc.	4.12	4.07	4.02	3.97	3.92	4.02	Accepted
9	Poor attitude towards acquiring ICT skills	4.16	4.11	4.06	4.01	3.96	4.06	Accepted
10	Unwillingness of some colleagues to teach others what they have acquired	4.05	4.00	3.95	3.90	3.85	3.95	Accepted
11	Poor information communication methods	4.22	4.17	4.12	4.07	4.02	4.12	Accepted
12	Priority issues on the part of both the faculty and the university	3.95	3.90	3.85	3.80	3.75	3.85	Accepted
13	Financial problem	4.06	4.01	3.96	3.91	3.86	3.96	Accepted
14	Lack of competence in internet searching skills on the part of many lecturers	3.78	3.73	3.68	3.63	3.58	3.68	Accepted
	Grand mean score	4.06	4.01	3.96	3.91	3.86	3.96	Accepted
	Number of Respondents	51	35	42	24	40	192	

Source: Field survey data (2018)

CONCLUSION

The study concluded that the areas of ICT mostly used by agricultural science lecturers for teaching in Imo State were; Microsoft word, internet services, data projector, microphone and audio amplifier, consequently, the practice of ICT in teaching among agricultural science lecturers in tertiary Institutions in Imo State was poor. The study also affirmed that the knowledge level of agricultural science lecturers in ICT application such as Microsoft Word and the Internet was high, although their level of knowledge of Microsoft PowerPoint was low. Non-availability of ICT training centers to update ICT knowledge, too busy

schedule, poor information communication methods, lack of internet access, etc were top challenges found limiting agricultural lecturers' better practice of ICT applications in Imo State.

RECOMMENDATIONS

Based on the findings of this study, it is recommended that;

1. Agricultural science lecturers at all levels should be trained in the use of ICT, especially Microsoft Office applications, applications for analysis, etc;
2. Tertiary institutions must ensure that ICT is fully integrated into instruction delivery by all agricultural science lecturers
3. Workshops/seminar should be periodically organized for agricultural science lecturers, specifically for the purpose of improving their literacy level and awareness on its importance for teaching.

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Theme: Agricultural Extension for Food Security and Community Empowerment

Risks Mitigation Strategies Utilized by Poultry Farmers in Akwa Ibom State, Nigeria

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ABSTRACT

This study investigated risks mitigation strategies utilized by poultry farmers in Akwa Ibom State. A total of 310 poultry farmers were selected across the three Agricultural zones in Akwa Ibom State using multi-stage sampling techniques. Relevant data were collected from the selected respondents with the aid of a questionnaire. The data was analyzed using descriptive statistics, Likert-type scale rating. Results from the study showed that majority of the farmers were male, the mean age of the respondents was 45.67 years, majority of the farmers were educated and the mean farm experience was 6.65 years. The farmers were faced with different types of risks such as; high cost of feed ($\bar{X}=2.58$), heat stress ($\bar{X}=2.58$), stampede among the birds ($\bar{X}=2.58$), poor veterinary services ($\bar{X}=2.49$), etc. Risks mitigation strategies employed by poultry farmers were avoiding overcrowding of birds, reducing poultry size and acquiring feed from safe and known sources. The result further showed that farmers adopted one measure in all items presented; sourcing for future market, use of control measures for predators and pests, disinfection of poultry premises etc. It was concluded that risks mitigation strategies adopted by poultry farmers in Akwa Ibom State has helped tremendously in sustenance and profitability of the enterprise. The study recommends better and stronger collaborations between the farmers, stakeholders and Extension agents for holistic review of the strategies for the sustainability of the poultry industry.

Key words: Risks, Mitigation strategies, Poultry farmers, Akwa Ibom

INTRODUCTION

The livestock sector can be regarded as a fundamental aspect of agricultural production (Udoka, Bassey and Okorie, 2019). Poultry production involves the process of rearing domestic birds chiefly for poultry meat and eggs supply for human consumption (Udo, Okorie and Udoekpo, 2019). Poultry production is a commercially feasible business that contributes significantly to Gross Domestic Product (GDP). In Nigeria, it has become a full-time job for many, especially in Akwa Ibom State, with most of the poultry farmers engaging majorly in small-scale production with slight options for diversification and insurance (Babalola, 2013), thus their attitude to risk mitigation measures often influences their adoption of new technologies and propensity for goal attainment.

About 180 million birds comprise the Nigerian poultry industry. Nigeria, behind South Africa, has the second-largest chicken population in Africa (SAHEL, 2015), in 2013, turned an output of 650,000 tonnes of eggs and 300,000 tonnes of poultry meat according to the Food and Agricultural Organization Statistic (FAOSTAT, 2018). An estimated total of 40 million hens is raised intensively, 60 million in semi-intensive systems, and 80 million in extensive systems (African Sustainable Livestock (ASL) 2050, 2018). The sector is one of the leading enterprises in Nigeria's Agricultural sector, with widespread acceptance among most

of the citizens in all regions in Nigeria due to its prolific instincts in rearing and short-term rate of returns in terms of monetary and other kinds of benefits, without any religious or cultural restriction.

Amidst the importance of poultry, rural communities in developing countries continue to face widespread chronic malnutrition and micronutrient deficiencies. Poultry production holds significant potential to enhance rural household nutrition, as many low-income rural families depend on domestic chickens as their main source of animal protein and essential micronutrients (Iannotti, Barron, & Roy, 2008). Despite this potential, the sector remains underutilized due to the high level of risk and uncertainty that characterizes agricultural enterprises.

Farmers in Nigeria routinely make production decisions under risky and uncertain conditions such as erratic weather patterns, outbreaks of disease, fluctuating prices, limited access to inputs, and unpredictable policy environments. These conditions hinder accurate forecasting and long-term planning, contributing to farmers' generally risk-averse behavior and hesitancy toward innovation adoption (Salman et al., 2012). The sustainability and success of poultry farming projects hinge on the farmers' risk attitudes and coping strategies. Smallholder farmers tend to prioritize stability over profit when allocating resources, particularly in uncertain conditions. Understanding how farmers perceive and manage risk is therefore vital for designing effective, farmer-centered support systems (Abimbola *et al.*, 2018).

In Akwa Ibom State, poultry production contributes only 1.6% to Nigeria's national output (FAOSTAT, 2018) a figure that is under threat due to prevailing risks and uncertainties. The situation is exacerbated by the increasing closure of poultry farms and dwindling investor interest, which have led to rising poultry product prices and declining protein consumption. This has far-reaching consequences on public health, education, income, and productivity. If left unaddressed, these challenges could lead to a collapse of the poultry industry, with dire consequences for food security, nutrition, and farmers' livelihoods (Baruwa & Adesuyi, 2018). While there is existing research on risk attitudes among farmers in other regions of Nigeria (e.g., Babalola, 2014; Banjoko et al., 2014; Iheke & Igbelina, 2016), there is a noticeable gap in studies examining the specific risk-coping strategies of poultry farmers in Akwa Ibom State.

This research is therefore necessary to fill this gap by assessing the types of risks faced by poultry farmers in Akwa Ibom, their coping mechanisms, and the effectiveness of these strategies. Findings from the study will help inform the development of robust, context-specific risk management frameworks to support sustainable poultry production and enhance rural livelihoods in the region.

OBJECTIVES OF THE STUDY

The broad objective of this study was to assess risk mitigation strategies adopted by poultry farmers in Akwa Ibom State. The specific objectives of this study were to;

- i. describe the socioeconomic characteristics of poultry farmers in the study area;
- ii. examine the different types of risks associated with poultry farming in the study area;
- iii. evaluate the risk mitigation strategies employed by poultry farmers in the study area;

RESEARCH METHODOLOGY

Study Area

The study was carried out in Akwa Ibom State, Nigeria. Akwa Ibom State is located in the Niger Delta region of Nigeria. It has an estimated population of 5.451 million (NBS, 2016) and a land area of 6,900 sq. Km. It lies between latitudes 05°00'N and longitudes 07°50'E. It is bordered on the east by Cross River State, west by Rivers State and Abia State, and on the south by the Atlantic Ocean. It is currently the highest oil-producing State in Nigeria. Agriculture is the dominant economic activity of Akwa Ibom State. Agriculture supports 60-75% of households of the State's population. The various agricultural products include palm oil, cassava, yam, cocoyam, plantain, maize, rice, rubber, seafood such as varieties of fish, shrimps, crayfish, oysters, etc., poultry eggs and meats, pork, and lately snail farming. Akpan *et al.*, (2013) noted that the poultry enterprise is an emerging business in most of the area, with commercial broiler and egg production becoming very popular among the inhabitants of the area.

Study population

The study comprised all the practicing poultry farmers in the six agricultural zones in Akwa Ibom State.

Sampling procedure and sample size

A simple random sampling technique was used to carry out a proportional selection of blocks from each of the six (6) zones using 20% as a benchmark. In addition, a random sampling technique was used to carry out a proportional selection of cells from the selected blocks in each zone using 20% as a benchmark which was followed by the sampling of ten households in each of the selected cells using a systematic random sampling technique. Household heads who are farmers will be allowed to respond to the questionnaire. Hence, approximately 10 blocks, 30 cells, and 300 practicing farmers was sampled across the state. Table 1 below gives clearer information on the sampling procedure and sample size.

Table 1. Sampling Frame of the Study

AZS	BAZ	SBRs	TCSB	PSSB	SRSH
Uyo	8	2	10	6	60
Etinan	4	1	8	4	40
Eket	7	2	10	5	50
Oron	4	1	4	2	20
Abak	9	2	12	6	60
Ikot Ekpene	8	2	16	8	80
TOTAL	40	10	60	31	310

AZS: Agric Zones in Akwa Ibom State; BAZ: Total no. Blocks in each Agricultural Zone; SBRs: 20% Selection of Block(s) via random sampling; TCSB: Total No. of Cells in the Sampled Block(s); PSSB: 20% Proportional Selection of cells from sampled Blocks; SRSH: Systematic Random Selection of 10 Households in Each Sampled Cell.

Analytical Techniques

Objective 1: Socio-economic Characteristics of Poultry Farmers in the Study Area

The socio-economic characteristics of the poultry farmers in the study area were analyzed using descriptive statistics which included the use of means, frequencies, tables, and percentages.

Objective 2: examine difference type of Risk Faced by Poultry Farmers in the Study Area. This objective was analyzed with the use of a three-point Likert-type scale which was rated; 3 = very serious, 2 = serious, and 1 = not serious as a response to risks faced by the farmers. For the purpose of decision making, the results were interpreted such that 2.50–3.00 indicated the factor was considered very serious, 1.50–2.49 indicated it was considered serious, and 1.00–1.49 indicated it was considered not serious.

Objective 3: evaluate the Risk Mitigation Strategies Utilized by Poultry Farmers in the Study Area

This objective was analyzed with the use of a three-point Likert-type scale which was rated; 3 = regularly, 2 = sometimes, and 1 = not at all as a response to risk mitigation strategies that were utilized. For the purpose of decision making, the results were interpreted such that a mean value of 2.50–3.00 indicated that the strategy was regularly utilized, 1.50–2.49 indicated it was sometimes utilized, and 1.00–1.49 indicated it was not utilized at all.

RESULTS AND DISCUSSION

Table 1 shows the result of the social characteristics of poultry farmers in the study area. The gender distribution of the respondents showed that the majority of the poultry farmers in the study area were male (64.19%), and 35.81% of the population were female. statistics point to the increasing role of women engaged in poultry production for commercial purposes and not just for household consumption as reported by Okoh, Rahman, and Ibrahim (2010). Banjoko *et al.* (2014), Iheke *et al.*, (2016), Okon (2017), Udoka *et al.*, (2019), Adeyonu *et al.* (2021), and Okorie *et al.*, (2022) all reported in their findings that the poultry industry is male-dominant. The age distribution of the respondents showed the mean age of the respondents was 45.67years. The mean age of the respondents revealed that many of the poultry farmers in the study area are middle-aged and in their prime. The mean age also allows them to adapt to changing trends in risk

management as the opportunity to learn and adapt to changes is high. Udo et al., (2019) and Adeyounet al. (2021) had a mean age of 42 and 43.41 years respectively.

The distribution of the respondents according to marital status revealed that a larger proportion (78.39%) of the respondents are married as compared to 17.09% of the respondents that have not been married while 2.58% and 1.94% of the respondents are divorced and widowed respectively. The result shows that many of the respondents with large households may take advantage of utilizing household members as labour sources. The result conforms to the findings of Udoka *et al.*, (2019) and Okorie *et al.*, (2022) who reported that 62.5%, and 68.5% of their respondents respectively were married. The educational attainment of the respondents showed that a larger proportion (62.26%) of the respondents had received secondary education, this was closely followed by 27.74% of the respondents who had gone to tertiary institutions, 6.13% of the respondents had only primary education. While few of the respondents (3.87%) had not received any form of formal education with a mean of 13.65. This result is conformity with Udoka *et al.*, (2019) a high level (78.3%) of education among the farmers. Adeyonu *et al.*, (2021) reported a mean year of schooling to be 13.63 years and opined that a high level of education would equip the farmers with the ability to have technical knowledge of the enterprise for enhanced productivity. Conversely, Okorie *et al.*, (2022) reported that 99.5% of the respondents spent below 6 years in education with an average of 4 years of schooling.

The findings showed that most (70.00%) of the respondents did not belong to any cooperative organization. The distribution of poultry farmers in the study area according to the years of experience in poultry. The mean distribution of the years of experience gained stood at 7.23 years. This finding is less than the mean experience reported by Iheke *et al.*, (2016) at 23 years and Adeyonu et al. (2021) at 19.48 years, but is in line with the findings of Banjoko et al., (2014) recorded a mean of 5 years. Okon (2017) and Okorie et al., (2022) reported a mean of 6 and 7 years of experience respectively. The distribution of the respondents according to household size showed a mean household of 6 persons. This could affect the attitude of the farmers towards risks and handling risks, as they may give priority to the welfare of their household over their enterprise. Banjoko *et al.*, (2014), Iheke *et al.*, (2016), Okon (2017), Udoka *et al.*, (2019) and Okorie *et al.*, (2022) reported a mean household size of 5, 6, 4 and 5 household members respectively. Iheke *et al* (2016) noted that a large household size is desirable and of great importance in farm production as rural households rely more on members of their household than hired workers.

Socio-Economic Characteristics of Poultry Farmers in the Study Area

Table1: Social Characteristics of Poultry Farmers in the Study Area n = 310

Characteristics	Frequency	Percentage
Gender		
Male	199	64.19
Female	111	35.81
Age		
20 – 30	53	17.09
31 – 40	87	28.06
41 – 50	118	38.07
51 - 60	44	14.19
>60	8	2.59
Mean	45.67	
Marital Status		
Single	53	17.09
Married	243	78.39
Divorced	8	2.58
Widowed	6	1.94
Education attainment		
No Formal	12	3.87

Primary	19	6.13
Secondary	193	62.26
Tertiary	86	27.74
Mean	13.65	
Member of Social Organization		
Yes	93	30.00
No	217	70.00
Farming Experience		
1 – 5	111	35.81
6 – 10	172	55.48
11 – 15	21	6.77
16 – 20	6	1.94
Mean	7.23	
Household Size		
0 – 5	118	38.07
6 – 10	155	50.00
> 10	37	11.94
Mean	6	

Source: (Field Survey), 2025.

Type of Risks Faced by Poultry Farmers in the Study Area

Table 2 shows the different types of risks associated with poultry farming in the study area. The result showed that high cost of feed ($\bar{X}=2.58$), heat stress ($\bar{X}=2.58$), stampede among the birds ($\bar{X}=2.58$), poor veterinary services ($\bar{X}=2.49$), cost of drugs and medications ($\bar{X}=2.43$), lack of storage and processing facilities ($\bar{X}=2.43$), ill health of the farmer ($\bar{X}=2.43$) improper record keeping ($\bar{X}=2.42$), the outbreak of diseases among the birds ($\bar{X}=2.41$) and acquiring of birds from wrong sources ($\bar{X}=2.41$) were considered serious risk to the farmers. It can be inferred from the result that many of the risks considered serious and high-ranking by the farmers were financial and management risks. Okorie *et al.*, (2022) noted the need to ensure that agricultural innovations or information reaching farmers is in line with the needs of the farmers and should be capable of contributing to the enhancement of their performance, considering the economic importance of the poultry sector. Iheke and Igbelina (2016) noted that financial risks, production risks, pricing, and market and casualty risks were major type of risks facing farmers. Binuyo *et al.*, (2020) mentioned the rise in costs of inputs, disease outbreaks, inadequate storage facilities, government policy change, and lack of loans to farmers as high-risk sources.

Risks Faced by Poultry Farmers in the Study Area

Table 2: Risks Faced by the Poultry Farmers in the Study Area

Risks	Not Serious	Serious	Very Serious	Mean Score	Rank
High cost of feed	40	49	221	2.58	1 st
Improper record keeping	66	49	195	2.42	4 th
Outbreak of diseases among the birds	69	44	197	2.41	5 th
Acquiring birds from the wrong sources	69	44	197	2.41	5 th
Lack of storage and processing facilities	54	71	185	2.43	3 rd
Poor veterinary services	34	65	211	2.49	2 nd
Lack of quality feed for improved yield	40	49	221	2.58	1 st
Stampede among the birds	54	71	185	2.43	3 rd
Market price fluctuations	68	93	149	2.31	6 th
Input price fluctuation	69	44	197	2.41	5 th
Ill health of the farmer	54	71	185	2.43	3 rd
Heat stress	40	49	221	2.58	1 st

Cost of drugs and medications	69	44	197	2.43	3 rd

Source: Field Survey, 2025

Risks Mitigation Strategies Utilized by Poultry Farmers

Table 3 showed that avoiding overcrowding of birds ranked highest, having a mean value of ($\bar{X}$ =2.94), reducing poultry size ($\bar{X}$ =2.90), acquiring feed from safe and known sources ($\bar{X}$ =2.94), sourcing for future market ($\bar{X}$ =2.77), use of control measures for predators and pests ($\bar{X}$ =2.77), Disinfection of poultry premises ($\bar{X}$ =2.75), Attending extension workshops on poultry ($\bar{X}$ =2.75), Use of disease-resistant breeds ($\bar{X}$ =2.73), acquiring birds from a safe and reliable supplier ($\bar{X}$ =2.71), Quarantine of sick or diseased birds ($\bar{X}$ =2.70), Keeping extra cash for emergencies ($\bar{X}$ =2.70), Relaxation of pens ($\bar{X}$ =2.70) and Controlled access of visitors around the poultry farm ($\bar{X}$ =2.62) were considered as regularly utilized risks mitigation strategies used by poultry farmers in the study area. The result implies that the farmers in the study area have employed a wide range of strategies to mitigate and combat the various risks they are faced with. The result indicated that many of the farmers actively practice the avoidance of overcrowding their birds and regularly disinfect their farms. Adeyonu *et al.* (2021) noted with high level of losses that farmers may experience in terms of mortality as a result of not giving the risks the attention required. It is indicated by the result that many of the farmers are aware of or have been confronted by various risk factors and have responded by adopting various risk mitigation measures to ease the effects and impacts of the risks.

Table 3: Risk Mitigation Strategies Utilized by Poultry Farmers in the Study Area

Mitigation Strategies	Not at all	Sometimes	Regularly	Mean	Rank
Avoiding overcrowding of birds	5	10	295	2.94	1 st
Controlled access of visitors around the poultry farm	46	27	237	2.62	9 th
Acquiring birds from a safe and reliable supplier	25	41	244	2.71	7 th
Reducing poultry size	10	24	276	2.90	2 nd
Acquiring feed from safe and known sources	16	31	263	2.79	3 rd
Sourcing for future market	26	17	267	2.77	4 th
Disinfection of poultry premises	21	34	255	2.75	5 th
Use control measures for pests, predators and rodents	17	37	256	2.77	4 th
Quarantine of sick or diseased birds	32	29	249	2.70	8 th
Attending extension workshops on poultry	6	66	238	2.75	5 th
Keeping extra cash for emergencies	13	67	230	2.70	8 th
Use of disease-resistant breeds	12	60	238	2.73	6 th
Changing of shoes when entering the poultry house	6	70	234	2.73	6 th
Relaxation of pens	20	48	242	2.70	8 th
Grand mean				2.75	

Mean Score = 2.0

Source: Field Survey, 2025

CONCLUSION

The study revealed that poultry farmers in Akwa Ibom State are confronted with multiple risks, the most critical being the high cost of feed, heat stress, and stampede among birds. Other significant risks include poor veterinary services, high cost of drugs and medications, lack of storage facilities, ill health of the

farmer, improper record keeping, outbreak of diseases, and acquiring birds from unreliable sources. These risks are predominantly **financial and management-related**, which corroborates previous studies highlighting the vulnerability of poultry enterprises to input cost fluctuations, disease outbreaks, and infrastructural deficiencies. Farmers have adopted a variety of risk mitigation strategies, with the most prominent being the avoidance of overcrowding, acquiring feed from safe and known sources, reducing poultry size, sourcing for future markets, and implementing predator and pest control measures. Regular disinfection, attendance at extension workshops, use of disease-resistant breeds, proper quarantine procedures, and maintaining emergency funds were also widely practiced. The high utilization of these strategies indicates that farmers are aware of the risks and actively work to minimize their impact. However, the persistence of these risks suggests that while mitigation measures are in place, more structural and policy interventions are needed to enhance their effectiveness.

RECOMMENDATIONS

Based on the findings from this research, the following recommendations were proposed;

1. **Input Subsidy and Credit Support** – Government and development agencies should provide subsidized feed, drugs, and vaccines to reduce the financial burden on farmers. Access to affordable credit facilities should also be improved to enable farmers to implement more effective risks mitigation measures.
2. **Strengthening Veterinary and Extension Services:** Expansion of veterinary clinics and recruitment of more extension officers to deliver timely training, disease diagnosis, and treatment services to farmers.
3. **Capacity Building:** Regular workshops and training sessions on improved biosecurity, record-keeping, and farm management practices should be organized, with emphasis on practical demonstrations.
4. **Infrastructure Development:** Investment in storage and processing facilities to reduce post-production losses and improve the profitability of poultry enterprises.
5. **Market Stabilization and Linkages:** Establish structured market linkages to reduce the uncertainty of selling produce and stabilize prices for poultry products.
6. **Policy Support for Risk Insurance:** Encourage the adoption of agricultural insurance schemes tailored to poultry farmers to cushion the effects of mortality, disease outbreaks, and market fluctuations.

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**Assessment of the Willingness of Agricultural Researchers to Utilize
E-Learning and E-Reporting Technologies for Research
Dissemination in Imo State, Nigeria**

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ABSTRACT

The study assessed the willingness of agricultural researchers in selected tertiary institutions to utilize e-learning and e-reporting technologies in disseminating research findings in Imo State, Nigeria. Specific objectives included examining the socio-economic characteristics of respondents and determining their willingness to adopt digital platforms for research dissemination. A sample size of 150 respondents was drawn using purposive and proportionate stratified sampling from four major institutions. Data were analyzed using descriptive statistics and multiple regression. Results revealed that most respondents were male (60.7%), with a mean age of 42 years and a strong educational background (91.4% held postgraduate degrees). Despite facing ICT access challenges (46% had restricted access), researchers expressed high willingness to adopt digital platforms such as ResearchGate, Zoom, and Google Meet. Regression analysis showed that socio-economic factors such as age, education, income, ICT access, and work experience significantly influenced willingness to adopt digital tools. The study recommends targeted interventions to improve infrastructure, digital literacy, and institutional support.

Keywords: Willingness, E-learning, E-reporting, Agricultural Researchers, Tertiary Institutions, Imo State

INTRODUCTION

Agriculture is central to Nigeria's economy, offering employment and food security, yet it suffers from low productivity, post-harvest losses, and limited adoption of modern techniques (Nwafor et al., 2020; Olayide & Alabi, 2018). Despite vast resources and the integration of computer studies in Nigerian institutions, research findings in agriculture often remain underutilized, failing to reach farmers and policymakers (Gbenga, 2006; Omotayo, 2011). Bridging this gap requires effective dissemination strategies and the adoption of digital technologies like mobile apps, social media, online databases, and cloud computing (Aker, 2020; Yahaya & Bello, 2019). These tools can accelerate the flow of research knowledge to stakeholders, improve communication, and drive innovation (Eze & Obike, 2021). Despite the growing availability and global relevance of digital technologies in research dissemination, agricultural research findings in Nigeria often fail to reach their intended beneficiaries—particularly farmers, extension agents, and policymakers (Ogunleye & Awoyemi, 2019). This disconnect between research institutions and the end-users of knowledge has significantly hindered the potential impact of agricultural innovations on productivity and rural livelihoods. Salau and Saingbe (2022) observed that valuable research outputs

frequently remain trapped within academic publications and institutional repositories, rendering them inaccessible and practically irrelevant to those who could apply them most directly. Omotayo (2011) similarly emphasized that the underutilization of agricultural research insights continues to be a major impediment to Nigeria's agricultural development.

Although the digital age offers robust opportunities—through tools such as mobile applications, e-learning platforms (Moodle, google classroom, google zoom meet, Edmodo, canvas etc), e-reporting platforms (ResearchGate, Academia.edu, Zenodo, Figshare, OSF etc), online databases, and cloud computing—the extent to which agricultural researchers in Nigeria effectively engage with these technologies remains largely unclear (Ekong & Ojo, 2018; Aker, 2020). Adoption is often inconsistent due to varying levels of digital literacy, inadequate institutional support, and limited personal motivation among researchers accustomed to conventional dissemination methods such as seminars, workshops, and printed materials (Chikaire et al., 2017; Musa et al., 2021).

Moreover, infrastructure challenges further complicate the situation. Poor internet connectivity, unstable electricity supply, lack of digital equipment, and insufficient training opportunities are pervasive in many tertiary and research institutions, particularly those located in rural areas (Mattern, 2009; Nwachukwu, 2013). These challenges create digital divides not only between urban and rural researchers but also within institutions, weakening efforts to standardize the integration of digital tools in research dissemination.

In addition to these operational barriers, there is also a lack of institutional frameworks or coherent digital policies promoting the use of ICT in agricultural research and extension systems. The absence of dedicated strategies to promote digital knowledge sharing often results in fragmented efforts that fail to yield consistent outcomes (Olojo, Adewunmi & Ajisola, 2012). Furthermore, personal and socio-cultural factors such as age, gender, and resistance to change also play significant roles in limiting digital technology adoption, as older or less technologically inclined researchers may resist transitioning from traditional dissemination approaches to digital ones (Adewale & Adeola, 2023).

This situation is particularly troubling given the critical role of research-extension-farmer linkages in agricultural development. Extension services rely on accurate, timely, and well-disseminated research findings to educate farmers and improve practices (Ekong, 2003). When dissemination breaks down due to poor digital engagement, it not only limits the reach of scientific discoveries but also perpetuates cycles of low productivity, food insecurity, and rural poverty.

Thus, it becomes imperative to investigate how agricultural researchers in Imo State utilize digital technologies such as e-learning and e-reporting platforms for disseminating research findings. It is equally important to identify the specific constraints they face—be they technical, institutional, infrastructural, or cultural—and to propose realistic strategies for improving digital adoption. As Musa et al. (2021) noted, understanding these factors is critical for designing targeted interventions that promote digital literacy and enhance the responsiveness of research to development needs. Therefore, this study sought to address these gaps by conducting a comprehensive assessment of the willingness of agricultural researchers to utilize digital technology in selected institutions in Imo State, Nigeria. This study sought to achieve the following set of objectives:

- i. determine the Socioeconomic characteristics of the respondents
- ii. assess the willingness of agricultural researchers among selected institutions to utilize these digital technological platforms in their fields

H0: There is no significant relationship between the socio-economic characteristics of the Agricultural researchers and their willingness to utilize e-learning and e-reporting digital technologies

METHODOLOGY

Study Area

Imo State, which derives its name from Imo River, was created in 1976 with Owerri as its capital and largest city. The state is divided into 27 Local Government Areas. The area known as Imo State today was originally part of the defunct East Central State (South East Archives, 2022). Imo State got its name from Imo River, which originates from the Okigwe/Awka upland. The state has a projected population of about

5 million people with a population density varying from 230-1,400 people per square kilometres (MyGuide, 2023). Imo state has seven tertiary institutions namely; Federal University of Technology, Owerri, Imo State University, Owerri, University of Agriculture, Umuagwo, University of Science and Technology, Omuna Isiako, University of Creative Technology, Umuna, University of Medical Sciences, Ogboko, University of Agriculture and Environmental Sciences. This Study however was carried out in four tertiary institutions namely: Federal University Technology, Imo State University, Owerri, Alvan Ikoku Federal University and University of Agriculture Umuagwo due to their high concentration of Agricultural Researchers.

Sampling and Data Collection

The population of the Study consisted of all agricultural researchers in all the tertiary institutions of learning in the state. Four (4) tertiary institutions were purposively selected from the seven tertiary institutions in the states due to their high concentration of agricultural researchers, working experiences and tertiary institution ranking on the internet. From the list obtained from the various tertiary institution of the three selected states, they were 318 Agricultural researchers, this constituted the sampling frame.

Secondly, Proportionate stratified sampling technique across the board was applied due to unequal number of researchers to select randomly 150 Agricultural researchers that will be used for the study. Data for the study will be obtained from primary sources. structured questionnaire will be used for the data collection. The questionnaire will be designed in such a way that it will capture all the objectives of the study. Thus, each objective of the study will represent a section in the instrument.

Sample Frame

Table 1 presents the sample frame of three hundred and eighteen (318) Agric researchers obtained from a recognizance survey in the four Tertiary Institutions.

Schools	Frame	sample size
Imo State University, Owerri	42	20
University of Agriculture and Environmental Sciences Umuagwo	44	21
Alvan Ikoku Federal University of Education Owerri	26	12
Federal University of Technology Owerri	206	98
Total	318	150

Source: Dean's Offices from the Schools

The Proportion Formular $nh_i = Nh_i \left(\frac{N_{hi}}{N} \right)$ was used to establish the sample size, where:

Nh_i =expected sample size for h_i (selected institutions),

n = total desired sample size (150)

N = Total Population across each Institution (318)

$$FUTO (nh_1) = 206 \left(\frac{150}{318} \right) = 98$$

$$IMSU (nh_2) = 42 \left(\frac{150}{318} \right) = 20$$

$$ALVAN IKOKU (nh_3) = 26 \left(\frac{150}{318} \right) = 12$$

$$IMO POLY (nh_4) = 44 \left(\frac{150}{318} \right) = 21$$

Method of Data Analysis

Descriptive and inferential Statistical tools were used to analyze data collected for the study, The descriptive statistical tools such as means, frequency table and percentages were used to analyze the objectives while ordinary least square multiple regression was used to analyze the hypothesis.

RESULTS AND DISCUSSIONS

Table 1 represents the socio-economic characteristics of respondents in the study area. Age distribution of respondents showed that majority of the researchers between ages 31–40 had the highest level of digital research engagement, younger researchers (25–34) showed strong digital skills but less research

productivity, possibly due to being early-career scholars, this is in consonant with Gbaje *et al* (2017) who in the studies asserted that Younger and mid-career researchers had higher engagement with digital research platforms.

Older researchers (51+ years) were least likely to use digital tools extensively for research often due to lower digital literacy and resistance to new technology.

Most of the researchers were male (60.7%) while 39.3% were female. This study agrees with Adebayo (2017) which revealed a gender gap in the use of ICT tools for research among academic staff. Male academics were found to use ICT more frequently for research than their female counterparts. A good number of the respondents had Master's degree (58.7%), 32.7% had a Ph.D and 8.6% had a first degree. With a total of 91.34% of the agricultural researchers attaining their second and third degrees in the field of agriculture, the competency rating of Imo State tertiary institutions is definitely high and the quality of research carried out by these institutions is expected to be formidable since the sample is highly literate.

Household size indicated 4-6 persons living with them, this means that household size of agricultural researchers was 5 persons and thus revealed that most agricultural researchers maintain a moderate household. A high number of the respondents (29.3%) had an average monthly income of 154,000(Naira), thus they live within a comfortable standard and are likely to be motivated for optimal performance.

A high number of the respondents (46%) has restricted access to information and communication Technology (ICT) facilities, this is in tandem with a study by Gbaje *et al* (2017) that states that although most universities subscribe to electronic databases many researchers still face limited access due to Unstable internet connectivity, Lack of training on digital tools and Inadequate institutional ICT infrastructure.

Table 1, Social Economics Characteristics of Respondents

Age of respondents (Years)	Frequency	Percentage(%)	Mean
21 – 30	23	15.3	42
31 - 40	56	37.4	
41 – 50	47	31.3	
51 – 60	21	14	
61 – 70	3	2	
Sex			
Male	91	60.7	
Female	59	39.3	
Educational Status			
First Degree	13	8.6	
Master's Degree/MPhil	88	58.7	
PhD	49	32.7	
Household Size (Persons)			
1 -3	51	34	5
4 -6	68	45.3	
7 -9	21	14	
10 and above	10	6.7	
Monthly Income			
1000 -50,000	7	4.7	154,000(Naira)
51,000 - 100,000	38	25.3	
101,000 - 150,000	25	16.7	
151,000 - 200,000	29	19.3	
201,000 - 250,000	44	29.3	
250,000	7	4.7	
Access to ICT			
No Access	26	17.3	
Restricted Access	69	46	
Full Access	55	36.7	
Working Experience (Years)			
1 -10	88	58.7	

11 -20	41	27.3	13(years)
21 - 30	17	11.3	
31 – 40	3	2	
41 – 50	1	0.7	

Source: Field survey data ,2023

Willingness to Utilize E-Learning and E-reporting Technologies by Agricultural Researchers in Imo State Tertiary Institutions

The result of Table 2 shows the distribution of Imo State agricultural Researchers' willingness to utilize e-learning and e-reporting technologies in their institutions on a three Likert -type measuring scale with a discriminating index of 2.0. Mean scores below 2.0 were considered as not willing, while mean scores equal to and above the discriminating index were considered as Willing. The result of the table above shows that the agricultural Researchers in Imo State Institutions were willing to Utilize all the technologies outlined in Table 2 with ResearchGate and zoom google meet ranking 1st on their different platforms respectively with a mean score of 2.74 and 2.59. while Moodle and Open science framework ranked last on the E-learning and E-reporting platforms.

The grand mean of $\bar{X} = 2.45$ was arrived at from the results of the table, which is far above the discriminating index of 2.0. This reveals that the assessment on the willingness of agricultural researchers to utilize e-learning and e-reporting of research findings in Imo State tertiary institutions is definitely high. This was also in consonance with the findings of Adebayo *et al* (2020) found that "Moodle and Google Classroom are the most used e-learning platforms in federal universities during the COVID-19 lockdown due to institutional preference and ease of deployment. Likewise, Olaifa *etal*(2019) observed that "over 70% of academic researchers in Nigerian public universities had active ResearchGate accounts for research dissemination." In strength of this, the positive attitude and will of agricultural researchers in the state towards innovations such as E-learning and E-reporting should be constantly maintained for continuous and sustainable development in the agricultural Sector

Table 2: Willingness to Utilize E- learning and E-reporting Technologies by Agricultural Researchers in Imo State Tertiary Institution

s/n	E-learning and E-reporting Technologies	Not willing f(%)	Moderately willing f(%)	Strongly willing f(%)	Mean	SD	Rank
E- Learning Platforms							
1	Google classroom	8(5.3)	48(32)	94(62.7)	2.57	0.41	2nd
2	Moodle	11(7.3)	52(34.7)	87(58)	2.50	0.45	4th
3	Zoom and google meet	8(5.3)	45(30)	97(64.7)	2.59	0.41	1st
4	Canvas	11(7.3)	44(29.3)	95(63.3)	2.56	0.45	3rd
E-Reporting Platforms							
1	Research Gate	5(3.3)	28 (18.7)	117(78)	2.74	0.36	1st
2.	Academia.edu	6(4)	35(23.3)	109(72.7)	2.68	0.39	2nd
3.	google Scholar	8(5.3)	45(30)	97(64.7)	2.59	0.41	3rd
4.	OpenScience Framework	34(22.7)	51(34)	65(43.3)	2.20	0.55	4th

Source: Field survey data,2023

Table 3 shows Hypothesis 1: Multiple regression result of the relationship between the socio-economic characteristics of agricultural researchers and their willingness to utilize e-learning and e-reporting technologies. Among the four functional forms, the linear function exhibited the highest explanatory power with an R^2 value of 0.560, indicating that 56% of the variation in willingness to utilize e-learning and e-reporting technologies was explained by the included socio-economic variables. The exponential function followed with an R^2 of 0.492, while the double-log and semi-log models recorded R^2 values of 0.498 and 0.466, respectively. The F-values across all models were statistically significant, particularly for the

exponential function ($F = 31.00$) and the linear function ($F = 25.968$), signifying the overall significance of the regression models.

Sex (X_1); The positive and significant influence of sex ($t = 2.983$) suggests that gender may play a role in digital tool adoption. **Marital Status (X_2)**; The positive coefficient for marital status ($\beta = 0.049$, $t = 4.176$), Age (X_3) Age showed a significant influence ($\beta = 0.808$, $t = 3.226$), **Educational level (X_4)**; Education was a significant predictor ($\beta = 0.240$, $t = 2.216$), supporting the idea that educational attainment enhances digital competence. **Membership of Social Organizations (X_5)**; The positive coefficient ($\beta = 0.205$, $t = 3.289$) confirms the role of social networks in technology dissemination. **Household Size (X_6)**; Though positive, household size was not statistically significant ($t = 0.315$), suggesting it has a limited direct effect. **Monthly Income (X_7)**; Income had a positive and significant effect ($\beta = 0.008$, $t = 2.112$), **Access to ICTs (X_8)**; The strong effect of ICT access ($\beta = 0.029$, $t = 2.326$) **Working Experience (X_9)**; Experience significantly influenced adoption ($\beta = 0.644$, $t = 3.311$), likely due to accumulated skills and institutional knowledge.

The regression analysis demonstrates that socio-economic characteristics significantly influence the willingness of agricultural researchers to adopt e-learning and e-reporting technologies. Key drivers include marital status, age, education, income, access to ICTs, and work experience. These findings are consistent with previous empirical studies such as Adebayo and Adesope (2007), who emphasized that “availability of ICT infrastructure is a primary enabler of adoption among agricultural researchers.” and underline the need for targeted policy interventions aimed at improving ICT access, fostering digital skills, and leveraging social networks to enhance technology dissemination in Nigeria’s research institutions.

Explanatory Variables	Linear Function	Double-log Function	Semi-log Function	Exponential Function
Constants	29.888	22.442	16.111	21.312
R ²	0.560	0.498	0.466	0.492
No of Observations	150	150	150	150
F-Value	25.968	14.115	15.11	31.0
Sex(X_1)	0.000(2.983)*	0.001(0.0.182)*	0.049(0.624)*	0.000(2.010)*
Marital Status(X_2)	0.049(4.176)**	0.004(3.448)**	0.808(4.220)**	0.670(3.124)**
Age(X_3)	0.808(3.226)**	0.000(2.020)*	0.240(2.910)*	0.865(4.210)*
Edu. Level(X_4)	0.240(2.216)*	0.030(2.187)*	0.205(2.160)*	0.004(2.136)*
Membership of Soc.Org(x_5)	0.205(3.289)**	0.240(1.468)*	0.040(3.192)*	0.065(2.448)*
Household Size(x_6)	0.040(4.315)**	0.02(3.098)**	0.008(2.120)*	0.068(3.148)*
Monthly income(X_7)	0.008(2.112)*	0.210(3.400)**	0.029(4.060)**	0.002(2.810)*
Access to ICTs(X_8)	0.029(2.326)*	0.000(4.012)**	0.644(0.418)	0.086(1.010)*
Working Experience(X_9)	0.644(3.311)**	0.808(1.284)	0.615(2.300)*	0.600(1.850)

Source: Field Survey data,2023

The stars (*) next to the values indicate whether the null hypothesis was rejected: = Significant at 5% level (null rejected)** = Significant at 1% level (null rejected). No star = Not significant (fail to reject null).

CONCLUSION AND RECOMMENDATIONS

The study concludes that agricultural researchers in Imo State demonstrate a high willingness to adopt e-learning and e-reporting platforms for the dissemination of research findings. Despite infrastructural limitations such as restricted ICT access and irregular power supply, most researchers are digitally literate, motivated, and open to innovation. Platforms such as ResearchGate and Zoom/Google Meet ranked highest in preference and usage, reflecting the shifting trend toward online dissemination and virtual collaboration. Socio-economic variables like education level, age, and work experience significantly influence willingness, reinforcing the need for institutional investment in digital training, infrastructure, and supportive policies.

To foster sustainable digital engagement in agricultural research, tertiary institutions and policymakers should: Improve ICT infrastructure and broadband access in research institutions; Provide regular digital

literacy training and technical support for researchers; Establish institutional policies and frameworks promoting digital dissemination; Encourage collaborations with technology providers and open-access platforms.

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Theme: Agricultural Extension for Food Security and Community Empowerment

Factors Influencing the Adoption of Pesticides Among Vegetable Farmers in Akwa Ibom State, Nigeria

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ABSTRACT

Pest remains a crucial challenge for vegetable farmers in Akwa Ibom State Nigeria, to examine factors influencing the adoption of pesticides among vegetable farmers. A multi-stage sampling technique was adopted in the study. At the first stage, a simple random sampling technique was used to select 120 respondents for the study. The age distribution shows that a greater number (50.8%) of the respondents were within the age range bracket of 31-40. With regards to educational attainment (75%) had formal education. Majority (66.7%) of the respondents earned between ₦21,000 – ₦40,000 per month. Result showed that all types of pesticides were available in the study area. The result of factor analysis shows that Factor 1 (Economic and Accessibility Challenges), which explains 34.37% of the variance, high cost of pesticide" (0.842), "Poor pesticides education" (0.828), and "inadequate fund to buy" (0.811) load heavily on this factor, emphasizing that economic constraints significantly hinder the use of pesticides. The study concluded that economic, logistical, and knowledge-related factors are the primary barriers preventing the widespread use of pesticides. The study recommended awareness creation by sensitizing farmers through the extension agents.

Keywords: Adoption, Pesticides, Vegetable farmers, Akwa Ibom State

INTRODUCTION

Vegetables are most important component of our food and are rich in vitamins, minerals and fibre essential for human health. Many vegetables are considered as protective food items which prevent many diseases and ailments. Many patients of some permanent diseases are advised to take vegetable diets to cushion the effects of the diseases, vegetable are grown all year round majorly as homestead crops, in garden or backyard for common uses which yield high economic and domestic returns. But regrettably vegetable production is seriously attacked by pests and diseases which resulted to farmers use of pesticide (chemicals).

Pesticide can prevent large crop losses and protect crops against insects, weeds, fungi and other pests and as such they play a significant role in food protection by also increasing yields but pesticides are potentially toxic to humans and can have both acute and chronic health effects depending on the quantity and way in which a person is exposed.

Pesticide, a damage control input to safeguard from insects and other pests, is considered to improve nutrition in food, and its use is assumed an economic, labor-saving and efficient tool for pest management (Damalas and Eleftherohorines, 2011). Furthermore, pesticide is believed to improve competitive advantage in agriculture (Delcour *et al.*, 2015). This is because pesticide use is deemed essential for retaining current production and yield levels, as well as maintaining a high-quality standard of life (Delcour *et al.*, 2015). There is a widespread acceptance that the use of modern agricultural technologies has led to

a sharp increase in pesticide use, along with other modern inputs, in the developing economies (Wei Zhou et al., 2024). The Pesticide Action Network (2022) estimates that globally over 4 million tons of pesticides are sold every year on average, mostly herbicides (50%), followed by insecticides (30%) and fungicides (17%) and other pesticides like rodenticides and nematicides (3%). In Europe alone, the FAO reports an annual use of over 460,000 tons of pesticides since the early 1990s (FAO, 2020). During the same period, the USA applied more than 406,000 tons, while less industrialized countries used on average over 24,000 tons of pesticides per year (FAO, 2020). However, there is a widespread claim that pesticides are harmful to human health and the environment (Ahmad et al., 2024). The environmental and social impact of pesticide use in the USA alone is estimated at USD 10 billion per year (Mahmood et al., 2016; Balasha et al., (2023). An estimated 1–5 million farm workers suffer from pesticide poisoning every year, and at least 20,000 dies annually from exposure, mostly in developing countries (Boedeker et al., 2020)

Both Asia and Latin America experienced dramatic increases in agricultural productivity due to rapid and widespread adoption of Green Revolution (GR) technologies, which incorporate widespread use of modern agricultural inputs and agro-chemicals (Rahman and Chima, 2018). However, Sub-Saharan Africa (SSA) did not or could not participate in this drive for GR technologies of the 1970s–1980s, and therefore could not gain from the application of modern agricultural inputs and agro-chemicals (Sheahan and Barrett 2017). The issue of climate change has also contributed to the alteration of planting season in the region leading to the proliferation of varieties of weeds and insect pests which has contributed to the sluggish yields in SSA. The adoption of improve agricultural technology in the region is inevitably, if food security and food self-sufficiency policies is prioritized (Nkeme *et al.*, 2017, Udousung *et al.*, 2019, Udousung *et al.*, 2024a; and Udousung *et al.*, 2024b). In fact, the low use of modern inputs, including pesticides, is assumed to be a norm in SSA agriculture, which led to the setting up of policy directives and programs such as the Comprehensive Africa Agriculture Development Program (CAADP), Abuja Declaration and Malabo Declaration (Sheahan and Barrett 2017).

Nigeria, the largest economy in Africa, is largely dependent on its agricultural sector for the supply of raw materials, food, and foreign exchange, and employs over 70% of the labor force (Liverpool-Tasie *et al.*, 2011). Small-scale semi-subsistence farmers comprising more than 70 million farmers/rural citizens also dominate the sector. The agricultural sector is characterized by low level of productivity and modern technology adoption (Nura, 2022). The major constraints on improving agriculture in Nigeria is the subsistence production system, the low level of modern technology adoption, land fragmentation, and crop failure, which increases production risk. Poor agricultural information dissemination and lack of the use of damage control inputs. This is because about 20–40% of potential food produced is lost to insects and other pests in Africa (Anang and Amikuzuno, 2015).

Pests are organisms, like insects and rodents that damage crops, livestock, or human health. They encompass a variety of species including insects, ticks, mites, and other arachnids; nematodes and other parasitic worms; weeds and other unwanted plants; fungi, bacteria, viruses, and other harmful microorganisms, as well as some vertebrates such as certain birds and rodents. (Miriam, 2022). Large number of insects may be external or temporarily internal pests of man and other animals. Most have alternate hosts which compounds problems of their eradication. Insect parasites generally weaken their hosts and make susceptible to attacks of disease-causing organisms. Others as a result of feeding may cause irritation or sores which may be infected.

The global losses due to various categories of pests vary with the crop, the geographical location and the weather. Despite the plant protection measures adopted to protect the principal crops, 42.1 % of attainable production is lost as a result of attack by pests. However, if no control measures were used to protect crops, the figure would be 69.8% (Miriam, 2022). To minimize the detrimental effects of these pests' farmers are obliged to use different pesticides. Majority of the modern synthetic insecticides have detrimental effects on beneficial insects including natural enemies of crop pests. It is necessary to have some knowledge on the safety of different insecticides to the natural enemy complex occurring in a given ecosystem.

Many insecticides when used in agro ecosystems target insect pests along with beneficial or natural enemies. Insecticides should not only suppress the insect pest population but also be safe to their natural enemies. Application of pesticides to crops that are in bloom can kill honeybees which act as pollinators

(Cornell University, 2020). Hence, it is imperative to screen the insecticides before incorporating them into the insect pest management programme. Screening is imperative to safeguard the beneficial from the hazardous effects of insecticides (George and Ambrose, 2024). Some beneficial insects have economic value that acts as biological control agents, may be exposed to the insecticides which are indiscriminately used to control the insect pests and consequently their physiological and behavioral functions get affected. Information on the impact of insecticides on the non-targeted beneficial is imperative for the researchers as well as farmers to select the most suitable insecticide (s) with least damage to beneficial (George and Ambrose, 2024).

In Akwa Ibom State, vegetable farmers rely extensively on pesticides, but their use is constrained by information gaps, inconsistent product quality in retail markets, and weak compliance with safe-use standards. Common challenges include misuse, improper disposal, and failure to observe pre-harvest intervals. These practices not only increase health risks and the chances of pesticide residues in fresh produce but also threaten consumer confidence. Studies from Nigeria reveal frequent detection of pesticide residues in vegetables, alongside regulatory interventions to reduce hazardous practices and restrict unsafe products. Nonetheless, local and crop-specific factors influencing both the adoption and safe use of pesticides in Akwa Ibom remain poorly understood, limiting the effectiveness of extension and regulatory efforts. It is on this note that this study was conducted to determine the factors influencing the adoption of pesticides among vegetable farmers in Akwa Ibom State, Nigeria. Specifically, the study examined the socio-economics characteristics of the respondents and types of pesticides available for vegetable production in the study area

METHODOLOGY

Study Area

The study was carried out in Akwa Ibom State, which formed a part of the core States in the production of vegetable of the Niger Delta region of Nigeria. The State is located at latitude $4^{\circ}33'$ and $5^{\circ}53'$ North and longitude $7^{\circ}25'$ and $8^{\circ}25'$ East and occupies a total land area of 8,421 square kilometres. There are two distinct seasons – rainy and dry seasons, with the rain evenly distributed throughout the year and decreasing from over 3,000mm in the south to about 2,700mm in the North (Udofia and Inyang, 1987). It has an estimated total population of 3,920,203 people (NPC, 2006). The predominant occupation of the people in the study area is farming where the major land use pattern is rain fed and food crop production including vegetable of all types and livestock rearing while fishing is conducted in the riverine areas of the State.

Sampling Techniques / Analytical Techniques

A multi-stage sampling technique was adopted in the study. At the first stage, a simple random sampling technique was used to select three (3) agricultural zones (Abak, Ikot Ekpene and Uyo) out of the six (6) ADP zones in the State; at the second stage simple random sampling technique was used to select 12 extension blocks from each of the zones, the third stage was a purposive selection of two (2) cells from each of the selected 12 blocks giving a total of 24 cells. Finally, five (5) vegetable farmers were randomly selected from each of the cells, giving a total of 120 vegetable farmers as the respondents which served as the sample size.

Model Specification

Factor Analytic Procedure using factor analysis procedure by principal component approach. The principal components method using an exact mathematical transformation of the original set of variables to a new set, with the later summarizing linear relationships exhibited in the data. The basic question to ask is: what are the best linear combinations of the original variable that would account for most of the relationships of variance in the data? When we say best, we mean that this particular linear combination of variable would account for more of the variance in the data than any other linear combination. The best linear combination of the variable gives the first component or factor of the variables. It means that this factor, more than any other, accounts for most of the variance or relationships observed in the data and hence is the best summary of the original data. The second component is similarly defined as the next best linear combination of the

variables that would account for the relationships observed in the data after the effect of the first component or factor has been removed, provided both components are uncorrected (orthogonal). Subsequent components are similarly defined until the relationships or variance in the data have been accounted for. The principal's components methods can result in as many components as will be required to exhaust all the variance in the data. If one component exhaust all the variance, then the relationship in the entire set of data can be explained by one component or factor. If more than one factor is required to explain the relationships in the entire set of data, then the number of components required is said to explain the relationship between the variables in the entire set of data. From what has been said so far, a factor can therefore be defined as:

$$F_a = aW_A + bW_B + \dots + kW_K \quad (1)$$

Where F_a = factor a, being the best linear combination of all the variable A-K

$a, b, \dots, k$ = are weight attached to variables

A-k = variable A-k

Other factors can be similarly defined, as explained earlier. When the factors are uncorrelated, they are said to be orthogonal and a variable "a" in the original data can be defined as

$$Z_a = W_{a1}F_1 + W_{a2}F_2 + \dots + W_{ak}F_k \quad (2)$$

Where Z_a = variable a in standard score format (mean = 0 and variance = 1), W_{a1} to W_{ak} = weights (normally called factor loadings) attached to factors, and F_1 - F_k = factors 1-K. formula 2 simply means that in factor analysis employing the principal components methods, a variable is viewed as the sum of weighted factors derived from the data. When the data is initially factored, the concern is more on the possibility of reducing the data to a smaller composite set of factors. At this stage, the factors may not make any meaning until they are rotated to a final solution.

RESULT AND DISCUSSIONS

Socio - economic characteristics of vegetable farmers in Akwa Ibom State as presented in Table 1. The result for sex distribution shows that the majority (56.7%) were females while (43.3%) were males. This indicates that vegetable production in the area was dominated by females. This corroborates the findings of Udousung *et al.* (2016), which indicated that cassava production is dominated by female farmers in Akwa Ibom State, also Ekanem *et al.* (2021) who reported that females made up the bulk of farming population in Akwa Ibom State. Also, studies by FAO (2020) emphasize that women contribute significantly to food production and processing in rural communities, particularly in sub-Saharan Africa, although, their limited access to resources and decision-making authority often constrains their productivity.

The age distribution revealed that a greater number (50.8%) of the respondents were within the age range bracket of 31-40. The mean age of the respondents was 37.3. This is in line with findings of Udousung *et al.*, (2019) which indicated that young energetic respondents were engaged in farming and they would be able to indulge in more demanding farm activities. With regards to educational attainment 16.7% of the respondents had acquired a primary/ vocational level of education, about 50% of the respondents had secondary education, negligible number 8.3% per cent of the respondents attended tertiary education, while 25% had no formal education. In all a greater proportion (75%) had formal education which suggested that farming activities in the study area is handled by enlightened people. Table 1 also shows that 71.6% of the respondents had acquired more than 10 years of farming experience. The result indicated that majority of the vegetable farmers had more than 10 years of farming experience. This implies that majority of vegetable farmers are experienced farmers who have practiced vegetable farming for a number of years. This study aligns with the findings of Udousung and Umoh (2024) who opined that the years of farming experience is factors that aid in the adoption of new innovations. Also, Adekunle *et al.*, (2021), reported that experienced farmers are better equipped to handled production challenges and make effective use of resources. Majority (66.7%) of the respondents earned between ₦21,000 – ₦40,000 per month while only 8.3% earned more than ₦ 80,000. This implies that poverty is prevalent in rural areas resulting in limited business expansion opportunities due to wealth and social power disparities. Information sources revealed that majority (52.5%) received information on farming practices from their fellow farmers, while 40.8% of the respondents, received information from radio/ television; a negligible number 4.17% respondents received information

from extension agents. This may be as a result of farmers not having regular contact with agricultural extension services as shown in Table 1, only negligible number 4.17% respondents had contact with extension services, extension agents give farmers access to information on innovations, advice on inputs and their use, and management of vegetable farming technologies. According to Giginyu and Danladi (2020), Agricultural extension primarily deals with human resources development and the transfer of technology and knowledge from agricultural research centers to farmers. Extension workers are professionals in the extension system responsible for developing individual's farmers in the community. Since they are constantly and consistently in touch with the farmers as well as the rural dwellers, it becomes necessary that their campaign should include proper education of their clientele on the enormous advantages associated with vegetable farming practices. An option of doing this is by encouraging the farmers to join co-operative societies, because more would be aware of how to apply various pesticides and methods of application. Extension education remains the best strategy used to reach the farmers using the appropriate teaching methods to create a situation learning environment and condition (Kaul, 2019).

Table 1 Socio-Economic Characteristics of Cassava Farmers in Akwa Ibom State, Nigeria (n=120)

S/N	Variables	Frequency	Percentages
1	Sex		
	Female	65	56.7
	Male	55	43.3
2	Age Distribution (years)		
	<30	-	-
	31-40	61	50.8
	41-50	47	39.2
	>51	12	10.0
3	Educational Status		
	Primary/Vocational	30	50.0
	Secondary	20	16.7
	Tertiary	10	8.3
	None of above	60	25.0
4	Primary Occupation		
	Farming	58	48.33
	Farming/Trading	53	44.16
	Farming/Civil Service	9	7.51
5	Farming Experience		
	Less than 10 years	86	28.4
	More than 10 years	34	71.6
6	Farm Income		
	Less than (₦) 20,000	30	25.0
	₦21,000– ₦40, 000	80	66.7
	₦41,000– ₦60, 000	-	-
	₦61,000– ₦80, 000	-	-
	More than ₦80,000	10	8.3
7	Sources of information		
	Radio/TV	49	40.8
	Newspaper	3	2.5
	Extension agents	5	4.17
	Fellow farmers	63	52.53

Source: Field Survey, 2024

Types of Pesticides for vegetable cultivation available in Akwa Ibom State

Table 2 presents the types of pesticides available for vegetable production in Akwa Ibom State. Findings have shown that all the pesticides listed were readily available in the study area. But quinones (88.3%), followed by bromethalin (86.7%), Organo chlorines (Aldrin) (82.5%), Organophosphorus compounds (81.7%), Zinc phosphorus (79.7%), and Niclosamide (76.7%) were the most available types of pesticides

as identified by respondents in the study area. The reason for this result might be from the fact that **Quinones** are commonly used in controlling fungal diseases, **Organophosphorus compounds** commonly used in targeting various insect pests and **Bromethalin** commonly used to control rodents that may damage produce or storage.

Table 2: Types of pesticides available in the Akwa Ibom State

Types of pesticides	Yes	No	Don't know
Carbamates	82(68.3)	25(20.8)	13(10.8)
Paraquat	85(70.8)	23(19.2)	12(10.0)
Glyphosate	82(68.3)	27(22.5)	11(9.2)
Oxadiazon	79(65.3)	30(25.0)	11(9.2)
Metolachor	77(64.2)	30(25.0)	13(10.8)
Benomyl	76(63.3)	30(25.0)	11(9.2)
Oxamyl	75(62.5)	75(62.5)	13(10.8)
Triazophos	73(60.8)	34(28.3)	13(10.8)
Carbosulfan	73(60.8)	32(26.7)	15(12.5)
Pentachlorophenol	79(65.3)	34(28.3)	7(5.8)
Quinones	106(88.3)	14(11.7)	-
Bromethalin	104(86.7)	16(13.3)	-
Zinc phosphorus	95(79.7)	19(15.8)	6(5.0)
Niclosamide	92(76.7)	25(20.8)	3(2.5)
Organophosphorus	102(81.7)	18(15.0)	-

Source: Field Survey, 2024

Factors influencing the adoption of pesticide in Akwa Ibom State

The factor analysis results for the factors influencing the use of orthodox methods of pest control reveal four key components, with each addressing different challenges in adopting these methods. The diagnostic statistics indicate that the factor analysis is valid and the data is suitable for this method. The high KMO value, significant Bartlett's test, and good Cronbach's alpha suggest that the factor model is reliable and meaningful. The fact that a substantial percentage of variance is explained by the factors (79.06% in total) further confirms that the model provides a strong explanation of the data's structure.

Factor 1 (Economic and Accessibility Challenges), which explains 34.37% of the variance, focuses on issues related to the high costs of pesticides and the inadequacy of funds to purchase necessary pesticides for treatments. Variables such as "high cost of pesticide" (0.842), "Poor pesticides education" (0.828), and "inadequate fund to buy" (0.811) load heavily on this factor, emphasizing that economic constraints significantly hinder the use of pesticides. These findings are consistent with previous studies of Akinbile *et al.*, (2014) that highlight the financial burden on small-scale farmers as a primary barrier to adopting these methods, leading many to revert to cheaper, traditional alternatives.

Factor 2 (Logistical and Procedural Inefficiencies), explaining 21.22% of the variance, reflects of challenges related to delays and inefficiencies in the application pesticides. The variables that load strongly on this factor include "long procedure before pesticides are administered" (0.865), "prevalence of fake or adulterated pesticides" (0.827), and "registration procedure" (0.811). These variables suggest that bureaucratic processes and the presence of counterfeit products reduce the trust and reliability of orthodox pest control methods. Farmers may perceive these methods as unreliable and time-consuming, which could explain their preference for more immediate and accessible alternatives, as noted in research by Rahman *et al.*, (2018).

Factor 3 (Communication and Service Accessibility), explaining 14.16% of the variance, includes variables like "poor communication facilities" (0.873), "inaccessibility of service providers" (0.849), and "long

distance to shops" (0.892). These findings highlight that communication and logistical barriers, such as inadequate access to pest control services and information, further discourage the use of pesticides. This aligns with existing literature that points to limited extension services and poor infrastructure in rural areas as significant obstacles (Kirsten *et al.*, 2016). Farmers are less likely to adopt new technologies when they have insufficient access to information and expert advice.

Factor 4 (Lack of Expertise and Technical Know-How), explaining 9.31% of the variance, includes variables such as "lack of technical know-how" (0.844) and "lack of extension agent/expert" (0.621), suggesting that the absence of adequate expertise and training further limits the effective use of pesticides. This reinforces findings from previous research, which indicates that a lack of knowledge and skilled personnel in rural areas undermines the adoption and success of such methods (Nkansah *et al.*, 2020). In summary, the results indicate that economic, logistical, and knowledge-related factors are the primary barriers preventing the widespread use of pesticides. Improving affordability, streamlining procedures, enhancing communication and service access, and providing better training and expertise are essential to overcoming these barriers and encouraging the adoption of pesticides use strategies.

Table 3: Factors Influencing the Adoption of Pesticide Use in Akwa Ibom State, Nigeria

Variables	Component Factors 1	Factors 2	Factors 3	Factors 4	CEI
High cost of pesticide	0.842				.656
Poor pesticides education	0.828				.806
Inadequate fund to buy pesticides	0.811				.701
Lack of adequate information, knowledge and awareness of the inherent dangers of pesticides	0.798				.659
Long procedure before pesticides are administered		0.865			.816
Prevalence of fake or adulterated pesticides		0.827			.476
Registration procedure		0.811			.662
Poor communication facilities			0.873		.615
Inaccessibility of service providers			0.849		.831
Long distance to shops				0.892	.719
Fear of losses by vegetable farmers				0.873	.633
Lack of technical know-how				0.844	.689
Adulterated Pesticide				0.810	.720
Lack of extension/ expert	0.621	0.593			.632
KMO	0.798				
Bartlett's test of sphericity	Sig. = 0.000				
Cronbach alpha	0.889				
Initial Eigenvalues	4.812	2.971	1.982	1.304	
% of variance	34.37	21.22	14.16	9.31	
Cumulative %	34.37	55.59	69.75	79.06	
Extraction Method: Principal Component Analysis.					
Rotation Method: Varimax with Kaiser Normalization.					
a. Rotation converged in 10 iterations.					

Source: SPSS 22 (2024)

CONCLUSION

Findings revealed that female farmers with low monthly income dominated vegetable production in the study area. They were aware of all the types of pesticides available in the study area. Results of factor analysis shows that economic, logistic and knowledge-related factors are the primary barriers influencing the widespread use of pesticides in the study area.

RECOMMENDATIONS

1. Extension agent should have contact with farmers at all times to enable them acquire knowledge of various pesticides and methods of application
2. Farmers are advised to join cooperative societies to gain access to credits facilities which will enable them improve in their production
3. Educational campaigns, awareness creation by relevant government agencies and NGOs Organization are needed if farmers must embrace pesticides application.
4. Improving affordability, streamlining procedures, enhancing communication and service access, and providing better training and expertise are essential to overcoming farmers challenges in adoption of pesticides.

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Theme: Agricultural Extension for Food Security and Community Empowerment

**Assessment of Women Involvement in Agribusiness Enterprises
before the Introduction of IFAD-VCDP Programme in Benue and Niger
States, Nigeria**

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ABSTRACT

The research was aimed at examining the specific agribusiness in which women were involved before the introduction of international funds for Agricultural Development-Value Chain Development Programme in Benue and Niger states, Nigeria. Multi-stage sampling technique was used to select a total of 330 respondents as the sample size for the study. The results showed that the mean age of the respondents in the study area was 49 years in Benue and 47 years in Niger state while the average family size was 7 and 9 persons in Benue and Niger states respectively. 79% and 89% were married in Benue and Niger states respectively, with almost 33% in Quranic education in Niger and 33% with primary education in Benue state. The results also show that majority (79.1%) and (79.1%) of the women were involved in livestock production in Benue and Niger states respectively, (54.2%) and (4.0%) were involved in vegetable farming in Benue and Niger States respectively. (4.5%) were involved in shea-nut picking in Niger State while none is involved in shea-nut picking in Benue state. This implies that women in the study area were involved in Agribusiness but at varying degree of their interest. This study has also identified and analyzed the various factors influencing women's participation in value chain of production, processing and marketing activities under the IFAD Value Chain Development Programme (VCDP). Accessibility to financial services is one of the constraints in each region due to stringent conditions required for obtaining loans. The study recommends that financial institutions and lending agencies should work out modalities for easy access to credit facilities to small holder farmers especially women to expand their agri-business in the study area.

Keywords: Agribusiness, Programme, Purposively, Beneficiaries and Communities.

INTRODUCTION

Women in Nigeria are a diverse group of individuals who have a wide range of experiences and backgrounds. They are mothers, daughters, sisters, wives, entrepreneurs, professionals, and activists. Women in Nigeria face numerous challenges, including gender inequality, poverty, and a lack of access to education and healthcare. Women involvement in agriculture can extend beyond traditional farming to agribusiness and entrepreneurship. They are engaged in value addition, processing, marketing, and distribution of agricultural products. Government policies and initiatives that promote women participation in agriculture, such as funding schemes, training programs and access to land, productive assets can encourage more women to enter the sector. Access to affordable financing options is crucial for women to start or expand agricultural ventures. Microfinance institutions and government-backed loan programs can help address this challenge. Providing relevant education and training in modern farming, processing techniques, agribusiness management, and marketing is essential to equip women with the necessary skills.

Ensuring that women have access to markets and fair prices for their produce are crucial. It's important to acknowledge and address challenges such as access to land, productive asset for value addition and market volatility that can deter women from entering or staying in agriculture. Involving women in agriculture in Nigeria can be a viable strategy for reducing gender inequality, unemployment, boosting food security, and driving economic growth, reducing vulnerability, raising their status. However, it requires a multi-faceted approach involving government support, education, access to resources, and a focus on innovation and sustainability

Despite these challenges, Nigerian women are making strides in all areas of life and are becoming increasingly empowered to take control of their lives and their futures. In Nigeria, a woman has few rights within her home and family, even though it may be her sole world and environment. All over the country, a woman is considered to have no legal right to her own children, all property of the house is considered to belong to the man, even if it is paid for by the woman (Lucas,2024). Women participation in Income-Generating Activities (IGAs) is a crucial mechanism for ensuring the rural development of developing countries. Consequently, over the past four decades, women's entrepreneurship has gained popularity around the world with a growing number of females to starting and running their own businesses (Ahmad, 2023). Women play different roles and perform different responsibilities concerning the livelihood of their households, men have the primary responsibility for income-earning and women have the primary responsibility for the utilization of food and home management in rural households (Abera *et al*, 2022).

The broad objective is to critically examine the specific agribusiness in which women were involved before they were introduced to IFAD-VCDP programme.

Specifically, objectives of the study are to:

- i. describe the socio-economic characteristics of the women in the study area.
- ii. describe the specific agribusiness that the women were involved before the programme
- iii. Identify the constraints faced by women participation in programme at the study area

METHODOLOGY

Study Area

The study was conducted in two States, namely: Benue and Niger in north central, Nigeria, concentrating on cassava and rice value chains including rural infrastructure, capacity building, advisory services. Benue State lies between latitudes 6° 25' and 8° 8' N and longitudes 7° 47' and 10° 0' E. It occupies an area of 33,955 km². Having a population of 4,253,641 people in 2006 while the projected population is 6,141,300 (National Bureau of Statistics, 2022). Niger state is a state in the North Central region of Nigeria and the largest state in the country by area, it lies between latitude 09° 61', 09° 37' north of the equator and longitude 06° 56', 06° 32' east of the Greenwich meridian. The town shares boundary with the Federal Capital Territory from the north-west direction (Mohammed et al., 2025). The population was 201,429 at the 2006 while the projected population is 6,783,300 (National Bureau of Statistics, 2022).

Sampling Procedure and Sample Size

The primary data was obtained through the use of pre-tested constructed interview schedule. The instrument was designed to gather relevant information on the socio-economic characteristics of the women that participated in the Programme, identified the income-generating activities of the respondents, determined the specific agribusiness women were involved before the programme and identified the constraint faced by women and strategies put in place that influenced women participation in the study area. Multistage sampling procedure was used to obtain sample from the study area. Purposive sampling technics was used in selection of beneficiaries. First stage was the purposive selection of Benue and Niger States in North central. At the second stage, women (producers, processors and marketers of rice) beneficiaries in the programme were purposively selected from three (3) LGAs from each of the state making a total of 6 LGAs. The third and fourth stages involved a purposive selection of LGAs and communities in each State respectively. In all, a total of 330 respondents were selected from the LGA as the sample size for the study

Table 1: Sampling procedure and sample size

S/N	STATE	LGA	VILLAGES SELECTED	NUMBER WOMEN SELECTED 15%	OF @
1	Benue	Kwande	Jato	12	
			Adaji	8	
			Ikyogen	14	
			Anwase	13	
			Adikpo	13	
			Agbagbe	13	
			Agana	11	
		Gwer East	Agano	12	
			Ugba	12	
			Nanev	11	
			Abeda	5	
			Akpajir	4	
			Anyin	12	
			Naka	13	
		Logo	Ikpe Nagi	6	
2.	Niger	Bida	Edogifu	12	
			Mansaba	12	
			Zukogi	15	
			Esozhi	15	
			Efu chiroma	2	
		Katcha	Tsadoyagi	15	
			Kataeregi	11	
			Shabawoshi	15	
			Badeggi	16	
			Kakakpangi	5	
		Kontagora	Ung/yamma	12	
			Nasara	4	
			Adarawa	15	
			Ung/Tukura	18	
			Usubu	4	
			Total		

Source: Field survey, 2025

Method of data collection

Data for the study was obtained from primary and secondary sources. The primary data was collected with the aid of structured questionnaire which was administered by the researcher and trained enumerators. The questionnaire consists of both open and close ended questions which was designed and administered through interview of the respondents, focus group discussion was used to obtain information from key informant. The questionnaire contained information on the women socioeconomic characteristics, income-generating activities carried out by the women, specific agribusiness that the women were involved before the programme, increase in income, constraint faced by women, strategies adopted by the Programme that influenced women participation, the effect of IFAD-VCDP in on women empowerment. Secondary information was obtained from published materials like textbooks, conference proceedings, journals annual reports and relevant websites.

Data Analysis

Data for the study was analyzed using descriptive and inferential statistics. The descriptive statistics was used to measure the central tendency such as mean, frequency distribution and simple percentages. Objective one, two, three were achieved using frequencies, percentages and means to describe the socio-

economic characteristics of the women in the study area. Objective four was achieved using double different estimator and welfare (human development index talking of health, education, infrastructure, equipment, standard of living, per capital) of the beneficiaries which was analyzed using factor analysis whereby each of the HDI mentioned was analyzed separately to know how important it is.

Objective five was achieved using five-point Likert scale and double different estimator an Ordered Logistic Regression Results on Welfare Status was used. Finally, the hypothesis was tested using t-test and Objective six identified the constraint faced by women in participating in the programme was achieved using probit regression model

RESULTS AND DISCUSSIONS

The socio-economic characteristics of the respondents under consideration include age, marital status, household size, and level of education. The result in Table 2 revealed that the average age of women participating in the Value Chain Development Programme (VCDP) were 49 years in Benue State with 45.8% and 47 years in Niger State with 43.5% respectively. This implies that a majority of the respondents are in their economically active and productive years. This finding is consistent with the research conducted by Damisa *et al.* (2024), which reported a mean age of 36 years among women involved in rice processing under the IFAD-VCDP in Nasarawa State, Nigeria. The distribution of marital status as presented in Table 2, indicates that a significant proportion (79.7%) and (89.8%), of the respondents were married. A smaller percentage (7.2%) and (3.4%) were single, while (13.1%) and (6.8%) were widows. Notably, there were no respondents reported as divorced in both Benue and Niger states respectively. This finding aligns with the study by Yelwa *et al.* (2025), which emphasized that active involvement in such programmes leads to increased productivity, creativity, self-worth, and empowerment among women. The findings further showed that the average household size in Benue State was 7 persons, while in Niger State, it was 9 persons. This suggests that, on average, respondents in both states had fairly large household sizes. This finding aligns with the results of Ahmad (2023), who identified that large family sizes can serve as a source of unpaid or family labour, reducing the cost of hiring external labour and increasing the capacity for farming and processing activities. The results on the level of education, as presented in Table 2 below, reveals that women in both Benue and Niger States had one form of education or another, although the distribution varied across the states. In Benue State, the educational distribution indicates that (11.8%) of the respondents had no formal education, while (7.2%) of the women had tertiary education, and (5.9%) reported receiving Qur'anic education. In Niger State, findings show that (14.1%) of the respondents had no formal education, while another (14.1%) had only primary education. Interestingly, the highest proportion of respondents in this state, (33.9%), reported Qur'anic education, which reflects the socio-cultural and religious context of the region. This agrees with the assertion by Usman (2025) that education equips rural women with the necessary knowledge to manage resources, adopt technology, and contribute meaningfully to agricultural development.

Table 2: Socioeconomic Characteristics of Respondents in Niger and Benue States

Variables	Niger (n=177) Freq (%)	Benue (n=153) Freq (%)
Age (years)		
15-25	6 (3.4)	3 (2.0)
26-36	71 (40.1)	38 (24.8)
37-47	77 (43.5)	41 (26.8)
48-58	20 (11.3)	70 (45.8)
60 and above	3 (1.7)	1 (0.7)
Mean	47	49
Marital Status		
Married	159 (89.8)	122 (79.7)
Single	6 (3.4)	11 (7.2)
Widow	12 (6.8)	20 (13.1)
Household Size		

1-5	48 (27.1)	69 (45.1)
6-10	105 (59.3)	66 (43.1)
11-15	23 (13.0)	17 (11.1)
16 and above	1 (0.6)	1 (0.7)
Mean	9	7
Primary education	25 (14.1)	51 (33.3)
Qur'anic education	60 (33.9)	9 (5.9)
Secondary education	36 (20.3)	64 (41.8)
Tertiary education	31 (17.5)	11 (7.2)

Source: *Field survey, 2025*

Specific Agribusiness women were involved before the Programme

The distribution according to specific **Agribusiness women were involved before the Programme in table 3 below are the** women in Benue and Niger States. The results show that: majority (79.1%) of the women in Benue state were involved in livestock production, (69.9%) involved in marketing of agricultural commodities, (56.9%) Subsistence farming (56.2%), commercial farming, (54.2%), processing of crop, (54.2%), vegetable farming and none is involved in shea-nut picking while results show that: majority (79.1%) of the women in Niger state the majority of the women (42.0%) were involved in livestock production, (33.5%) marketing of agricultural commodities, (35.8%) Subsistence farming (7.4%) commercial farming, (23.9%) processing of crop, (4.0%) involved in vegetable farming and (4.5%) were involved in shea-nut picking. This implies that women in the study area were involved in **Agribusiness** but at varying degree of their interest. (Mahmud, *et al.*, 2024).

Table 3: Specific Agribusiness Involved Before the Programme

Agribusiness Activity	Niger (Frequency (%))	Benue (Frequency (%))
Commercial farming	13 (7.4%)	86 (56.2%)
Subsistence farming	63 (35.8%)	87 (56.9%)
Processing of crops	42 (23.9%)	83 (54.2%)
Vegetables farming	7 (4.0%)	83 (54.2%)
Livestock production	74 (42.0%)	121 (79.1%)
Marketing of agricultural commodities	59 (33.5%)	107 (69.9%)
Sheanut picking	8 (4.5%)	0 (0.0%)

Source: *Field survey, 2024*

Before the implementation of the Nigeria Value Chain Development Programme (VCDP), women in Niger and Benue states were mainly domestic in nature, focusing on activities like sowing, transplanting, weeding, and harvesting. (Abel, S., 2024). **Production Focus:** Before VCDP, women were heavily involved in the initial stages of agricultural production, often within the context of household food security. **Limited Development:** While their contributions were significant for subsistence agriculture, they were not fully integrated into agricultural development activities that would enhance their livelihoods and economic empowerment (Ebuka, *et al.*, 2024). **Domestic Contributions:** Women's work in agriculture was largely seen as a domestic task, supporting family needs rather than a commercial venture. (Dayo, F., 2025). **Specific Activities:** Women's activities included tasks like sowing, nursery management, transplanting, weeding, irrigation, fertilizer application, plant protection, harvesting, winnowing, and storing. **Livestock as a Livelihood:** Livestock rearing was also a primary livelihood activity for women, supplementing household income and providing food. (Grace, A., 2024).

Constraints faced by women participation in programme at the study area

In Benue and Niger States, factors influencing participation in income-generating activities within the Value Chain Development Programme (VCDP) include socio-economic characteristics, access to inputs and credit, and extension services, as well as program-specific factors like the provision of matching grants

and the focus on specific crops like rice and cassava. Strategies for increasing participation involve addressing constraints like poor extension ratios, inadequate capital, and market linkages, and promoting cooperative membership and functional groups to facilitate credit and dynamism. The distribution of Strategies and factors influencing participation in income-generating activities in VCDP activities in Benue States is shown in Table 4 below. In Benue State, results shows that very serious factors influencing participation of women in the VCDP activities show that majority (79.7%) of the women said Prioritizing women participation, (76.5%) Regular and prompt training, (75.8%) Capacity building, (73.2%) Form and strengthen more women-only groups were some of the factors that influenced the participation of women in the VCDP. This is in line with Marcel and Suleiman (2024) Women training and development have a number of positive effects on the social welfare of the beneficiaries, programme can help women to improve their economic status, health and empowerment, which can lead to a number of benefits for families and communities. In Niger State, results shows that very serious factors influencing participation of women in income generating activities in the VCDP activities show that majority (83.6%) of the women said Regular and prompt training, (81.9%) Prioritizing women participation, (79.7%) Forming and strengthen more women-only groups, (75.7%) Capacity building, (75.1%) Taking cognizance of women in various roles as actors in the rice value chains, (71.8%) Empower women to leverage on opportunities were among some of the factors that influenced the participation of women in the VCDP.

Table 4: Distribution of constraints faced by women participation in programme at the study area.

Variable	B/VS (Freq)	B/S (Freq)	B/NS (Freq)	N/VS (Freq)	N/S (Freq)	N/NS (Freq)
Taking cognizance of women in various roles as actors in the rice value chains	109(71.2)	44(28.8)	0(0.0)	133(75.1)	44(24.9)	0(0.0)
Access to land	36(23.5)	112(73.2)	5(3.3)	120(67.8)	53(29.9)	4(2.3)
Access to production and processing machines/equipment	92(60.1)	60(39.2)	1(0.7)	121(68.4)	45(25.4)	11(6.2)
Access to financial services/credit	56(36.6)	84(54.9)	13(8.5)	99(55.9)	45(25.4)	33(18.6)
Access to water	61(39.9)	77(50.3)	15(9.8)	119(67.2)	51(28.8)	7(4.0)
Access to processing center	96(62.7)	34(22.2)	23(15.0)	110(62.1)	22(12.4)	45(25.4)
Access to market stalls and store	54(35.3)	41(26.8)	58(37.9)	94(53.1)	26(14.7)	57(32.2)
Empower women to leverage on opportunities	112(73.2)	39(25.5)	2(1.3)	127(71.8)	42(23.7)	8(4.5)
Capacity building	116(75.8)	37(24.2)	0(0.0)	134(75.7)	42(23.7)	1(0.6)
Price subsidy (Input, equipment)	108(70.6)	45(29.4)	0(0.0)	120(67.8)	49(27.7)	8(4.5)
Prioritizing women participation	122(79.7)	30(19.6)	1(0.7)	145(81.9)	29(16.4)	3(1.7)
Regular and prompt training	117(76.5)	36(23.5)	0(0.0)	148(83.6)	29(16.4)	0(0.0)
Form and strengthen more women-only groups	112(73.2)	41(26.8)	0(0.0)	141(79.7)	36(20.3)	0(0.0)

Source: Field Survey, 2025 B= Benue, N=Niger, VS=very serious S= serious, NS=not serious, WS=weighted sum, WM=weighted Mean

Level of Welfare Status of Respondents in Benue Niger States

The study categorized the welfare status of women participating in Value Chain Development Programme (VCDP) activities in Benue and Niger States, revealing that a significant proportion of the women (83.3%) had attained a high level of welfare status. This high welfare status was attributed to several contributing factors, notably increased income, enhanced purchasing power, and considerable improvements in their general living conditions (Mohammed *et al.*, 2025).

Table 5: Categorization on level of Welfare Status of Respondents in Benue Niger States

	Niger	Benue	Pooled
Level of Welfare Status			
Low	50 (28.2)	16 (10.5)	66 (20.0)
Moderate	95 (53.7)	59 (38.6)	154 (46.7)
High	32 (18.1)	78 (51.0)	110 (33.3)

CONCLUSION AND RECOMMENDATIONS

The study revealed that there is high level of participation of women in VCDP agricultural activities. The majority (83.3%) of the respondents were better- off after participating in the project as it evidently improved their welfare status. This study has also identified and analyzed the various factors influencing women's participation in value chain of production, processing and marketing activities under the IFAD Value Chain Development Programme (VCDP) in Benue and Niger State. To achieve a desired national transformation, the platform for women's involvement in leadership where gender sensitive interests can be expressed as critical because this will reduce their vulnerability. The need to view political participation as a continuous process will help to steady the rate of women's participation against a decline level. This is possible with a resilient political will and democratic leadership spirit, which is not limited to political parties but inclusive of trade unions, educational sector, employment, social institutions and with the growing recognition of the need to incorporate women into mainstream development projects in order to promote accountability and yield results, a conscious effort is needed to encourage women involvement in nation building. It is therefore recommended that women should be given more opportunities they needed; it will lead to full development of their roles. Women lack the training and the means to bloom and this is needed for advancing the position of women, strengthening their capacities and skills and expanding the opportunities for women to more fully develop their roles. Policy-makers should work with women to improve their positions and accelerate national development. A comprehensive approach must be taken to remove the social, economic and legal constraints on women.

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Theme: Agricultural Extension for Food Security and Community Empowerment

Assessment of Rural Households' Participation in Oil Palm Processing in Umuahia Agricultural Zone of Abia State, Nigeria

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ABSTRACT

The study assessed the participation of rural households in oil palm processing in Umuahia agricultural zone, Abia State. Specifically, the study identified the methods of oil palm processing utilized by the processors; assessed the level of participation of rural households in oil palm processing; and determined the constraints limiting the respondents' participation in oil palm processing. A multi-stage random sampling technique was adopted in selecting the sample size of 107, out of which 97 copies of questionnaire were returned and used. Data for the study were collected through the use of a well-structured questionnaire. Means and ordinary least square regression analysis were used in analyzing the data. The result revealed that semi-mechanized method is the most utilized processing method ($\bar{x} = 2.77$), followed by traditional method ($\bar{x} = 2.23$). The grand mean of 2.57 showed that the oil palm processors were highly engaged in oil palm processing. The result further revealed that high cost of harvesting ($\bar{x} = 3.54$), long duration of processing ($\bar{x} = 3.33$), and deterioration of produce ($\bar{x} = 3.31$), were the foremost constraints limiting participation in oil palm processing. Sex, marital status, education, household size, and processing experience were significantly related with engagement in oil palm processing. The study concluded that the oil palm processors were highly engaged in oil palm processing, but are hampered by several constraints. Therefore, the study recommends subsidizing the cost of palm fruit processing equipment, provision for soft loans to processors for acquisition of modern processing machines, as well as encouraging greater participation of rural households in oil palm production, processing and marketing through embarking on enlightenment campaign, provision start-off capitals, establishment of palm oil mills at strategic locations in the rural areas and subsidizing of modern processing facilities.

Keywords: Rural households, Participation, Oil palm, Oil palm processing

INTRODUCTION

Oil palm is a versatile tree crop with almost all its parts having economic value and usefulness for everyday livelihood. The component parts of oil palm namely: the fronds, leaves, trunk and roots give a wide range of products and are used for several purposes, ranging from palm oil, palm kernel oil, palm wine, broom and palm kernel cake (Agbelemoge, Adetipe, Lawal, and Uthman-Akinsanmi, 2020). The palm fruit which is the most important product of oil palm is processed to obtain three commercial products, namely- palm oil, palm kernel oil and palm kernel cake. Palm oil and palm kernel oil are two distinct oils which are important in World Trade. Oil palm which is often referred to as a crop of multiple values.

Literature has shown that the domestic consumption of palm oil in Nigeria in 2017/2018, amounted to about 1.29 million metric tons. Palm oil is also used in the manufacturing of margarine, soap candle, base for

lipstick, waxes and polish bases in a condense form, confectionary (Alabi et al, 2020). Hence, the importance of oil palm to the national economy of Nigeria cannot be over emphasized (Ibitoye et al, 2019). This ranges from production of food for human consumption, employment, income to farmers and nation and raw materials for industries. Oil palm is largely used in various food products, such as margarines, shortenings, cooking oils and confectionary fats. Research has reviewed that it can also be used as fuel blend for internal combustion engines. It is therefore essential for producers in West Africa to increase production and to improve the processing techniques in order to increase oil yield (Baryeh, 2019; Teoh, 2020). According to Oyeronke and Adedotun (2019), palm fruit can be processed by using the traditional method or modern methods. The Traditional process is simple, but tedious, inefficient and involves much drudgery. The technologies used for the production of palm oils are mostly traditional in form and have been passed on from generation to generation through induction. The traditional or manual method is normally referred to as “low” technology. The traditional is the method of extraction mostly used by small scale processors, which produces low grade palm oil with high free fatty acid (FFA) content and a large quantity of dirt and water (Taiwo et al., 2019). In the mechanized method, the processes from the fruit sterilization to palm oil clarification are completely mechanized with sophisticated conveyance systems. Also, the use of screw expellers in oil separation and the recapturing of oil by a sludge centrifuge for further clarification enable over 90% of the oil to be extracted (Owolarafe et al., 2020).

Research has shown that Oil palm processing has been of immense economic benefit. Palm oil production is a major source of income and employment to a large proportion of the poor rural farmers in Nigeria (Okemini, 2020). Ndu (2020) noted that oil palm processing is a very important part of a nation's economy for several reasons, principal among which is the number of persons the sub sector employs. Oil palm fruit processing is one of the major economic activities for the people in Umuahia agricultural zone of Abia State. The oil palm processors in this zone just like in many other South Eastern regions are predominantly small-scale processors who mostly used traditional and semi-modern processing methods (Onu et al., 2021). Despite the economic benefits of oil palm processing, current research has shown that local production cannot meet local demand and one of the reasons for such is low participation in palm oil processing activities. The observed low participation in palm oil processing activities can be attributed to major palm oil processing constraints, which according to Alabi et al. (2020) include low supply of inputs, the inefficiency of processing methods, the low quality of the output, the lack of infrastructure and inefficient distribution, predominant use of the traditional method which gives rise to low yield, tedious and laborious status of the traditional method. It is observed that traditional methods of extracting palm produce are inefficient and tedious. Ahmed (2020) noted that the negative effect of low participation in oil palm processing among rural people is that local demand is not satisfied and competing in the palm oil export market with other producing nations like Malaysia and Indonesia becomes totally impossible.

Having observed the afore stated problems, it then becomes extremely imperative to assess the participation of rural households in oil palm processing in Umuahia Agricultural Zone LGA, Abia State. Specifically, the study identified the methods of oil palm processing utilized in the study area; assessed the level of participation of rural households in oil palm processing activities; and identified the constraints limiting the respondents' participation in oil palm processing in the study area.

H0: Selected socio-economic characteristics of the respondents do not have a significant effect on the participation of rural households in oil palm processing.

METHODOLOGY

The study was conducted in Umuahia Agricultural Zone of Abia State. The zone comprises of five Local Government Areas (LGAs) namely: Umuahia North, Umuahia South, Ikwuano, Isiala Ngwa North and Isiala Ngwa South. The state is approximately within latitudes 4° 41' and 6° 14' north of the equator and longitudes 7°, 10° and 8° east of the Greenwich meridian. The major occupation of the people is agriculture and civil services. Major agricultural produce in Umuahia Agricultural Zone LGA includes oil palm, Cocoa maize, yam, plantain, rice, vegetable, melon, beans, etc.

The population for the study consists of all the palm oil processors in Umuahia Agricultural Zone LGA. A multi-stage sampling technique was used in selecting the sample for the study. At the first stage, Umuahia

Agricultural Zone LGA was purposively selected from the three agricultural zones (Umuahia, Aba and Ohafia) in Abia State because of the high number of oil palm production and palm oil processing in the area. At the second stage, two blocks were randomly selected from Umuahia Agricultural Zones. In the third stage, three circles were purposively selected from the two blocks, making a total of six circles. The circles were selected because of the high involvement of the community inhabitants in oil palm production and palm oil processing. In the fourth stage, two cells were further selected from the selected circles making a total of 12 circles. At the final stage, 9 oil palm processors were randomly selected from each of the cells making a total of 108 respondents for the study, out of which 97 were returned and used for the study. Primary data were collected and used for the study. The primary data were collected with the aid of a structured questionnaire. Data were analyzed using means and ordinary least square regression analysis.

The methods of oil palm processing utilized in the study area was realized using mean score from three points rating scale of always = 3, sometimes = 2 and never = 1. Mid-points of 2.0 was used as the basis for decision making. The level of participation of rural households in oil palm processing was realized using three points rating scale on the processing activities, categorized as follows: always =3, sometimes = 2 and never = 1. The mean cut off point was 2.00 that is $3 + 2 + 1 = (6/2) = 2.00$. Hence, mean response from 2.0 and above was considered low participation, while mean response below 2.0 was considered low participation. The constraints limiting the respondents' participation in Oil Palm Processing in the study was measured using mean from a 4-points rating scale of Strongly Agree, Agree, Disagree and Strongly Disagree with assigned scores of 4, 3, 2 and 1 respectively. The mean cut-off point was 2.50 that is $4 + 3 + 2 + 1 = (10/2) = 2.50$ and any mean response below 2.50 was considered as constraints limiting the respondents' participation in Oil Palm Processing activities in the study area.

The ordinary least square regression model is specified explicitly as follows:

1. Linear function

$$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8 + \beta_9X_9 + \beta_{10}X_{10} + e_i \dots \text{eq 1}$$

2. Exponential function

$$\text{Ln}Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8 + \beta_9X_9 + \beta_{10}X_{10} + e_i \dots \text{eq 2}$$

3. Semi log function

$$Y = \text{Ln}\beta_0 + \beta_1\log X_1 + \beta_2\log X_2 + \beta_3\log X_3 + \beta_4\log X_4 + \beta_5\log X_5 + \beta_6\log X_6 + \beta_7\log X_7 + \beta_8\log X_8 + \beta_9\log X_9 + \beta_{10}\log X_{10} + e_i \dots \text{eq 3}$$

4. Double Log function

$$\text{Ln}Y = \text{Ln}\beta_0 + \beta_1\text{Ln}X_1 + \beta_2\text{Ln}X_2 + \beta_3\text{Ln}X_3 + \beta_4\text{Ln}X_4 + \beta_5\text{Ln}X_5 + \beta_6\text{Ln}X_6 + \beta_7\text{Ln}X_7 + \beta_8\text{Ln}X_8 + \beta_9\text{Ln}X_9 + \beta_{10}\text{Ln}X_{10} + e_i \dots \text{eq 4}$$

Where

Y = Level of participation in oil palm processing (Mean)

X₁ = Age (Years)

X₂ = Marital status (married = 1, otherwise = 0)

X₃ = oil palm processing experience

X₄ = Monthly Income (naira)

X₅ = Education (years of schooling)

X₆ = Extension contacts (Number of times or frequency of visits)

X₇ = Cooperative membership (years)

X₇ = Household size

β₀ = Intercept

e_i = Error term

RESULTS AND DISCUSSION

Methods of Oil Palm Processing Utilized By the Processors

Table 1 shows the result of the processing methods utilized by the processors in the study area.

Table 1: Distribution of oil palm processors according to the processing methods utilized

Methods of oil palm processing	Always	Sometimes	Never	Mean	Std. dev.

Traditional Method	105 (36.1)	98 (50.5)	35 (36.1)	2.23	0.669
Semi-mechanized method	234 (80.4)	32 (16.5)	3 (3.1)	2.77	0.490
Modern method	48 (16.5)	26 (13.4)	68 (70.1)	1.46	0.765

Source: Field survey, 2023

The result in Table 1 shows that semi-mechanized method is the most utilized processing method ($\bar{x} = 2.77$), followed by traditional method ($\bar{x} = 2.23$), while modern method is the least utilized processing method ($\bar{x} = 1.46$). The implication of the result is that the majority of the respondents used a combination of both traditional and modern method in their palm fruit processing. This is in tandem with Onu et al (2021), which equally showed that the majority of the processors used semi-modern method in the processing of their palm oil produce. However, the study is contrary to the findings of Ogbonna (2022) where traditional method was found as the dominant processing method among oil palm processors.

Level of Participation of Rural Households in Oil Palm Processing

The result in Table 2 shows the result of the level of participation of rural households in oil palm processing in the study area.

Table 2: Distribution of oil palm processors according to their level of participation in oil palm processing activities in the study area

Oil palm processing activities	Always	Sometimes	Never	Mean	Std. Dev.
Fruit loosening	258 (88.7)	12 (6.2)	5 (5.2)	2.84	0.493
Fruit digestion	261 (89.7)	4 (2.1)	8 (8.2)	2.81	0.565
Boiling of fruits	252 (86.6)	10 (5.2)	8 (8.2)	2.78	0.581
Oil clarification	228 (78.4)	40 (20.6)	1 (1.0)	2.77	0.445
Pressing/oil extraction	240 (82.5)	18 (9.3)	8 (8.2)	2.74	0.600
Packaging of oil	180 (61.9)	58 (29.9)	8 (8.2)	2.54	0.646
Storage	120 (41.2)	98 (50.5)	8 (8.2)	2.33	0.625
Threshing or bunch quartering	186 (63.9)	2 (2.1)	33 (34.0)	2.30	0.948
Gathering of bunches	186 (63.9)	1 (1.0)	34 (35.1)	2.29	0.957
Harvesting of palm bunches	180 (61.9)	6 (3.1)	34(35.1)	2.27	0.952
Grand mean				2.57	

Source: Field survey, 2023

The result in Table 2 revealed that the foremost palm processing activities engaged by the processors were fruit loosening ($\bar{x} = 2.84$), fruit digestion ($\bar{x} = 2.81$), boiling of fruits ($\bar{x} = 2.78$) and oil clarification ($\bar{x} = 2.77$). The result further revealed that the least engaged palm processing activities were gathering of bunches ($\bar{x} = 2.29$), and harvesting of palm bunches ($\bar{x} = 2.27$). The grand mean of 2.57 implies that the oil palm processors were highly engaged in oil palm processing in the study area. This is in tandem with Onu et al (2021) which affirmed high engagement in the processing of oil palm produce in Abia State. Alabi (2020) affirmed oil palm processors were majorly moderately involved in oil palm post-harvest activities.

Constraints Limiting Participation in Oil Palm Processing

The result in Table 3 shows the constraints limiting participation in oil palm processing activities in the study area.

Table 3: Distribution of processors according to constraints limiting participation in oil palm processing activities

	Strongly agree	Agree	Disagree	Strongly disagree	Mean	Std. Dev.
High cost of harvesting	60 (61.9)	27(27.8)	6 (6.2)	4 (4.1)	3.54	0.737
Long duration of processing	66(68.0)	3(3.1)	22(22.7)	6(6.2)	3.33	1.028

Deterioration of produce	60(61.9)	18(18.6)	8(8.2)	11(11.3)	3.31	1.034
Lack of storage facility	32(33.0)	63(64.9)	1(1.0)	1(1.0)	3.30	0.543
Lack of infrastructure (eg, electricity)	49(50.5)	25(25.8)	21(21.6)	2 (2.1)	3.25	0.866
Difficulty in obtaining credit facilities	61(62.9)	8(8.2)	18(18.6)	10(10.3)	3.24	1.088
Inaccessibility of palm tree	32 (33.0)	55(56.7)	6 (6.2)	4 (4.1)	3.19	0.726
Unavailability of markets	55(56.7)	10(10.3)	25(25.8)	7(7.2)	3.16	1.048
Unavailability of human labour	54 (55.7)	4(4.1)	36(37.1)	3(3.1)	3.12	1.023
Lack of modern processing equipment	43(44.3)	24(24.7)	24(24.7)	6(6.2)	3.07	0.971
High level of skill needed	24(24.7)	13(13.4)	27(27.8)	33(34.0)	2.74	1.252
Instability of government policy	22(22.7)	24(24.7)	42(43.3)	9(9.3)	2.61	0.942
Grand mean					3.16	

Source: Field survey, 2023.

The result in Table 3 revealed that high cost of harvesting ($\bar{x} = 3.54$), long duration of processing ($\bar{x} = 3.33$), deterioration of produce ($\bar{x} = 3.31$), and lack of storage facility ($\bar{x} = 3.30$) were the foremost constraints limiting participation in oil palm processing in the study area. The high cost of harvesting could be due to high cost of living, switch to better livelihood sources and high exodus of people from rural areas which made the few available palm fruit harvesters to charge exorbitantly. Deterioration of farm produce is as a result of lack of storage facility which result in high spoilage resulting to loss in quality consequently reduction in price. Other constraints include lack of infrastructure (eg, electricity) ($\bar{x} = 3.25$), difficulty in obtaining credit facilities ($\bar{x} = 3.24$), inaccessibility of palm tree ($\bar{x} = 3.19$), unavailability of markets ($\bar{x} = 3.16$), unavailability of human labour ($\bar{x} = 3.12$), lack of modern processing equipment ($\bar{x} = 3.07$), high level of skill needed ($\bar{x} = 2.74$) and instability of government policy ($\bar{x} = 2.61$). Ogbonna (2022) showed inadequate finance and credit facilities as the major constraints in oil palm fruit processing. Onu et al (2021) showed that lack of modern processing equipment, instability of government policy and high cost of labour as the major constraints to engagement in oil palm processing.

Effect of Selected socio-economic characteristics of the respondents on the participation of rural households in oil palm processing activities.

Table 4 shows the ordinary least square regression analysis result of the relationship between selected socio-economic characteristics of the processors and their engagement in oil palm processing.

Table 4: OLS Regression analysis of the relationship between selected socio-economic characteristics of the processors and their engagement in oil palm processing

Variables	Linear	Exponential	+Semi-log	Cob Douglas
Constant	1.806 (8.114)***	0.614 (5.893)***	1.280 (3.555)***	0.912 (4.797)***
Age	-0.002 (0.255)	-0.001(-0.291)	-0.020 (-0.092)	-0.002 (-0.018)
Sex	0.399 (7.150)***	0.173 (6.605)***	0.407 (8.419)***	0.170 (7.453)***
Marital status	0.091 (1.946)*	0.04 (1.847)*	0.099 (2.182)**	0.042 (1.963)*
Education	0.063 (4.550)***	0.029 (4.526)***	0.529 (3.898)***	0.267 (4.155)***
Household size	0.060 (1.683)*	0.032 (1.905)*	0.245 (2.407)**	0.130 (2.699)**
Processing experience	0.015 (1.797)*	0.007 (1.809)**	0.134 (2.495)**	0.038 (1.892)*
Access to credit	0.033 (0.314)	0.0023 (0.462)	0.000 (0.251)	0.005 (1.107)
Cooperative membership	0.183 (1.102)	0.066 (0.844)	0.301 (1.922)*	0.098 (1.321)
R-Square	0.807	0.785	0.824	0.799
Adjusted R-Square	0.790	0.765	0.808	0.781
F-ratio	46.146***	40.146***	51.437***	43.837***

Source: Field survey, 2023.

From Table 4, the Semi-log was chosen as the lead based on the econometric parameters such as high magnitude of co-efficient of determination and F-ratio as well as the number of significant variables. The coefficient of determination value of 0.808 implies that 80.8% of the variations in engagement in oil palm processing activities were explained by the socioeconomic variables. The F-ratio of 51.437 which was significant at 1% shows the goodness-of-fit of the model. From the result, sex, marital status, education, household size and processing experience were found to be significantly related with engagement in oil palm processing activities.

The coefficient of sex (0.407) was positive and significantly related with engagement in oil palm processing activities at 1% significant level. This shows that the engagement in oil palm processing activities tend to increase with the male. This could be due to the fact that oil palm processing is full with many rigorous activities of which is mostly being undertaken by the men. This is consistent with the findings of Alabi, et al (2020) where sex was shown to be positive and significantly related with involvement in oil palm processing.

The coefficient of marital status (0.099) was positive and significantly related with engagement in oil palm processing activities at 5% significant level. This shows that the engagement in oil palm processing activities increases with the married processors. Being married comes with a lot of responsibilities which call for means of taking care. Hence a married processor may most likely engage in multiple activities as long as such activities helps in meeting the needs of the family.

The coefficient of education (0.529) was positive and significantly related with engagement in oil palm processing activities at 1% significant level. This shows that the engagement in oil palm processing activities increases as the level of education increases. The inclination to adopt improved technologies tend to increase with increase in education. Education increases the mental horizon of an individual which makes the individual open and receptive to new technologies. Hence, an educated processor will not settle on only traditional method of processing, but will most likely use the semi-modern or modern processing and therefore will be involved in multiple processing activities. According to Osondu et al. (2014), education exposes a person to the right methods of utilizing available resources and has positive effect on the business acumen of entrepreneurs. Nwaobila (2013) asserted that education enhances farmers' ability to make accurate and meaningful management decision. According to Onu (2020), educational attainment will likely make the farmers more responsive to many agricultural extension programmes and policies as well as enhances their productivity.

The coefficient of household size (0.245) was positive and significantly related with engagement in oil palm processing activities at 5% significant level. This shows that the engagement in oil palm processing activities increases as the household size of the processors increases. Large household size entails that there will availability of household members to undertake the processing the activities.

The coefficient of processing experience (0.134) was positive and significantly related with engagement in oil palm processing activities at 5% significant level. This shows that the engagement in oil palm processing activities increases as the years of processing experience of the processors increases. This is in agreement with the result of Odoemlam (2019) who affirm that farming experience that enhance the participation, increasing agricultural output.

CONCLUSION AND RECOMMENDATIONS

The oil palm processors used a combination of both traditional and modern method in their palm fruit processing. The oil palm processors were highly engaged in oil palm processing. The oil palm processors are confronted with many constraints such as high cost of harvesting, long duration of processing and deterioration of produce. Based on the findings of the study, the following recommendations were made: Government should subsidize the cost of palm fruit processing equipment in order to promote its use among palm fruit processors and enhance their income since processing cost constitute one of the major cost items in oil palm processing. There should be provision for soft loans to processors for acquisition of modern processing machines, creation of awareness and capacity building training for palm fruits processors on the use of modern processing machines. Efforts should be intensified towards providing basic infrastructure

such as electricity and good, motorable roads in the oil palm processing catchment areas so as to enhance the efficiency of processing and marketing of oil palm products.

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Theme: Agricultural Extension for Food Security and Community Empowerment

Fish Farming Output in Anambra State, Nigeria: Drivers & Constraints

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ABSTRACT

This study examined fish farming output in Anambra State, Nigeria: drivers and constraints. Through hypothesis-based, multi-stage sampling approach, 80 fish farmers in twelve communities in four Local Government Areas were sampled. Socio-economic characteristics, fish types produced fish pond systems adopted, output-determining factors, and constraints were analyzed using descriptive statistics and the Cobb- Douglas fishpond model. Results showed that catfish farming was the most common type of aquaculture practiced, accounting for 96.67% of respondents engaged in its production. Most dominated farmers operated tarpaulin and concrete ponds systems and majority had access to credits, extension services and organizational support. The Cobb-Douglas regression results showed that processing cost, years of production experience, household size, extension contact and association membership, access to credit, feed cost significantly affected the output whereas labour cost, age, and fertilizer cost had negative impact on it. Critical limitations including financing, high feed cost, price volatility and lack of preservation were also reported in this study. The study recommends targeted interventions in credit access, input subsidy, infrastructure, and extension services to enhance the productivity and sustainability of fish farming as a livelihood strategy.

Keywords: Fish, Fish farming, Cobb-Douglas production function, ,Anambra State

INTRODUCTION

Aquaculture, especially inland fish farming, is really taking off in Sub-Saharan Africa as a practical way to tackle food shortages, rural joblessness, and poverty issues. In Nigeria, the aquaculture scene is booming, largely because of the growing need for animal protein and the decline in wild fish populations. But it's not just about nutrition; fish farming is also getting attention for its socioeconomic perks, particularly in empowering rural families and low-income neighborhoods. This study looks into the viability of fish farming in Anambra State and examines how it could help with sustaining livelihoods in the area.

Agriculture is still a key player in Nigeria's economic growth plan. However, even with its potential, the sector isn't fully tapped, and rural poverty remains a big concern. In southeastern Nigeria, where there's a high population density but limited land access, aquaculture brings a distinct edge. It offers a way to generate high productivity on limited space and provides income, employment, and food security within short production cycles. **Anambra State**, in particular, offers fertile ground for aquaculture owing to its tropical climate, extensive inland water systems, and proximity to urban fish markets like Awka, Onitsha, and Nnewi.

According to recent studies, fish farming has emerged as a major source of income for a large number of households in Anambra State. Catfish farming is a popular activity for small and medium-sized producers, who frequently use concrete tanks or earthen ponds. In addition to being profitable, these systems have demonstrated the ability to sustain household income despite shifting commodity prices and general

economic instability (Nwigwe & Ndem, 2024; Ikechukwu, 2023). However, due to limitations like limited access to financing, the high cost of fish feed, a lack of extension services, and insufficient training in contemporary production technologies, the scale and sustainability of these businesses continue to be a concern (Obiora & Ohanu, 2025). The paper addressed the objectives of the study by describing the socioeconomic characteristics of the respondents in the study area, identified various types of fish produced and management systems available in the area, analyzed the factors influencing the output of fish farmers in the area and identified the constraints militating against fish system management.

It's important to note that fish farming is not just a business; it's also a public good with big policy implications. It is very similar to the Sustainable Development Goals (SDGs), especially SDG 1 (No Poverty), SDG 2 (Zero Hunger), and SDG 8 (Decent Work and Economic Growth). The Agricultural Promotion Policy (APP 2016–2020) and other government policies at both the federal and state levels have named aquaculture as a priority sub-sector with the potential to change things. Still, there are gaps in implementation, and access to state-level agricultural extension, finance, and inputs is still not equal.

The research helps us understand how agriculture, and aquaculture in particular, can be a powerful way to reduce poverty in a way that lasts by breaking down its economic logic and social effects. This paper makes a location-specific contribution to the national conversation about agricultural development and rural transformation by focusing on Anambra State. It aims to answer important research questions like: What are the socio-economic characteristics of the people who took part in the study? What are the different types of aquatic food and management systems that are available in the area? What are the factors that affect the output of aquatic food systems in the study area? What are the problems that make it hard to manage aquatic food systems?

Given the continued need for sustainable livelihoods in Nigeria and the growing demand for affordable protein, given Nigeria's enduring sustainable livelihood and rising need for reasonably priced protein sources, fish farming has become a potentially game-changing agricultural subsector. With its tropical climate, abundant inland water resources, and close proximity to urban markets like Onitsha and Awka, Anambra State, which is known for its dense population and scarcity of arable land, provides ideal conditions for aquaculture (Ikechukwu, 2023). But even with these benefits, most fish farmers in the state are still small-scale businesses with severe production and market limitations (Obiora & Ohanu, 2025).

The dual nature of fish farming as an economic endeavor and a means of reducing poverty serves as the rationale for this study. According to recent studies (Nwigwe & Ndem, 2024), fish farming supports food security by regularly supplying protein, diversifying household income, and giving rural youth jobs. However, because of ineffective management techniques, high feed prices, restricted extension services, and poor credit availability, these advantages are still underutilized. Analyzing the **economic viability** of fish farming in Anambra State using metrics like **gross margins, net returns, return on investment (ROI), and input-output ratios** offers practical insights for stakeholders. These indicators help distinguish whether fish farming represents a sustainable livelihood strategy or merely a subsistence activity.

Additionally, fish farming is an important area for policy intervention due to its alignment with the Sustainable Development Goals (SDGs), particularly SDG 1 (No Poverty), SDG 2 (Zero Hunger), and SDG 8 (Decent Work and Economic Growth) (FAO, 2022). Aquaculture is a priority sector according to Nigeria's Agricultural Promotion Policy (APP 2016–2020), but there are still gaps in its practical implementation, especially in rural areas like Anambra State (Federal Ministry of Agriculture, 2021).

METHODOLOGY

This study was conducted in Anambra State, Nigeria. Anambra State is a state in South-eastern Nigeria. Anambra as a name is an anglicized version of the original 'Oma Mbala', the native name of the Anambra River which is a tributary of the famous River Niger. The Capital and the Seat of Government is Awka. Onitsha and Nnewi are the biggest commercial and industrial cities in the State. Anambra lies between geographical coordinates; longitude 6° 20'N 7° 00' East of the Greenwich and latitude 6° 33'30" N 7° 00' E. It has an area of 4,884km² (1,870sq mi) and a projected population of 5,527,800 (NPC, 2016).

Anambra State is endowed with significant natural resources, including natural gas, crude oil, bauxite, and ceramic deposits, alongside fertile arable land. Additionally, the state supports diverse agro-based activities

such as crop farming, fishery, animal husbandry, and pasture cultivation. Notably, Anambra currently records the lowest poverty rate in Nigeria (Anambra State Ministry of Agriculture, 2025).

A multi-stage sampling technique was employed for this study. In the first stage, the two agricultural zones; Aguata, & Anambra, were purposively selected out of the three agricultural zones in the state as a result of their prominence in fish farming activities and availability of their wetland environment. In the second stage, two Local Government Areas (LGAs) were randomly selected from each of the two agricultural zones, resulting in a total of four LGAs namely; Ihiala LGA, & Anaocha LGA under Aguata zone; Anambra West LGA & Idemili South LGA under Anambra zone. The third stage involved the random selection of five communities from each of the four selected LGAs, yielding a total of twenty communities for the study. The fourth stage involved a simple random selection of two villages each from the twenty chosen communities, and this gave a total of 40 villages for this study. lastly, 2 farmers were selected from the 40 villages which gave a total of 80 respondents.

The study relied on primary data sources. Data were collected using structured questionnaires, supplemented by oral interviews in cases where respondents were unable to read or write. The primary data collected include: socio-economic characteristics of the respondents in the study area, various types of fish produced and management systems available in the area, factor influencing output of fish farmers in the area, and the constraints militating against fish system management.

Model specification:

The socio-economic characteristics of the respondents in the study area, various types of fish produced and management systems available in the area and the constraints militating against fish system management were determined using descriptive statistics like frequency, percentage, mean and standard deviation.

Cobb-Douglas Production Function

To analyze the factors that influenced the output of the aquatic food system in the study area, the Cobb-Douglas production function was applied. The model was explicitly specified as follows:

$$\ln Y_{ij} = \beta_0 + \beta_1 \ln X_{1ij} + \beta_2 \ln X_{2ij} + \beta_3 \ln X_{3ij} + \beta_4 \ln X_{4ij} + \beta_5 \ln X_{5ij} + \beta_6 \ln X_{6ij} + \dots + \beta_{12} \ln X_{12ij} + U_i \quad \text{--1.2}$$

Where ij refers to the i^{th} observation of the j^{th} farmer., $\ln$ = logarithm to base e , Y = the farm gross margin from i^{th} farmer in Naira.

Y = the farm gross margin from i^{th} farmer in Naira

X_1 = Labour cost (₦), X_2 = Marital Status (1 = married, 0 = otherwise), X_3 = Fuel (Litres), X_4 = Amount of Credit accessed (₦), X_5 = Initial capital (₦), X_6 = Age of farmers (Years), X_7 = Processing cost (Cost cooking gas, hired machine, basins, took pick, water proof, firewood etc), X_8 = Gender (male =1, female =0), X_9 = Production experience (years), X_{10} = Household size (number of persons), X_{11} = Extension contact (Number of visit), X_{12} = Farmer association (Membership =1, non-membership =0), X_{13} = Stock size at maturity (Numbers), X_{14} = Cost of feed (₦), X_{15} = Duration of feed fish (weeks, month, year, etc), X_{16} = Cost of fertilizer and hiring (₦), X_{17} = Rent on land (₦), X_{18} = Number of pond owned (Numbers).

RESULTS AND DISCUSSION

Socio-economic characteristics of the respondents

The socio-economic characteristics of fish farmers is summarized and presented in Table 1.

Table 1: Socio-economic characteristics of fish farmers

Socio-economic characteristics	Frequency (f)	Percentages (%)	Mean	Stand Dev
Sex				
Female	32	53.3		
Male	28	46.7		
Marital Status				
Single	27	45.0		
Married	29	48.3		
Divorced	4	6.7		
Level of Education				
Primary	13	21.7		

Secondary	22	36.7		
Tertiary	25	41.7		
Credit access				
No	27	45.0		
Yes	33	55.0		
Extension contacts				
No	22	36.7		
Yes	38	63.3		
Fish farming Organization				
No	18	30.0		
Yes	42	70.0		
Organization assistant				
No	21	35.0		
Yes	39	65.0		
Age				
24 -33	40	66.7	33.233	8.160
34 -43	14	23.3		
44 -53	4	6.7		
54 -63	2	3.3		
Household size				
1 – 4	29	48.3	4.433	2.102
5 – 8	29	48.3		
9 – 12	2	3.3		
Years in fish production				
1 – 4	16	26.7		
5 – 8	36	60.0	6.233	3.770
9 – 12	4	6.7		
13 – 16	2	3.3		
17 – 20	2	3.3		
Total	60	100.0		

Source: Field survey, 2023

The majority of respondents (53.3%) are female, while 46.7% are male, according to data on fish farmers' sex. Given that they outnumber men by a small margin, this distribution indicates that women are actively engaged in fish farming. This is noteworthy given that men predominate in many Nigerian agricultural sectors due to capital advantages and land access. Perhaps as a result of its comparatively low labor and land requirements, the greater participation of women suggests that fish farming is more gender inclusive. Additionally, it indicates that fish farming can be a major factor in women's economic empowerment, which is essential for reducing household poverty. The percentage of people who are married (48.3%) and single (45.0%) is almost equal. While single people are driven by entrepreneurial goals, married respondents might be drawn to fish farming as a reliable source of income to support family needs. The fact that 6.7% of respondents were divorced suggests that they depend on fish farming for their own financial survival. All things considered, these groups demonstrate that a variety of household structures are supported by fish farming. About 41.7% of the respondents had tertiary education, 36.7% had secondary education, and 21.7% had only primary education, according to the results based on educational attainment. More than 41% of fish farmers have a tertiary degree, indicating that a sizable portion of them are highly educated. This suggests that fish farming is no longer limited to unskilled workers. Better adoption of new technologies, sound farm management techniques, and financial planning are all suggested by the presence of educated farmers. Additionally, it has a positive correlation with the enterprise's economic viability and productivity. Farmers with higher levels of education are more likely to maintain documentation, pursue training, and obtain institutional support all of which are essential for long-term poverty reduction. An encouraging sign is that more than half of the respondents (55%) had access to credit. Credit availability allows farmers to make investments in equipment, pond construction, fingerlings, and high-quality feed, all

of which have a direct impact on output and profitability. Nonetheless, 45% of people lack access, which is still a sizable portion and could impede the expansion of smaller-scale operators. To scale fish farming as a business that reduces poverty, this credit access gap must be closed.

Extension services are essential for sharing knowledge, particularly when it comes to better fish farming techniques. The outreach seems to be quite effective, as 63.3% of respondents reported having extension contact. Access to extensions puts people in a better position to gain from innovation, training, and suggestions from others. To guarantee inclusive growth, extension networks must be expanded, as indicated by the 36.7% of people who are still uncontacted. Strong institutional involvement is implied by the high membership rate of 70% in cooperatives or organizations dedicated to fish farming. Access to bulk inputs, group marketing, training, and even credit are all improved by such membership. Participation in government or NGO programs and the voice of farmers in advocacy are also improved by group involvement. It is essential for expanding operations and lowering operational risks, which enhances livelihoods and lowers poverty. Cooperatives, non-governmental organizations, or government initiatives are likely to provide farmers with financial, material, and knowledge support. Fish farming in Anambra appears to have strong institutional support, with 65% of farmers benefiting from it. This support increases livelihood resilience, decreases vulnerability, and increases farm sustainability and profitability. The remaining 35% who do not receive this kind of assistance point to possible program coverage gaps that need to be filled. The majority of respondents are comparatively young, as evidenced by the results displayed under the Age column, which showed that the farmers' mean age was 33 years. This implies that farmers in this age range are likely to possess a reasonable level of experience, while also possessing the stamina and physical prowess required to meet the labor-intensive demands of fish farming. Age has a major impact on a person's ability and willingness to invest in agricultural businesses, claim Duijn et al. (2018). The farmers' average household size was four people, according to the respondents' family size distribution in the table. Consumption burden and labor availability are influenced by household size. Moderate household sizes allow for adequate labor without placing undue strain on household income, claim Obasi & Nweze (2015). This equilibrium increases the potential for savings and reinvestment from aquaculture revenue. Farmers may be able to save money and put it back into their farms if households are smaller. However, slightly larger households (5–8) are able to provide family labor. While reducing production cost. All things considered, household size affects the labor supply and spending pattern that are crucial for assessing poverty vulnerability. Last but not least, the majority of respondents had between five and eight years of experience in fish production, indicating that they had advanced past the novice stage and were now able to maximize operations and profit. This moderate amount of experience improves economic viability by fostering operational stability and cumulative learning. The average of more than six years demonstrates that fish farming is evolving into a reliable source of income rather than merely a temporary or seasonal endeavor. This longevity lends credence to the claim that fish farming helps reduce poverty and generate sustainable income.

Various Types of Fish Produced and Management Systems available in the Area

Distribution of the respondent based on type of fish produced and management systems available in the area is summarized and presented in Table 2 and 3

Table 2: Distribution of the respondent based on fish produced by the farmers

Type of fish produced	Frequency	Percentages	Stock size /beginning	Stock size/ending
Catfish	58	96.67	9603	5095
Tilapia	9	15.00	150	144
Shrimp	2	3.33	7	6
Trout	0	-	-	-
White fish	0	-	-	-
Salmon	0	-	-	-

Source: Field survey, 2023

According to the findings, the most common species raised by fish farmers in Anambra State is catfish. 58 farmers, or 96.67% of the 60 respondents, said they were involved in catfish farming. With an initial inventory of 9,603 fish and an ending stock of 5,095, this species also had the largest stock size. Catfish farming is active, profitable, and probably the mainstay of aquaculture-based livelihoods in the area, as evidenced by the notable decline in stock size over the production period, which may be ascribed to harvesting for sale, mortality, or consumption. Catfish farming's rapid growth rate, robust consumer demand, ability to adapt to local water conditions, and ease of access to inputs like feed and fingerlings are all factors in its widespread adoption. Shrimp farming was reported by only two respondents, accounting for just 3.33% of the sample, with stock sizes starting at seven and ending at six. This extremely low level of shrimp cultivation implies that it is not yet a common or economically significant aquaculture venture in Anambra State. The limited practice may be due to the specialized knowledge, environmental conditions (such as water salinity), and capital required for successful shrimp farming, which are likely lacking among smallholder farmers in the area.

Moreover, none of the respondents raised salmon, trout, or white fish. Because of their incompatibility with the region's current climatic and ecological conditions, or because of a lack of market demand and technical capacity for their production, these species were completely missing from the dataset. For example, trout and salmon usually need colder, oxygen-rich water, which may not be possible or available in the aquaculture environment of Anambra.

According to the data, fish farming in Anambra State is primarily focused on producing catfish, with little diversification into other species. The significance of catfish as the main species sustaining rural livelihoods and regional economic activity is highlighted by this production pattern. Although the existence of shrimp and tilapia farming indicates some diversification, their scope is still quite small.

Management systems available in the area

Distribution of the respondent based on type of fish pond used by farmers is summarized and presented in Table 3.

Table 3: Distribution of the respondent based on type of fish pond used by farmers

	Frequency	Percentages
Earthen Pond.	4	6.67
Concrete Pond.	30	50.00
Tarpaulin Pond.	48	80.00
Plastic Or Rubber Pond.	4	6.67
Fiberglass Tanks.	0	0.00
Cage Or Pen Ponds.	0	0.00

Source: Field survey, 2023 *multiple response recorded.

According to the results, 48 respondents, or 80% of the sample, indicated that they used tarpaulin ponds, making them the most popular type. This high adoption rate indicates that tarpaulin ponds are especially popular because they are inexpensive, flexible, simple to set up, and ideal for urban or small-scale fish farming. Another reason for their popularity is that they don't require a lot of land or long-term construction, which makes them affordable for fish farmers with little funding.

With 30 respondents, or 50% of the farmers surveyed, using concrete ponds, they are the second most popular type. The widespread use of concrete ponds is probably due to their reputation for longevity, ease of maintenance, and effective water control. Semi-commercial or more seasoned fish farmers seeking long-term operations may find them appealing due to their long lifespan and superior environmental control, despite the fact that they are more costly to build than tarpaulin ponds.

Four respondents, or just 6.67% of the sample, reported using earthen ponds, while four respondents reported using plastic or rubber ponds. Due to problems like land availability, water seepage, and inadequate water quality management all of which are typical problems with unlined soil ponds earthen

ponds are not used as much as they could be. In a similar vein, the low usage of rubber or plastic ponds might be due to limited availability locally or durability concerns. Interestingly, none of the respondents mentioned cage/pen pond systems or fiberglass tanks. The lack of fiberglass tanks is ascribed to smallholder farmers' ignorance, their high cost, and their specialized use. Similarly, cage or pen pond systems that are commonly utilized in open water bodies like lakes or rivers were not documented, perhaps because of access issues to appropriate water bodies, legal constraints, or environmental constraints.

Factor Influencing Output of Aquatic Food System in the Area

To analyze the factor influencing output of aquatic food system in the area, Cobb-Douglas production function was used. The result of estimated Cobb- Douglas estimate of the production function of fish farmers in Anambra State were summarized and presented in Table 4.

Table 4. Estimate of Cobb-Douglas production function for catfish farmers

Variables	Coefficient	Std. Error	Z-value
(Constant)	4.887	0.900	5.429***
X ₁ = Labour cost	-0.018	0.007	-2.455**
X ₂ = Marital Status	0.032	0.031	1.036
X ₃ = Fuel	0.029	0.036	0.802
X ₄ = Amount of Credit accessed	0.019	0.004	4.188***
X ₅ = Initial capital	-0.001	0.039	-0.023
X ₆ = Age of farmers	-0.005	0.002	-2.125**
X ₇ = Processing cost	0.922	0.045	20.714***
X ₈ = Gender	0.028	0.031	0.891
X ₉ = Production experience	0.094	0.038	2.445**
X ₁₀ = Household size	0.024	0.004	5.903***
X ₁₁ = Extension contacts	0.024	0.007	3.239***
X ₁₂ = Farmer association	0.036	0.003	10.463***
X ₁₃ = Stock size at maturity	0.072	0.042	1.707*
X ₁₄ = Cost of feed	0.011	0.003	3.619***
X ₁₅ = Duration of feed fish	0.100	0.062	1.628
X ₁₆ = Cost of fertilizer and hiring	-0.099	0.053	-1.887*
X ₁₇ = Rent on land	-0.007	0.025	-0.267
X ₁₈ = Number of ponds owned	-0.010	0.019	-0.524
R ²	0.947		
R ⁻²	0.920		
F-ratio	34.068***		

Source: Field Survey data (2023) *** Significant at 1%, ** Significant at 5%,*significant at 10%.

The coefficient of multiple determination (R²) was 0.947, indicating that approximately 94.7% of the variation in fish farmers' output was explained by the explanatory variables included in the model. The results showed that variables such as labour cost, amount of credit accessed, age of farmers, processing cost, production experience, household size, extension contact, membership in farmer associations, stock size at maturity, cost of feed, and cost of fertilizer and hiring were significantly related to fish production output.

Specifically, the coefficients of labour cost (P<0.01), amount of credit accessed (P<0.01), processing cost, production experience (P<0.05), household size (P<0.01), extension contact (P<0.01), farmer association membership (P<0.01), stock size at maturity (P<0.1), and cost of feed (P<0.01) were found to have significant and positive relationships with output. This implies that increases in any of these variables would lead to a proportionate increase in output, and vice versa. In practical terms, as fish farmers access more credit, incur higher processing costs, gain more production experience, have larger household sizes, receive more extension services, participate in farmer associations, increase stock size at maturity, and spend more on feed, their output (farm gross margin) improves accordingly. This finding aligns with the study by Oyase and Jemerigbe (2016), who also reported that fish farmers' output depends significantly on extension contact, farmer association membership, and feed costs (P<0.01).

Conversely, a negative and significant relationship was found for labour cost ($P < 0.05$), age of farmers ($P < 0.05$), and cost of fertilizer and hiring ($P < 0.01$). This indicates that increases in any of these factors would lead to a reduction in output. Specifically, as labour costs rise, as farmers age, and as expenditures on fertilizer and hired services increase, fish production output tends to decline. This result supports the findings of Anwar Hossain Mondal et al. (2019), who noted that labour costs are negatively associated with fish farm output.

Constraints Militating against Fish System Management

Constraints faced by the respondents are shown in Table 5

Table 5: Constraints militating against fish system management

	Min	Max	Sum	Mean	Std Dev	Remark
Finance	2	5	280	4.667	0.857	Accepted
Extension officers' services	1	4	144	2.400	0.718	Rejected
High cost of feed/other inputs	2	5	274	4.567	0.851	Accepted
Government assistance	1	5	152	2.533	1.049	Rejected
Market price fluctuation	3	5	270	4.500	0.77	Accepted
Preservation/storage/processing problem	2	5	196	3.267	0.778	Accepted
Flooding during the raining season	1	5	178	2.967	1.089	Rejected
Land acquisition	2	5	236	3.933	1.056	Accepted
Water problem during the dry season	1	5	180	3.000	0.957	Accepted
Poaching/theft	2	5	206	3.433	0.831	Accepted
Predators	2	5	201	3.350	0.799	Accepted
High mortality rate	2	5	218	3.633	0.823	Accepted
Disease/pest infestation	1	5	218	3.633	0.843	Accepted

Source: Field survey (2023)

Bench Mark = 3.0 Very serious (5), Serious (4), Minor (3), Unserious (2), Do Not Know (1)

Ten variables were found to be significant constraints, according to the results, because their mean scores were higher than the 3.0 threshold. The respondents cited limited access to financing as the main constraint ($\bar{X} = 4.667$), followed by the high cost of feed and other inputs ($\bar{X} = 4.567$) and price fluctuations in the market ($\bar{X} = 4.5$). These results imply that policies targeted at increasing financial access, lowering input costs, and stabilizing market prices could increase farmers' profitability. Although aquaculture plays a vital role in rural livelihoods and food security, ongoing financial constraints and growing production costs continue to impede its growth in developing nations (Belton et al., 2017; Duijn et al., 2018; Elfitasari).

CONCLUSION AND RECOMMENDATIONS

Productivity is positively impacted by important elements like cooperative membership, extension contact, and credit availability. However, growth is hampered by issues like unstable markets, high feed costs, and limited funding. Fish farming has the potential to be a sustainable means of subsistence and development with the right interventions.

Recommendations are made to improve the sustainability, productivity, and potential to alleviate poverty of fish farming in Anambra State in light of the study's findings. Improving farmers' access to reasonably priced credit through focused loan programs catered to their requirements is crucial to raising the sustainability and productivity of fish farming in Anambra State. Profitability would also be greatly increased by lowering the high cost of feed and other inputs through subsidies or the promotion of locally sourced alternatives. Encouraging farmers to join cooperatives or associations would increase their collective access to resources, training, and better markets, while strengthening agricultural extension services by assigning trained aquaculture officers can assist farmers with technical advice and innovation adoption.

In order to lower production losses and enhance value addition, it is also essential to invest in infrastructure for processing, storage, and preservation, such as cold rooms and smoking kilns. Securing farmer incomes would be aided by government policies that support organized markets and stabilize fish prices. Finally, to

ensure inclusive and sustainable aquaculture growth, special empowerment programs should be put in place for women and youth, who make up a significant portion of the sector. These programs should include training, production inputs, and startup support.

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**SOCIETY FOR COMMUNITY & COMMUNICATION DEVELOPMENT RESEARCH
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Theme: Agricultural Extension for Food Security and Community Empowerment

**Economic Analysis of Palm Fruit Processing Among Rural Farmers In
Ezeagu Local Government Area of Enugu State, Nigeria**

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ABSTRACT

The study focused on the economic analysis of palm fruit processing among rural farmers in Ezeagu Local Government Area of Enugu State, Nigeria. Specifically, the study described the socio-economic characteristics of palm oil processor identified the various methods of palm oil processing, estimated the cost and returns of palm oil processing, determined the factors influencing the output of the palm oil processed and identified the constraints to palm oil processing in the study area. A multi-stage stratified random sampling technique was adopted in selecting 60 respondents for the study. Data were collected with the use of structured questionnaire and analyzed with both descriptive (frequency, percentage, mean and gross margin model) and inferential statistics such regression and Z-test models. The major results showed that 35% of the producers were using mechanized technologies while 65% were using traditional methods of processing. The profitability for traditional method of processing revealed that the BC ratio was 1.30 while the profitability for the modern method of processing revealed a BC ratio of 11.8. The multiple regression results revealed that age (-.773), education (1.149***), household size (.068***), farming experience (.089***), income (.113***), and access to credit (.228***) were the determinants of palm oil processing in the study area. Some of challenges encountered in palm oil processing were lack of electricity (100%), non-availability of palm fruit (93.3%), lack of government support (93.3%), lack of credit facilities (86.7%) and inadequate land (85%). The Z-test result revealed that there was a significant difference in the income from modern and traditional palm fruit processing methods in the study area. The study concludes that modern method of processing is more profitable than its traditional counterpart and encourages farmers to utilize such. The study also recommends that farmers should be aided in the use of modern techniques of processing through relevant and regular extension contact because most times underutilization is due to lack of experience.*

Keyword: palm oil, palm oil processing, economic analysis, rural farmers

INTRODUCTION

Palm oil, a kind of edible vegetable oil, which is derived from the pulp of the fresh palm fruit in its various forms, has become the leading vegetable oil produced globally, accounting for one quarter of global consumption and nearly 60% of international trade in vegetable oils (World Bank, 2020). The increase in consumption is due to its multiple uses in both food industry and non-food sectors. It also has many competitive advantages over other competing oils, such as having low cost of production, high yield, and being free from trans-fatty acids (Oil World, 2018). Oil palm commercially cultivated on about 12 million hectares of land in the humid tropics. Major producers are Malaysia and Indonesia (85% of global output). Other smaller but significant producers include Nigeria, Colombia, Costa Rica, Ecuador, Honduras, Cote d'Ivoire, Nigeria, Cameroon, Papua New Guinea, and Thailand (World Bank, 2020).

Palm oil, in its various forms, has become the leading vegetable oil produced globally accounting for one quarter of global consumption and nearly 60% of international trade in vegetable oils (World Bank, 2020). In 2007/2008, the world consumption of palm oil reached almost 40 million tonnes and in 2050, it is forecast to reach 93.256 million tonnes, depending on the edible oil substitute demand (Oil World, 2018). In recent decades, the domestic consumption of palm oil in West Africa has also increased more rapidly than its production. After centuries as the leading producing and exporting region, West Africa has now become a net importer of palm oil (Olagunju, 2018). Nigeria has a long history of palm oil production. It was its primary export in late part of the 19th century and the early part of the 20th century (Ayodele, 2020)

According to Ayodele (2020), the palm oil industry in Nigeria since independence has been geared towards meeting domestic demand and thus reducing import bills, (i.e. it has largely been an import substitution industry). The growth in oil palm cultivation from the 1970s was in response to the increase in domestic demand as a result of growth in population, urbanization and industrialization. The structure of the palm oil industry in Nigeria has been shaped by the presence of two different markets: home consumption and industrial use in domestic manufacturing (Fold & Whitfield, 2012). As a result, Nigeria 's industry has two sub-sectors which are largely separated. The industrial use sub-sector consists of medium and large-scale oil palm plantations and mills. Processing mills under large scale sub-sector process more than 10 tonnes fresh fruit bunches (FFB) per hour while installations that process between three and eight tonnes FFB per hour are termed medium scale (Poku, 2012). Large sub-sector is characterized by more efficient technology, economies of scale, higher productivity on farms (in terms of yields of oil palm bunches) and in mills (in terms of quantity of oil extracted). It also produces better quality of crude palm oil and further refined palm oil products, which are sold to companies for use in manufacturing. The small-scale sub-sector, however, consists of household processors (who process manually and private smallholder oil palm cultivators, who largely sell their fruit bunches to small scale mechanized mills (Processing units handling up to 2 tonnes of fresh fruit bunches (FFB) per hour) (Poku, 2012). The small-scale sub-sector is characterized by low-yielding oil palm variety, low productivity of farm and mill, and low-quality crude palm oil which is sold in the village or at small town markets (Onu, Aguaguiyi and Ufomba 2022).

Basically, there are two methods of processing palm oil, the traditional and the industrial. Within these two major methods, there are widespread variations. They all apply physical means in processing to obtain crude oil. Chemicals are used if they have to go through the refining, bleaching and deodorizing (RBD) stages. Weiss (2023) has detailed the various stages of processing fats and oils, which generally applies to palm oil as well. These processes may alter significantly the quality of the palm oil; each may be determined by the quality indices which are basically chemical or physical in nature. For example, RBD reduces the level of carotenes in palm oil. The study will, therefore, be of immense help to the country as a whole and the palm oil industry in particular.

The local method is a very laborious process. The palm bunches are quartered and left overnight for easy separation of nuts from the spikelets. The fruits are boiled for 1.0 to 1.5 hours, pounded in a mortar or macerated with feet in a canoe-like container. Water is added and well-shovelled up. All nuts are carefully removed out by hand. The fibres are well-shaken over in the sludge until oily foam floats to the surface of the sludge. The foams continue to collect in a container until the operation is completed. This is later boiled in pot for about 30-40 minutes. The clean edible oil then collects on the surface leaving the dirty oil at the bottom of the pot. Onu *et al* (2021), observed that delay in the processing of fruits can lead to increase in free fatty acid (FFA) content of palm oil and this causes a drop in quality.

The modern method uses such simple machines as presses to more sophisticated palm oil mill in processing fresh fruit bunch (FFB) into palm oil and other products (CTA, 2010). Palm oil mill consists of a series of operations designed to separate the harvested bunch into distinctive fractions – stalk, fruit, fibre, oil, sludge, nut, and kernel and so on. These operations are: sterilization, stripping, digestion, crude oil extraction clarification, kernel extraction.

The increased demand for palm oil resulting from an increase in population and income growth, relative to the low productivity of the oil palm sector have mounted pressure on Nigeria to increase oil processing to meet up with market demands. Thus, Nigeria first goal is to meet the domestic demand and then, if possible, seeks to become competitive in export markets. In recent times, its production has drastically downsized.

Evidence from (Alabi *et al.*, 2020) revealed that this situation has been brought about by a number of socio economic and political factors along with the technological knowhow in the industry. Principal among the factors responsible for this decline is the inefficiency that exists in the production system for palm oil processing. Such inefficiencies arise from high cost of labour, lack of linking roads for transportation, electricity, water, inadequate credit facility.

According to Lawal (2020), processing method affects the quality and quantity of palm oil produced. There is still a confusion about the method of palm oil processing that will be viable that is efficient and effective. Many studies have concluded that modern method of palm oil processing is more efficient and effective in producing both quality and quantitative palm oil (Ayodele, 2017), still others have opposed such view as Okoro *et al.*, (2019) says that the traditional method of processing produces quality palm oil than the modern method in a study that analyzed the farmers perception of the advantage of the various processing techniques. Moreso, the cost and return of the two processing techniques have been in debate as some studies claim that traditional method of processing is cost effective, while some studies say that the modern method although not cost effective but rake in more returns than the traditional method. Based on this confusion, this study is set to do an economic analysis of palm oil processing among rural farmers in the study area.

OBJECTIVES OF THE STUDY

The broad objective of this study was economic analysis of palm oil processing among rural farmers in Ezeagu Local Government Area of Enugu State, Nigeria. Specifically, the study

- i. identified the various methods of palm oil processing;
- ii. estimated the cost and returns of palm oil processing;
- iii. determined the factors influencing the output of the palm oil processed; and
- iv. identified the constraints to palm oil processing in the study area.

HYPOTHESIS

This null hypothesis was tested in the study;

H₀: There is no significant difference between the income from traditional and modern oil processing methods in the study area.

RESEARCH METHODOLOGY

Ezeagu is a Local Government Area of Enugu State, Nigeria. Its headquarters is in the town of Aguobu-Owa. The average temperature in this city is cooler to mild (60 degrees Fahrenheit) in its cooler months and gets warmer to hot in its warmer months (upper 80 degrees Fahrenheit) and very good for outdoor activities with family and friends or just for personal leisure. There are 28 communities in Ezeagu namely; Amasiodo-Oghe, Amankwo-Oghe, Akama-Oghe, Oyofe-Oghe, Opkogho, Olo, Iwollo-Oghe, Neke-Oghe, Obinofia, Ndiagu, Umana, Ndiuno, Obinofia Ndiuno, Obeleagu-Umana, Umumba Ndiuno, Umana Ndiagu, Aguobu, Umumba, Umana-Agba, Imezi Owa, Mgbagbuowa, Ezema-Ogulogu, Ibite-OloObinofia Ndiagu, Ogwofia Imezi-Owa. Ezeagu being mainly agricultural with expanding population shows evidence of out-migration of the youths from the rural sector in search of white-collar jobs and trading. The state produces many food crops and cash crops like cocoa, oil palm, cashew, rubber etc. The population of the study consisted of all oil palm processors in Ezeagu L.G.A of Enugu State, Nigeria.

A multi-stage stratified random sampling technique was adopted in selecting 60 respondents for the study. The first stage involved random select of 12 autonomous communities. The communities selected includes Akama-Oghe, Oyofe-Oghe, Opkogho, Iwollo-Oghe, Neke-Oghe, Obinofia, Ndiagu, Umana, Ndiuno, Obinofia Ndiuno, Obeleagu-Umana, Aguobu and Umumba. In the second stage, 1 village was randomly selected from the 12 communities already selected. This made a total of 12 villages. In the third and final stage, five (5) oil palm processors were purposively selected which gave a total of 60 respondents. The essence of the purposive selection was to ensure that rural farmers whose major occupation is palm oil processing were selected to avoid bias and uninformed responses.

The study made use of primary data through the use of questionnaire. Secondary sources of information were gotten via internet, books, bulletins, periodical, past related research work, magazines, journals and academic preceding's.

Objectives i and iv were analyzed using statistical tools such as frequency, percentage and mean while objective ii was analyzed using gross margin analysis while objective iii was analyzed using Ordinary Least Square regression analysis. The hypothesis of the study was tested using Z-test analysis.

Arithmetic mean

The formula to compute the mean count used in this study is specified below. The mean ($\bar{x}$) is computed by multiplying the frequency (f) of the responses under each category by assigned value and dividing the sum ($\sum$) of the product by (N) number of respondents to the particular indicator as shown:

$$\bar{x} = \frac{\sum fx}{N}$$

Where,

$\sum$ = Summation

F = Frequency

X = assigned scores to response category

N = number of respondents

$\bar{x}$ = Arithmetic mean

Gross Margin Model

This is stated as follows:

$$GM = TR - TVC = \sum P_1 Q_1 - \sum P_X X_1$$

where:

GM= Gross margin

PI= Unit price of output

PIX= Unit Price of Variable Input

QI= Quantity of each Output

XI= Input (Variable)

£= Summation of -----

NR= GM- TFC ----- (II)

$$BCR = \frac{TR}{TC}$$

Where,

TR= Total Revenue (₦)

TVC= Total Variable Cost (₦)

NR= Net Returns (₦)

TFC= Total Fixed Cost (₦)

BCR= Benefit Cost Ratio



Regression Model

Objective iv: was tested using Ordinary Least Square regression model.

The four functional forms of OLS in explicit form is specified as;

Linear Function

$$Y = \beta + \beta_1 x_1 + \beta_2 x_2 + \dots \dots \dots \beta_n x_n + e_i$$

Exponential function

$$\log Y = \beta + \beta_1 x_1 + \beta_2 x_2 + \dots \dots \dots \beta_n x_n + e_i$$

Semi-log function

$$Y = \beta_0 + \beta_1 \ln x_1 + \beta_2 \ln x_2 \dots \dots \dots \beta_n \ln x_n + e_i$$

Cobb Douglas function

$$\log Y = \beta_0 + \beta_1 \ln x_1 + \beta_2 \ln x_2 \dots \dots \dots \beta_n \ln x_n + e_i$$

The implicit model is expressed thus;

$$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8 + e_i)$$

Where,

Y= Palm oil output (litres)

X₁ = age (years)

X₂ = sex (male = 1, female =0)

X₃ = household size (numbers)

X₄ = farm income (naira)

X₅ = marital status (married = 1, otherwise = 0)

X₆ = farming experience (years)

X₇ = education (years)

X₈ = credit (naira)

X₉ = extension contact (number of times)

X₁₀ = membership to cooperative society (yes =1, no = 0)

e_i = error term.

Hypothesis: which stated that there is no significant difference in the income from modern and traditional processing methods in the study area was tested using z-test analysis the model is specified as thus;

$$Z = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$

RESULTS AND DISCUSSION

Technologies used by the processors

Table 1: Distribution of respondents based on the technologies used in processing palm fruit

Palm fruit processing technologies	Frequency	Percentage
Mechanized technologies	21	35.0
Traditional	39	65.0
Total	60	100.0

Source: Field survey, 2023

The findings on technologies used by the processors presented in table 1 above shows that 35% of the processors were using mechanized technologies while 65% of the processors were using traditional methods of processing. This implies that traditional method of processing was the main method of processing used by oil palm producers in the area. The reason for the predominant use of traditional method of processing may be attributed to lack of finance to purchase the modern methods of processing, lack technical knowhow on the use of the modern method, age, economic factors predominant in the area (rural) etc. Ziga, (2014) in his study concluded that farmers in rural areas where less likely to adopt modern methods of farming because of the aforementioned factors.

Average cost and returns of palm fruit processing

Table 2: Average Cost and Returns estimate of Palm fruit processing in the study area

Traditional method	Item value/month
Returns	
Total Revenue (TR)	193,500.00
Fixed cost	
Cost of processing equipment	103,200.00
Depreciated cost	10320.00
Variable cost	
Labour cost	12,540.00
Transport cost	17,500.00
Storage cost	3200.00
Other costs	2210.00
Total Variable cost (TVC)	138,650.00
Total Cost	148,970.00

Gross Margin (TR – TVC)	54850.00
Profitability (Pr = TR/TC x 100)	1.30
Modern method	
Total Revenue	1,330,924.6
Depreciation on Fixed Cost	51,229.2
Variable Cost (TC)	
Labour/man-day	13077.8
Threshing cost	5233.8
Par boiling cost	4079.3
Cost of water in litre	17513
Cost of firewood	2313.0
Extraction	441.2
Clarification	17262.2
Transportation cost	2058.3
Total variable cost (TVC)	61978.6
Total Cost (TC= TFC + TVC)	113,207.8
Gross Margin (TR – TVC)	1,268,946
BCR (TR/TC)	11.8

Source: *Field Survey, 2023*

From the cost analysis as presented in Table 2, returns per Naira invested in palm oil production were evaluated by dividing their net revenue by the total cost. For traditional method, the total variable cost was computed by taking a sum of the following costs: labour cost, transport cost, storage cost and other cost. The total fixed cost included cost of processing equipment and depreciated cost. For modern method, the total variable cost includes cost of labour/man-day, threshing cost, par boiling cost, cost of water, firewood, extraction, clarification and transportation.

From the result, the total variable cost stood at ₦138,650.00 and ₦ 61,978.60 for traditional and modern methods respectively, the total cost stood at ₦ 148,970.00 and ₦ 113,207.80 for traditional and modern methods respectively. The total revenue was 193,500.00 and 1,330,924.60 for traditional and modern methods of processing respectively, while the gross margin was at 54,850.00 and 1,268,946.00 for the traditional and modern method of processing respectively. The profitability for traditional method of processing was 1.30, which implies that for every ₦1.00 invested in palm oil production using traditional methods will yield ₦0.30 in revenue in the area. The profitability for the modern method of processing shows a B/C ratio of 11.8, which implies that for every ₦1.00 invested in palm oil production using the modern method will yield ₦10.8 in revenue in the area.

The gross margin analysis above shows that the modern method of palm oil processing in the area is more profitable than the traditional method, which is line with what was expected. Modern method of processing palm oil required less expenses to run than requires less than the traditional method and is more efficient which explains why the profitability of the modern method was way higher than the traditional method of processing. When modern method of processing is used, the only major expenses will be the cost of purchasing the equipment *ab initio* after which the cost of processing drastically reduces because apart from harvesting the fruits, the modern technique takes care of every other step. And in the end produces more oil per kilogram of palm than the traditional method (Ziga, 2014).

Factors influencing palm processing

Table 3: Regression result of the factors influencing palm fruit processing in the study area.

Variables	Parameter	Linear	Exponential	Semi-Log	+ Double Log
(Constant)	B_0	-2338.142 (-0.032)	8.980 (9.566)***	103387.027 (4.714)***	11.173 (4.507)***
Sex	X_1	39594.605 (0.651)	0.659 (0.473)	29725.679 (1.363)	.637 (0.588)
Age	X_2	-194.886 (-0.255)	0.007 (0.681)	-37351.323 (-0.972)	-.773 (-1.779)*

Marital status	X_3	-26405.1 (-3.097)***	-0.303 (-2.794)**	-28338.511 (1.236)	-0.417 (1.361)
Educations	X_4	3244.229 (1.805)*	0.064 (2.501)**	-34888.386 (1.151)	1.149 (3.355)***
Household size	X_5	-302.356 (-0.122)	0.005 (0.172)	1376.132 (0.106)	.068 (3.461)***
Farming experience	X_6	1950.902 (1.983)**	0.010 (0.832)	14972.501 (4.160)***	.089 (3.767)***
Monthly income	X_8	0.422 (2.071)	1.823E-6 (0.705)	474.305 (2.037)**	.113 (5.768)***
Access to credit	X_9	-0.057 (-0.637)	1.967E-6 (1.740)*	4482.591 (4.112)***	.288 (2.60)**
R-Square		0.685	0.655	0.616	0.765
R Adjusted		0.618	0.609	0.597	0.733
F – ratio		14.710***	11.711***	12.27***	16.144***

Field Survey, 2023

Key: * Significance at 10%, ** Significance at 5%, *** Significance at 1% ***, + = Lead Equation and the values in bracket are the t-value

Table 3 shows the factors affecting palm oil processing in the study area. From the table, double log has been chosen as the lead equation. The choice was based on the high value of $R^2(0.765)$, which is in conformity with a priori expectations in respect of the signs of the estimated coefficients of the explanatory variables in the model. The R^2 of 0.765 implies that 76.5% of the total variations in palm processing method (Y) were accounted for by the dependent variables (X_t).

The results shows that sex is positively related to the method of processing used by the farmers, with a coefficient of 0.637 which implies that a 1 unit increase in sex will bring about a 63.7% increase in farmers choice of processing method, however sex has a significant effect on the choice of processing method used by farmers.

The coefficient of education was statistically significant at 1% meaning that any unit increase in education will bring about 1.149 units increase in choice of processing method, this means that an increase in education will lead to possible adoption of modern processing method by farmers.

Household size can have 6.8% effect on processing technique used by farmers, when the family has larger household which portends more hands to do the work, then the use of traditional method may be likely, but smaller household may lead to the use of modern method.

Farming experience when increased by 1 unit can cause an 8.9% change in choice of processing, monthly income had a positive relationship with processing technique as any unit increase in monthly income will increase choice of processing technique by 11.3% which implies that the higher the income, the higher the chances of choosing modern methods of processing.

Access to credit also showed a positive relationship processing technique used, increase access to credit will lead to 28.8% increase in the opportunity to use modern method of processing. The findings is in tandem with the works of Ziga, (2014) and that of Ekine and Onu (2018), who all found the above characteristics to be positively related to processing technique used.

On the other hand, age was negatively related to processing method as an increase in age will lead to a 73.3% decrease in the choice of modern method, while marital status when it tends to 1 (married) leads to 41.7% decrease in choice of modern technique for processing. This result implies that increased age reduces the ability of farmer to use more sophisticated techniques such as modern method of processing and such they continue with what they have been using all their lives which support the proverb that “old monkeys don’t learn new tricks”. Also, when they are married, they tend to choose traditional method because of large household number, thereby reducing their choice of the modern method.

The f-ratio of 16.144 shows that the explanatory variables put together have can have a significant effect on the dependent variable at 1% level of significance.

Constraints to palm fruit processing**Table 4: Distribution of respondents according to their perceived constraints to palm oil in the study**

Constraints	Frequency	Percentages
Modern method		
Non availability of palm fruits	56	93.3
Inadequate land	51	85.0
Non availability of labour	41	68.3
Lack of credit facilities	52	86.7
Lack of government support	56	93.3
High cost of modern processing facilities	42	70.0
Lack of electricity	60	100.0
Shortage of firewood	22	36.7
Scarcity of water	17	28.3
Traditional method		
Inadequate land	56	93.3
Shortage of firewood	51	85.0
High cost of labour	41	68.3
Poor access to credit	52	86.7
Poor quality of processed oil	56	93.3
Poor access to market	42	70.0
High cost of transportation	60	100.0

Source: Field Survey, 2023**Multiple responses recorded*

The result shows that for the modern method of processing, 100% indicated lack of electricity, 93.3% of the respondents indicated non-availability of palm fruit as a problem, and lack of government support, 86.7% indicated lack of credit facilities, while 85% said inadequate land.

For the traditional method, some of the problems indicated as constraints include inadequate land and poor quality of processed oil 93.3%, shortage of firewood 85%, poor access to market 70% and high cost of labour 68.3%. the factors mentioned are not far from apriori expectations, lack of infrastructural facilities in many areas has led to farmers underutilization of modern techniques of farming and processing, lack of access to land to engage in larger farm operations has also been a serious impediment to farmers use of technology, lack of support in the forms of extension services, lack of credit are also factors that has affected farmers use of modern techniques which is in line with the findings of Nwuzor, (2020).

Hypothesis Testing**Table 5 Z-test Comparative analysis of the difference in the income from modern and traditional palm fruit processing in the study area**

Methods	Mean	Std. Deviation	Z-Calc.	Df	Z-Tab.
Modern method ^a	198,920	10975.8			
Traditional method ^b	153,600	9,889.8			
A – B	453,128	1086.0	6.214***	118	1.96

*key: There is significant difference.

*** = significant at 1%.

The result presented in Table 5 shows the Z-test for the comparative analysis of the difference in the income from modern and traditional palm fruit processing in the study area and the result shows a Z-calc. of 6.214 which is greater the z-tab. (1.96). Therefore, the result implies that there is a significant difference in the mean income from the traditional and modern method of processing palm oil.

CONCLUSION AND RECOMMENDATIONS

Based on the findings of this study, the study concludes that traditional method of processing was the major processing technique used in the study area, as a result of various factors such as age, educational qualifications, farming experience, household size, income and access to credit. The study concludes that modern method of processing is more profitable than its traditional counterpart and encourages farmers to utilize such.

Based on the findings of this study, the following recommendations have been made:

1. Farmers should be aided in the use of modern techniques of processing through relevant and regular extension contact because most times underutilization is due to lack of experience.
2. The high profitability recorded by the use of modern method underscores the need to introduce modern methods of processing in rural communities by helping farmers get the needed materials in forms of subsidy.
3. The constraints to use of modern processing techniques can be curbed if government funds are properly utilized to provide the necessary social infrastructure for farmers in the rural areas.

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**Analysis of Quantity and Value of Post-Harvest Losses in Marketing
Pawpaw and Banana in Selected Markets in Kano Metropolis, Kano
State, Nigeria**

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ABSTRACT

The study analyzed the quantity and value of post-harvest losses in pawpaw and banana marketing in selected markets in Kano Metropolis of Kano State, Nigeria. The specific markets selected for the research purposefully for the study due to their significant concentration of fruit traders operating at both retail and wholesale levels included the Yan Lemo fruit market, Yankaba, and Yankura. The age distribution shows that majority of wholesale marketers have a mean age of 48.50 years, while retail pawpaw marketers fall within the 31-40 age group (51.7%). It was revealed from the results that Retail pawpaw marketers predominantly have a household size of 11-20 persons (44.2%), with a mean of 11.65. Wholesale pawpaw marketers have a larger mean household size of 18.42. In the case of pawpaw during the sorting stage, the mean quantity lost was 2.53 pieces (with a minimum of 2 and a maximum of 5 pieces) and the mean value lost was approximately ₦3,640.00 (with a minimum of ₦2,000 and a maximum of ₦11,250). This substantial loss underscores the vulnerabilities at this stage, as sorting is critical for maintaining quality, and poor practices can lead to increased waste.) The study highlights the significance of post-harvest losses in pawpaw and banana marketing in Kano Metropolis, Nigeria. The results demonstrate that post-harvest losses are substantial and occur at various stages of the supply chain. The study also identifies the need for effective strategies to reduce post-harvest losses, including improving transportation facilities, using jute bags for packaging, spreading under shade for storage, training on new management skills, and adopting new management techniques.

Key words: post-harvest losses, Quantity, Value, Retail, Wholesale

INTRODUCTION

Quantitative food loss can be defined as a reduction in the weight of edible grain or food available for human consumption. This reduction in weight can be caused by factors such as spoilage, consumption by pests, and physical changes in temperature, moisture content, and chemical changes. However, it's important to note that reduction in weight due to drying, a necessary post-harvest process for all grains, should not be counted as loss since it does not result in a loss of food value.

Qualitative loss can occur due to insect pests, rodents, handling, physical changes, or chemical changes in fat, carbohydrates, and protein, and contamination of mycotoxins, pesticide residues, insect fragments, or

excreta of rodents and birds. When this qualitative deterioration makes food unfit for human consumption and is rejected, it contributes to food losses. Post-harvest losses in tropical fruits vary widely from 10 percent to 80 percent in both developed and developing countries (Trostle, 2015; James *et al.*, 2018). These losses occur across the supply chain, from harvesting to packaging, storage, transportation, retailing, and consumption (WFLO, 2015).

In most developing countries, these losses are mainly due to poor infrastructure and logistics, poor farm practices, lack of post-harvest handling knowledge, and a convoluted marketing system (Kitinoja, 2002; Ray and Ravi, 2005; WFLO, 2015; FAO, 2016). Approximately 40 to 50 percent of horticultural products, including fruits and vegetables, are lost before they reach consumers due to high rates of bruising, water loss, and subsequent decay during post-harvest handling (FAO, 2016). Fruits and vegetables in sub-Saharan Africa suffer considerable post-harvest losses, affecting their quality, quantity, aesthetic appeal, and nutrition (Kereth *et al.*, 2013). It is against this background this study was design to determine the following objective;

The main objective of the study is to analyze quantity and value of post-harvest losses in pawpaw and banana marketing in selected markets in Kano Metropolis of Kano State. The specific objectives are to;

- i. describe the socio-economic characteristics of pawpaw and banana marketers in selected markets of Kano metropolis
- ii. determine the quantities and values of pawpaw and banana lost during marketing at different stages of post-harvest losses

METHODOLOGY

Study Area

The research study is scheduled to be conducted in Kano State, which is situated in the northern region of Nigeria. The specific markets selected for the research include the Yan Lemo fruit market, located in Kumbotso Local Government Area along Na'ibawa Zaria Road and opposite Sa'adatu Rimi College of Education. Additionally, Yankaba market is situated along Hadeja road in Nasarawa LGA, and Yankura is positioned in Fagge LGA, bordering Sabongari market to the north and Singa market to the west. These markets have been chosen purposefully for the study due to their significant concentration of fruit traders operating at both retail and wholesale levels.

Sampling Technique

Table 1a; sample frame and sample size for pawpaw sellers.

Market	Sampling Frame Whole seller	Retailer	Sample size Whole seller	Retailer
Namibia 'Yan lemo	39	110	36	86
'yankaba	1	14	1	14
'yankura	2	20	2	20
Total	42	144	39	120

Source; Nigeria Fruits Sellers Association Kano Chapter, 2024.

Table 1b; sample frame and sample size for banana marketers.

Market	Sampling Frame Whole seller	Retailer	Sample size Whole seller	Retailer
Na'ibawa 'Yan lemo	16	90	16	76
'yankaba	1	13	1	13
'yankura	2	12	2	12
, Total	19	115	19	101

Source; Nigeria Fruits Sellers Association Kano Chapter, 2024.

Analytical Tools

The analysis of the data for this study involved using descriptive statistics, Descriptive statistics is a simple and commonly used tool by researchers (Edward, 1996). It is used to describe and summarize large amounts of data in a way that is easily understandable (Babalola *et al.*, 2002). In this study, descriptive statistics

such as frequency counts, percentages, mean, coefficient of variability, and standard error will be used to describe the socio-economic characteristics of the marketers, identify causes of post-harvest losses, and analyze strategies adopted to reduce these losses

Post-Harvest Loss Estimation (PHLE) Model

The PHL model is a tool used to measure post-harvest loss of agricultural commodities. It aims to quantify post-harvest losses at wholesale and retail levels of marketing to achieve objective (iv). The main post-harvest activities in the supply chain include sorting, packaging, storage, and transportation. The model will use computing principles and index estimation to estimate losses at different stages of post-harvest. Other literature was reviewed to validate the accuracy of the model. It was found that the developed model was in agreement (Aulakh and Regmi, 2014). Mohammed *et al.*, (2021) adopted and modified the model to quantify post-harvest loss in tomato marketing. The total PHL at any post-harvest stage for a specific commodity is the sum total of food losses occurring at each stage of the processes of the PHLE Model, expressed as: [missing information].

$$TPHL = \sum (\sum U_i + \sum S_i + \sum P_i + \sum R_i + \sum T_i + \sum D_i) \dots\dots\dots (1)$$

Where

TPHL = Total post-harvest losses (kg)

U_i = PHL during loading (kg)

S_i = PHL during sorting (kg)

P_i = PHL during packaging (kg)

R_i = PHL during storage (kg)

T_i = PHL during transportation (kg)

D_i = PHL during downloading (kg).

Table 1: Distribution of Pawpaw and Banana marketers according to their socio-economic variables (Quantitative)

variable	PAWPAW				BANANA			
	Wholesale frequency	%	Retailer Frequency	%	Wholesale Frequency	%	Retailer frequency	%.
Gender								
Female	40	100.0	5	4.2	18	94.7	113	98.3
Male	-	-	115	95.8	1	5.3	2	1.7
Total	40	100	120	100.0	19	100.0	115	100.0
MStatus								
Married	1	2.5	126	96.7	15	79	77	67.0
Single	39	97.5	4	3.3	4	21	38	33.0
Total	40	100.0	120	100.0	19	100.0	115	100.0
Education								
Quaranic	16	40.0	52	43.3	1	5.3	20	17.5
Primary	20	50.0	56	46.7	4	21.1	10	8.5
Secondary	4	10.0	12	10.0	7	36.9	73	62.6
Tertiary	-	-	-	-	7	36.8	12	10.4
Total	40	100.0	120	100.0	19	100.0	115	100.0
CMembership								
Yes	39	97.5	111	92.5	10	52.6	76	66.1
No	1	2.5	9	7.5	9	47.4	39	33.9
Total	40	100.0	120	100.0	19	100.0	115	100.0

Source: Field Survey, 2024

Gender refers to the natural segregation of the human race into male and female and represents the sex of farmers. Result shows that wholesale pawpaw marketers are female (100%), while Retail pawpaw marketers are predominantly male (95.8%). And for the banana it was revealed that wholesale banana

marketers are also mostly female (94.7%). Retail banana marketers are overwhelmingly female (98.3%), this suggests a gendered division of labor, with males dominating retail pawpaw marketing and females dominating wholesale pawpaw marketing, as well as both retail and wholesale banana marketing (Kwamboka, 2018). Differences in gender preferences might stem from the different roles that women and men play in the banana value chain, such as cooking for women and beer production for men (Marimo *et al*, 2020)

This means the state of an individual whether married or single, result shows that wholesale pawpaw marketers are single (97.5%), while majority of retail pawpaw marketers are married (96.7%), wholesale banana marketers are also mostly married (79%), while Retail banana marketers are mostly married (67.0%). Married individuals may have more stability and resources for engaging in retail marketing, while single individuals may find wholesale marketing more accommodating to their circumstances (Schindler, 2010).

Education is very important in all human endeavors as an avenue through which technology is imparted. Thus, Amanchukwu *et al*, (2015) asserted that education is important in the objective analysis of problem, planning and implementation of the decision and evaluation of the results especially if it is functional in whatever business an individual engages. Retail pawpaw marketers are almost evenly split between Quranic (43.3%) and primary education (46.7%), while wholesale pawpaw marketers have Quranic (40%) and primary education (50.0%). Banana wholesale marketers have primary (21.1%), secondary (36.9%), and tertiary education (36.8%). While Retail banana marketers have a mix of Quranic (17.5%), primary (8.5%), secondary (62.6%), and tertiary education (10.4%). Banana marketers generally have higher levels of formal education than pawpaw marketers, which may influence their marketing strategies and access to information (Mateows *et al*, 2015). Higher education levels among banana marketers may lead to better adoption of new cultivars and marketing strategies (Flarian *et al*, 2018)

Cooperative means an autonomous association of persons united voluntarily to meet their mutual economic social and cultural needs and aspirations through a jointly owned and democratically controlled enterprise organize and operated on co-operative principles (Okem, 2016)). It was revealed that wholesale (97.5%) pawpaw marketers belong to a marketing association while a larger number (92.5%) are retailers. Result also shows that wholesale banana marketers have a membership of 52.6%, while banana retail marketers show lower membership (66.1%) compared to pawpaw marketers. Membership in marketing associations can provide access to resources, market information, and collective bargaining power, which may explain the higher participation rates among pawpaw marketers. Encouraging membership in marketing associations can empower marketers, improve their access to resources, and enhance their bargaining power (Ma, *et al*, 2023).

Table 2: Distribution of Quantities and Values of Pawpaw and Banana lost during marketing at different stages of one circle selling the quantities in the table, (1week).

Actors	Stage	Quantity of pawpaw/banana lost in 12 pieces (15) kg/100 pieces					Value of pawpaw/banana lost in 12pieces (15) kg/ 100 pieces				
		Mi n.	M a	Mea n	STD .	Var.	Min.	Max.	Mean	STD.	Var.
Wholesalers Pawpaw	Uploading	1	2	1.05	.221	.049	1000	2400	1291.2500	212.40	45113.78
	Sorting	2	5	2.53	.847	.717	2000	11250	3640.0000	2627.59	6904256.
	Packaging	2	3	2.18	.385	.148	2000	3200	2532.5000	328.46	107891.0
	Storage	1	5	2.35	.770	.592	1000	2400	1291.2500	212.40	45113.78
	Transportation	1	3	2.00	.679	.462	2000	3200	2540.0000	318.49	101435.8

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	Unloading	1	3	2.47	.554	.307	2000	3200	2567.5000	338.46	114557.6
	Unloading	1	1	1.00	.000	.000	1000.00	2400.00	1315.7895	284.82579	81125.73
	Sorting	1	4	1.58	.769	.591	2000.00	3600.00	2705.2632	559.23925	312748.
Wholesalers	Packaging	1	2	1.32	.478	.228	2000.00	3200.00	2542.1053	330.51440	109239.7
Banana	Storage	1	2	1.26	.452	.205	1000.00	2400.00	1315.7895	284.82579	81125.73
	Transportation	1	2	1.32	.478	.228	2000.00	3200.00	2584.2105	360.96038	130292.3
	Unloading	1	2	1.21	.419	.175	2000.00	3200.00	2584.2105	360.96038	130292.3
				RET							
				AIL							
	Unloading	1	3	1.18	.430	.185		900.00	5400.00	1379.1667	570.109
	Sorting	1	2	1.08	.266	.071		1000.00	4600.00	1477.5000	788.942
Retailers	Packaging	1	3	1.20	.460	.212		1000.00	5000.00	1512.5000	850.463
Pawpaw	Storage	1	2	1.05	.219	.048		1000.00	5500.00	1560.8333	907.049
	Transportation	1	4	1.26	.587	.344		1000.00	6000.00	1649.1667	1039.14
	Unloading	1	2	1.08	.264	.070		1000.00	5000.00	1820.0000	1186.23
	Unloading	1	3	1.35	.496	.246	1500.00	2200.00	1761.7391	160.36286	25716.2
	Sorting	1	4	1.65	.663	.439	1500.00	2200.00	1750.4348	151.23695	22872.6
Retailers	Packaging	1	3	1.57	.651	.423	1500.00	2200.00	1740.0000	144.97429	21017.5
Banana	Storage	1	3	1.54	.611	.373	1500.00	2200.00	1703.4783	119.89062	14373.7
	Transportation	1	2	1.11	.315	.099	1500.00	2200.00	1717.3913	140.33848	19694.8
	Unloading	1	2	1.26	.452	.205	1600.00	2200.00	1743.478	139.0004	19321.1

Source: *Field Survey, 2024*

The findings reveal substantial post-harvest losses, which are significant for understanding the economic impact on the marketing of these fruits. In the case of pawpaw during the sorting stage, the mean quantity lost was 2.53 pieces (with a minimum of 2 and a maximum of 5 pieces) and the mean value lost was approximately ₦3,640.00 (with a minimum of ₦2,000 and a maximum of ₦11,250). This substantial loss underscores the vulnerabilities at this stage, as sorting is critical for maintaining quality, and poor practices can lead to increased waste (Ikpe & Shamsuddoha, 2024). The high variance in both quantity and value signals a significant fluctuation in loss levels, suggesting that some batches may face severe issues while others may not. This suggests that sorting, which is essential for quality control and market readiness, proves to be a particularly hazardous point for both product quantity and value, resonating with findings in

other studies that have similarly identified sorting as a critical stage vulnerable to high loss rates. This aligns with broader research which has shown that mishandling during sorting can lead to significant decreases in the overall quality of perishable products, often resulting in economic losses for vendors.

For the packaging stage, pawpaw experienced a mean loss of 2.18 pieces (with a minimum of 2 and maximum of 3) and a mean value loss of ₦2,532.50 (minimum ₦2,000, maximum ₦3,200). Similarly, the storage stage had a mean quantity loss of 2.35 pieces and the same mean value loss as packaging (₦1,291.25). These figures emphasize the need for improving both packaging techniques and storage conditions to mitigate losses. The findings from this table align with broader research on post-harvest losses in fruit marketing, which often highlight that substantial losses occur due to inadequate handling practices, poor infrastructure, and environmental factors such as temperature and humidity (Osei-Kwarteng *et al*, 2024).

In the banana marketing process, significant losses also occurred. During the sorting stage, the mean quantity lost was 1.58 pieces (with a range from 1 to 4 pieces) and the mean value lost was ₦2,705.26 (minimum ₦2,000, maximum ₦3,600). This reflects similar issues as seen with pawpaw, where sorting inadequacies can lead to economic setbacks.

At the retail stage, the losses were comparatively lower, but still notable. The mean losses for uploading, sorting, packaging, and storage ranged from 1.05 to 1.35 pieces, with corresponding mean value losses from ₦1,379.17 to ₦1,512.50. For example, the uploading phase for banana showed a mean loss of 1.32 pieces with a mean value of ₦2,584.21.

The cumulative effect of losing an average of 2.53 pieces of pawpaw during sorting alone can significantly affect the bottom line of producers and marketers, particularly given the high variance in value at this stage. Osei *et al.* (2018) suggest that the economic viability of fruit marketing heavily relies on minimizing these losses. Therefore, the observed losses, such as the ₦3,640.00 mean value loss during pawpaw sorting and similar figures across other stages, highlight the critical need for improved handling practices and better infrastructure. Addressing these issues through training, better packaging, and enhanced logistical approaches can reduce the economic impact of these losses and improve the sustainability of pawpaw and banana marketing (Opara, 2003).

CONCLUSION AND RECOMMENDATIONS

The study highlights the significance of post-harvest losses in pawpaw and banana marketing in Kano Metropolis, Nigeria. The results demonstrate that post-harvest losses are substantial and occur at various stages of the supply chain. The study also identifies the need for effective strategies to reduce post-harvest losses, including improving transportation facilities, using jute bags for packaging, spreading under shade for storage, training on new management skills, and adopting new management techniques. It is recommended that governmental and non-governmental organizations encourage female participation in pawpaw and banana enterprises to reduce the possible imbalance in the supply chain of pawpaw and banana in the study area. It is recommended that there should be an improvement in transportation facilities to reduce post-harvest losses during transportation. Wholesalers and retailers should be trained on new management skills to improve post-harvest management practices.

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Theme: Agricultural Extension for Food Security and Community Empowerment

Estimation of Water Requirements of Early and Late Season Sweet Potato (*Ipomoea batata*) in Umudike Area of Abia State, Nigeria

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ABSTRACT

This study estimated the crop water requirement and irrigation water requirement of sweet potato for agricultural practices in Umudike, Abia state. Estimation of the water requirements of early and late season sweet potato was carried out based on 10 years meteorological data at Umudike, typical of the humid tropical zone using the Penman's equation. The results obtained showed that the total seasonal crop evapotranspiration (ET_{crop}) values for early and late season sweet potato were 376.24 mm/month and 375.24 mm/month respectively. The irrigation water requirement was zero for the early planting and 80.89 mm/month for the month of November in the late season. To obtain quality and good yield of sweet potato in Umudike, supplementary irrigation is required in the month of November of late season planting.

Key words: *Evapotranspiration, irrigation, water requirement, Penman's equation, sweet potato*

INTRODUCTION

Sweet potato is a root crop, native to the tropics and requires warm days and nights for optimum growth and root development. It contains starch, protein, dietary fiber and minerals such as; Potassium, Manganese, Iron and Copper (Shih *et al.*, 2007). It equally contains pro-vitamin A (as carotenoid), flavonoid and anthocyanins found in purple sweet potato (Bovell–Benjamin, 2007). Sweet potato has great potentials in Nigeria and majorly cultivated and consumed by rural households. In Nigeria, white-fleshed cultivars predominate, but only orange-fleshed sweet potato contains beta carotene a precursor for pro-vitamin A. (Low *et al.*, 2001), indicated that replacing white-fleshed with orange-fleshed varieties could reduce the Vitamin A deficiency by 15-22% in Sub-Saharan African countries that grow sweet potato.

Climate is an important environmental factor which influences the cultivation of crop in any particular location (Agugo, 2001). Among all the climatic variables, availability of moisture throughout the growth cycle of a crop is an index of crop suitability to a particular agro-ecology.

Sweet potato yields best results when irrigated at 25% available soil moisture and there is no increase in storage yield by maintaining soil moisture >50% (Zhou *et al.*, 2023). Under typical production conditions, sweet potato requires 500 mm rainfall throughout its growth cycle to ensure that the crop is established in the moist soil (Stathers *et al.*, 2013). However, tuber yield decreases under water deficit stress (WDS) particularly when the available soil moisture decreases below 20% (Zhou *et al.*, 2023). Irrigation less than 50% of cumulative pan evaporation rate also has been reported to decrease tuber yield (Zhou *et al.*, 2023). Evapotranspiration (ET) or Crop Water Use is the process in which the plant extracts water from the soil for tissue building and cooling purposes, as well as soil evaporation (Al-Kaisi and Broner, 2012). Penman's Reference Potential Evapotranspiration equation is one of the equations that have been used to estimate Reference Potential Evapotranspiration (ET_o). It is used to derive crop water needs based on climatic data (Penman, 1948). Objectives of this study were to establish the crop water requirements of sweet potato crop

using Penman's equation and to determine the months with water deficit and suggest irrigation regime to better the yield of sweet potato in Umudike, South-eastern Nigeria.

MATERIAL AND METHODS

Location of the Study

This study was carried out at National Root Crops Research, Umudike. Umudike is located in the humid forest zone of Nigeria and lies between latitude $05^{\circ} 28'N$ and $05^{\circ} 30'N$ and $07^{\circ} 31' E$ and $07^{\circ} 33'E$ with an altitude of 122 m above sea level (Igboekwe *et al.*, 2012). The location has an annual rainfall range of 1900 to 2200 mm which is bimodal distribution with peaks in July and September.

Climatic Data Collection

Ten (10) years climatic data (2011 - 2020) were collected from a meteorological station in National Root Crops Research Institute, Umudike of Abia State and used for the computation of water requirement of sweet potato in this study. The data are presented in Table 1.

Crop Water Requirement

Crop water requirements are expressed by rate of evaporation in mm/day which is related to the evaporative demands of the air. To determine the water requirement of sweet potato throughout its growth period or gestation period of 115-120 days (Opatola *et al.*, 2018). The growth period was separated into initial, crop development, mid-season and late season stages of 25, 30, 30 and 30 days respectively using the method outlined by Akinmutimi (2015), Roja *et al.*, (2020), Ubi and Osodeke (2009) and Attoe and Odey (2012). The estimation of crop evapotranspiration (ET_{crop}) involves computation of Reference evapotranspiration (ET_o) and crop coefficient (K_c) with respect to its corresponding stage of development. The estimation of sweet potato water requirement was done in five (5) stages presented thus;

1. Reference Evapotranspiration (ET_o)

Reference crop evapotranspiration (ET_o) is defined as the rate of evaporation of an extended surface of 8 to 15 cm tall green grass cover actively growing, completely shading the ground and not short of water (Iren and Osodeke, 2006). It represents the climatic evaporation demand and predicts the effect of climate on crop.

Reference crop evapotranspiration (ET_o) was estimated using the Penman's Equation given as:

$$ET_o = c \{ W \times R_n + (1-W) \times f(U) \times (e_a - e_d) \} \quad \dots\dots\dots (1)$$

Where

($e_a - e_d$) = Vapour pressure deficit (mbar)

$F(U)$ = Wind function U (km/day)

W = Altitude and temperature dependent factors (T in $^{\circ}C$ and Alt in M)

R_n = Total net radiation in mm/day

C = Adjustment factor for the ratio of $U/(day/night)$

2. Estimation of Crop Coefficient (K_c)

Crop coefficient of different stages of sweet potato was gotten from Doorenbos and Pruitt (1977). Crop coefficients of 0.45, 0.75, 1.125 and 0.90 were for initial, crop development, mid-season and late stages of sweet potato gestation period respectively. The K_c values at each of the growth stage were converted to monthly K_c as shown in equation (2).

$$K_c/month = \frac{K_c \text{ growth stage}}{30} \times N \quad \dots\dots\dots (2)$$

Where:

K_c is crop coefficient

N = number of days growth stage lasted and each month was assumed to have 30 days.

3. Maximum Evapotranspiration (ET_m)

Maximum evapotranspiration rate of the crop, when soil water is not limited, is also called the water requirements in mm/day or mm/period was obtained as a product of ET_o and K_c/month. Seasonal ET crop values were calculated by summing the monthly values.

$$ET_m = K_c \times ET_o \quad \dots\dots\dots (3)$$

4. Effective Rainfall (ER)

The effective rainfall (ER) was calculated using the formula

$$\begin{aligned} ER &= 0.8R - 25, \text{ if } R > 75 \text{ mm/month} \\ ER &= 0.6R - 10, \text{ if } R < 75 \text{ mm/month} \end{aligned} \quad \dots\dots\dots (4)$$

Where, ER= Effective rainfall and R = Monthly rainfall (mm)

5. Irrigation Water Requirement (IR)

Irrigation water requirement (IR) was calculated as the difference between ET crop and effective rainfall (ER).

$$IR = ER - ET_{crop} \quad \dots\dots\dots (5)$$

Where:

IR = Irrigation requirement

ER = Effective rainfall

ET_{crop} = Crop evapotranspiration

Calculation of Ten Years Means Climatic Data

$$\text{Climatic data (Rainfall Sunshine)} = \frac{2011-2020 \text{ (Rainfall Sunshine)}}{10}$$

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RESULTS AND DISCUSSION

Table 1 shows the mean monthly climatic data of Umudike (2011-2020). From the table, the rainfall amount was highest in the month of September (389.4 mm) and the mean relative humidity was highest in the month of July (85.6 %) while the mean temperature was lowest in the same month of July (26.1°C). The wind speed was lowest in the month of September (78.0 Km/hr) and highest in the drier period of February (92.4 Km/hr) while the sunshine hours was highest in the month of December (6.7 hr/day) and lowest in the month of July (3.0 hr/day). These were similar to the findings of Akinmutimi, 2015.

Crop Coefficient and Reference Evapotranspiration for Early and Late Season Sweet Potato

The crop coefficient (K_C) values for different growth stages were calculated using the equation of (K_C). The values obtained were 0.38, 0.75, 1.13, and 0.9 for April, May, June, and July respectively for the early season sweet potato production and 0.38, 0.75, 1.13 and 0.9 for August, September, October, and November respectively for the late season sweet potato production (Table 2). The result was similar to that of Akinmutimi (2015), Iren and Osodeke (2006), and Agugo *et al.*, (2009) which revealed that K_C values increase from a low value at the time of crop emergence to a maximum value during the period when the crop reaches full development and declines as the crop matures. The highest K_C values were observed in the months of June and July (1.13 and 0.9) for early season and October and November (0.13 and 0.9) for the late season sweet potato production. These months coincided with the reproductive and maturity stages of growth in sweet potato which are reportedly the most active growth stages FAO (1986).

The maximum evapotranspiration for the early season planting was 126.79 mm/month in the month of June and the late season was 139.42 mm/month in October. These periods were the reproductive stage of the sweet potato which shows that the sweet potato needs more moisture in the soil to thrive well. Table 3 shows that the rainfall in the months of June (321.0 mm/month) and October (251.7 mm/month) were sufficient for the reproductive stage of the sweet potato. This is in line with the findings of Peninah *et al.*, 2022 and Huang *et al.*, 2024 that sufficient rainfall or irrigation helps in better crop yield.

Crop Evapotranspiration (ET_{crop}), Effective Rainfall and Irrigation Water Requirement of Early and Late Sweet Potato

Table 3 shows the crop evapotranspiration (ET_{crop}), Effective rainfall (ER) and irrigation water requirement (IR) for the early and late season sweet potato. From the table, the total effective rainfall for early season was 748.24 mm, while total late season was 682.1 mm. Total irrigation water requirement was zero for early season and 80.89 mm for late season. During the early season, effective rainfall was higher than the crop water need (ET_{crop}) of sweet potato throughout the growth period. At the late season, the effective rainfall was higher than the crop water need (ET_{crop}) of sweet potato throughout the growth period expect for the month of November with irrigation water requirement (IR) of 80.89mm which coincides with the late season stage. This apply that irrigation supplement will be needed during the late season stage of sweet potato production to meet its crop water requirement in Umudike. Seasonal water deficit affects good yield demands of farmers; therefore, supplementary irrigation is required for high yield (Opafola *et al.*, 2018).

Table 1: Mean Climatic Data of National Root Crops Research, Umudike from 2011-2020

Month	Rainfall (mm)	Temp _{mean} (°C)	RH _{max} (%)	RH _{min} (%)	RH _{mean} (%)	Wind Speed Km/hr	Sunshine (Hr/day)
Jan	17.4	27.8	59.0	50.4	54.7	91.9	6.1
Feb	47.2	29.0	72.3	60.2	66.3	92.4	5.6
March	105.9	28.9	78.9	69.4	74.2	90.9	5.3
April	140.2	28.5	79.3	72.0	75.7	86.9	5.5
May	283.1	27.9	81.3	75.3	78.3	84.5	5.4
June	321.0	26.7	83.1	79.2	81.2	81.0	4.0
July	316.0	26.1	87.8	83.4	85.6	80.0	3.0
Aug	264.3	26.4	86.0	80.8	83.4	81.0	3.3
Sept	389.4	26.6	85.4	80.9	83.2	78.0	3.4
Oct	251.7	27.1	84.2	78.8	81.5	85.9	4.4
Nov	71.3	26.7	81.2	73.8	77.5	86.9	5.7
Dec	10.8	27.4	67.7	57.5	62.6	102.0	6.7
Total	2218.3	329.1	946.2	861.7	904.2	1041.4	58.4

Table 2: Calculated Monthly Crop Coefficient and Maximum Evapotranspiration for Early and Late Season Sweet Potato

Months	ET _o /day (mm)	ET _o /month (mm)	K _c /month	ET _m /month (mm)
Early season sweet potato				
April	4.73	141.90	0.38	53.92
May	4.45	137.95	0.75	103.46
June	3.74	112.20	1.13	126.79
July	3.30	102.30	0.90	92.07
Late season sweet potato				
August	3.57	110.67	0.38	42.05
September	3.56	106.80	0.75	80.10
October	3.98	123.38	1.13	139.42
November	4.21	126.30	0.90	113.67

Table 3: Crop Evapotranspiration (ET_{crop}), Effective Rainfall (ER) and Irrigation Water Requirements (IR) of early and late season Sweet Potato Production in Umudike

Month	ET _m /month (ET _{crop}) (mm)	ER (mm)	ER-ET _{crop}	Total Rainfall	IR (mm)
Early season sweet potato					
April	53.92	87.16	33.24	140.20	0
May	103.46	201.48	98.02	283.10	0
June	126.79	231.80	105.01	321.00	0
July	92.07	227.80	135.73	316.00	0
Total season values	376.24	748.24	372.00	1060.30	0
Late season sweet potato					
August	42.05	186.44	144.39	264.30	0
September	80.10	286.52	206.42	389.40	0
October	139.42	176.36	36.94	251.70	0
November	113.67	32.78	-80.89	71.30	80.89
Total season values	375.24	682.10	306.86	976.70	80.89

CONCLUSION

Crop water requirements of sweet potato in Umudike, Abia state of South-eastern Nigeria can be met by effective precipitation in both early and late season of sweet potato production except in the month of November where supplementary irrigation is required. The late season planting can be adjusted from July - October in the absence of irrigation to avoid water deficit during the maturity stage of the sweet potato. The total excess rainfall in the early season (372.00 mm) and late season (306.86 mm) can be regulated through special farming techniques to reduce the negative impact of excess water in the sweet potato production of the studied area.

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Theme: Agricultural Extension for Food Security and Community Empowerment

Utilization of Biochar Fertilizer for Regenerative Agriculture among Rural Women in Umuahia Agricultural Zone of Abia State, Nigeria

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ABSTRACT

The study assessed the utilization of biochar for regenerative agriculture among rural women in Umuahia Agricultural Zone of Abia State, Nigeria. Primary data were collected using structured questionnaire to obtain data. A total of 90 women were selected using multi-staged and purposive sampling techniques while descriptive and inferential statistics were used to analyze the data collected. The result revealed that the mean age of the women was 42 years with a mean household size 4 persons. Their mean years of farming experience was 12 years and an average annual income of ₦13,700. The findings showed that there was a high level ($\bar{x} = 3.39$) of utilization of the biochar fertilizer by the women in the study area. However, the most challenging issue faced by the women in the utilization of biochar fertilizer is the cost of production ($\bar{x} = 2.93$). Using multiple regression model, the result further showed at $P < 0.05$, Participation in cooperative activities (-3.586) was significant and negatively related to the level of utilization of biochar fertilizer. The study concluded that the level of utilization of biochar fertilizer for regenerative agriculture by the women in Umuahia Agricultural zone of Abia State, Nigeria was high and therefore recommended that Government and agricultural development agencies should provide subsidies or financial support to rural women to reduce the cost of producing biochar. This will encourage its adoption by making it more affordable and accessible to women farmers.

Key words: Utilization, Biochar fertilizer, Regenerative agriculture, Rural women

INTRODUCTION

According to Dokua (2023) between January and March 2021, agriculture contributed to 22.35 % of the total Gross Domestic Product and over 70 % of Nigerians engage in the agriculture sector, mainly at a subsistence level (Tsokar, 2022). Tsokar (2022) further reported that despite the contribution to the economy, Nigeria's agricultural sector faces many challenges which impact on its productivity which include; poor land tenure system, low level of irrigation farming, climate change and land degradation. Others are low technology, high production cost and poor distribution of inputs, limited financing, high post-harvest losses and poor access to markets (Tsokar, 2022). Smallholder farmers, particularly women, encounter numerous obstacles in maintaining agricultural productivity, soil health, and environmental conservation. In addressing these unique challenges, biochar emerges as a promising soil amendment due to its distinctive physical and chemical properties.

Biochar, a type of charcoal that is produced by heating organic material in the absence of oxygen. It is scientifically defined as a solid material produced by the thermo chemical conversion of biomass in an oxygen-limited environment through a process called pyrolysis (International Biochar Initiative, 2023). Lehmann and Joseph (2015) described biochar as a carbon-rich product that results when biomass, such as wood, manure, or crop residues, is heated in a container with little or no available air. When applied as a

soil amendment, biochar can effectively improve the physical, chemical, and biological properties of soil, addressing many soil limitations.

Yaashikaa, Kumar, Varjani, and Saravanan (2020) also define the biomass as a complex solid substance comprised of biological, organic, or inorganic elements originating from living organisms. Furthermore, biomass used to produce biochar can be categorized into two primary types: woody biomass and non-woody biomass. Woody biomass, which includes tree residues and forestry residues, is characterized by low moisture content, minimal debris, reduced voidage, high density, and substantial calorific value (Zubairu, Michéli, Ocansey, Boros, Rétháti, Lehoczy, and Gulyás, 2023). In contrast, non-woody biomass, such as animal waste, industrial residues, and agricultural solid wastes, has high debris content, elevated moisture levels, increased voidage, low density, and lower calorific value (Zubairu *et al.*, 2023). Higher moisture levels in biomass significantly impede the formation of biochar and necessitate greater energy to achieve the pyrolysis temperature (Jafri, Wong, Doshi, Yoon, and Cheah, 2018). Onwuka and Nwangwu (2016) in their work on characterization of biochar produced from diverse feedstocks used as amendment on acidic Ultisols at Umudike, Abia State, found out that palm bunch and cocoa pod husk were high in potassium, *Mucuna Flagellipes* was high in phosphorus followed by pig waste or dung. They have been able to incorporate biochar to improve agricultural productivity and sustainability in different communities and villages in Abia State such as: Amaowom, Umuobia, Ogbodukwu, Lodu, Ahieke, Bende, Ndoró and Umuana Villages.

According to the National Research Development Corporation (NRDC) (2021), regenerative agriculture is a land management philosophy that sees agriculture as an interconnected web rather than a linear supply chain. It promotes farming practices that nourish people and the earth, varying by grower and region. Its holistic principles aim to restore soil and ecosystem health, address inequity, and improve the condition of land, waters, and climate for future generations (NRDC, 2021). Biochar and regenerative agriculture complement each other as natural methods to improve soil health while reducing the need for inputs like fertilizer and water. They also promote waste utilization, as biomass such as wood and agricultural waste can be used to make biochar. Additionally, producing biochar provides financial benefits by generating heat, biochar, and valuable carbon credits, all while building soil carbon levels.

However, research on biochar is still limited in the areas of soil fertility and crop productivity, particularly in Abia State. Farmers face significant challenges in disposing of agricultural residues after cultivation. The emergence of biochar technology, which converts agricultural waste into a recalcitrant, carbon-rich substance through pyrolysis, offers a potential solution. Therefore, integrating biochar into regenerative agriculture practices not only aligns with the holistic goals of restoring soil and ecosystem health but also addresses the specific issues faced by farmers in managing agricultural waste. Despite its potential, much understanding is needed on how to use biochar properly to maximize its benefits.

The study has the following specific objectives; to

- i. describe the socio-economic characteristics of the respondents
- ii. determine the level of utilization of biochar among the respondents.
- iii. identify the challenges of production and utilization of biochar.

HYPOTHESIS

H0: There is no significant relationship between the socio-economic characteristics of the women and their level of utilization of biochar fertilizer for regenerative agriculture

METHODOLOGY

The study was conducted in the Umuahia agricultural zone of Abia State, located in the South East agro-ecological zones of Nigeria. Multi-stage and purposive sampling techniques were used in the selection of the respondents (Rural Women). In the first stage, three Local Government Areas 1. Umuahia North, 2. Umuahia South, and 3. Ikwuano — were purposively selected because a training on biochar had previously been conducted in the LGAs. In the second stage, three communities were randomly chosen in each LGA. In the third stage, ten farmers were randomly selected from each of the three selected communities of the village, consequently resulting in the selection of a total of 90 farmers designated as the respondents for

this study. Data collected for the study were realized using both descriptive and inferential statistics while the null hypothesis was analyzed using Multiple regression analysis (OLS).

Population of the Study

The population of this study constituted of the rural women in the utilization of Biochar for Regenerative agriculture, in Umuahia Agricultural Zone of Abia State, Nigeria

Method of Data Analysis

Data collected for the study were realized using both descriptive and inferential statistics.

Objective i: which sought to describe the socio-economic characteristics of the respondents was realized using percentage, mean and frequency counts.

Objective ii: which sought to determine the level of utilization of biochar among the respondents was realized using a 4-point Likert type scale of Always -4-, Sometimes -3-, Seldomly -2- and Not utilized -1-. A midpoint was obtained thus; $4+3+2+1 = 10 \div 4 = 2.5$. The mean score greater than 2.5 implied a positive outcome and a mean score less than 2.5 implied a negative outcome.

Objective iii: Which sought to identify the challenges of production and utilization of biochar was realized using a 4-point Likert type scale of, strongly agree -4-, agree -3-, disagree-2- and strongly disagree -1-. A midpoint was obtained thus; $4+3+2+1 = 10 \div 4 = 2.5$. The mean score greater than 2.5 implied a positive outcome and a mean score less than 2.5 implied a negative outcome.

Test of Hypothesis

The hypothesis which stated that, there was no significant relationship between the socio-economic characteristics of the respondents and the level of utilization of biochar fertilizer for regenerative agriculture was tested using Multiple regression analysis. (OLS)

The implicit model is specified as:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + \dots + b_9X_9 + u \dots \dots \dots (1)$$

Where,

Y= Level of utilization of Biochar fertilizer (mean scores)

X₁= Age (Number of years)

X₂= Education status (years spend in school)

X₃= Martial Status (married =1, otherwise = 0)

X₄= Household size (Number of persons living and eating from the same pot)

X₅= Years of experience (measured in years)

X₆= Income (measured in naria)

X₇= Religion

X₈= Membership participation in cooperative organization (Always=3, Sometimes=2, and Never=3)

a= constant

b₁-b₃= Regression coefficient

u= error term

RESULTS AND DISCUSSION

Socio-economic characteristics of respondents

Table 1 shows the socio-economic characteristics of respondents. The mean age of 42 years, the result indicates a concentration of biochar use among experienced farmers. It is crucial to communicate the benefits of biochar to all age groups and encourage greater participation from younger women for a sustainable agricultural future. Majority of farmers (44.44%) were married, had a household size between 1-3 persons (40.00%) and had a mean year of farming experience 11.6 years. Ukoha and Nzeakor (2020) opined that age affects the rate of farmer's utilization of innovation, which in turn affects household productivity and livelihood improvement strategies.

Large household size means more mouth to feed thereby putting pressure on the family income (Kanu, 2020). According to Ogunsola, Oseni and Bankole (2020) the farming experience of cocoa farmers is expected to have a positive impact on their production level.

The result further showed that the majority of the women had an annual income between ₦17,000 and above, 44.44% always participate in cooperative organizations. This is agreement with finding of Kanu (2020) that majority of the cocoa farmers (84.44%) do not belong to any cooperative society. The women were majorly Pentecostals (55.56%) and a good percentage ((47.78%) of them were farmers.

Table 1: Distribution of Respondents according to socio-economic characteristics n = 90

Variables	Frequency	Percentage (%)	Mean
Age (yrs.)			
20-29	14	15.6	41.6 years
30-39	22	24.4	
40-49	31	34.4	
50 and above	23	25.6	
Marital status			
Single	18	20.0	
Married	40	44.4	
Divorced	10	11.1	
Widow/Widower	22	24.4	
Household size			
1-3	36	40.0	3.8
4-5	35	38.9	
6 and above	19	21.1	
Years of experience			
1-10	59	65.6	11.6 years
11-20	14	15.6	
21-30	10	11.1	
31 and above	7	7.8	
Monthly income			
₦5,000-₦10,000	25	27.8	N13,700
₦11,000-₦16,000	17	18.9	
₦17,000 and above	48	53.3	
Participation in cooperative Organization			
Always	40	44.4	
Sometimes	31	34.4	
Never	19	21.1	
Religion			
Pentecostal	85	94.4	
Islam	5	5.6	
Major source Income			
Trading/business	42	46.7	
Farming	43	47.8	
Support from children/husband	5	5.6	

Source: Field Survey, 2024

Level of Utilization of Biochar among the Respondents.

The findings showed that the majority of the women had utilized biochar, as all responses scored above the mid-point ($\bar{x} = 2.5$), indicating that they knew how to apply it on their farms. Similarly, the grand mean of ($\bar{x} = 3.39$) signifies that the level of utilization of biochar is high, very much above the benchmark mean. This finding collaborates the findings of Nwokocha (2022) that farmers can accept and utilize innovations when they are fully aware of the relevance of the innovation

Table 2: Determine the Level of Utilization of Biochar among the Respondents.

Level of utilization of biochar	Always	Sometimes	Seldom	Not utilized	Total	Mean
Do you apply biochar in your farm?	60(240)	14(42)	6(12)	10(10)	304	3.38
How frequent do you apply it?	53(212)	17(51)	11(22)	9(9)	294	3.27
Do you like using biochar?	62(248)	16(48)	6(12)	6(6)	314	3.48
Do you produce biochar?	57(228)	8(24)	5(10)	20(20)	292	3.24
Will you like to introduce it to others?	64(256)	11(33)	7(14)	8(8)	311	3.46
Will you like to continue using biochar?	62(248)	16(48)	5(10)	7(7)	313	3.48
Grand Mean						3.39

Source: Field Survey, 2024

Challenges of production and utilization of biochar

The study reported that majority of the women identified that the major and only challenge in biochar is the cost of production ($\bar{x} = 2.93$), indicating that the cost of materials needed for producing biochar may be expensive in their local environment. However, the grand mean of 2.17 shows that its below the benchmark mean, implying that the challenges are not severe generally.

Table 3: Distribution of Respondents according to the challenges of production and utilization of biochar

challenges of production and utilization of biochar.	Strongly agree	Agree	Disagree	Strongly disagree	Total	Mean
Very costly to produce	39(156)	18(54)	21(42)	12(12)	264	2.93
Very costly to buy	8(32)	23(69)	41(82)	18(18)	201	2.23
Very bulky to carry to the farm	18(72)	6(18)	46(92)	20(20)	202	2.25
Not enough raw materials to produce it	11(44)	24(72)	30(60)	25(25)	201	2.23
More expensive that the inorganic fertilizer	10(40)	12(36)	20(40)	48(48)	164	1.82
Not enough knowledge on how to produce it	9(36)	22(66)	10(20)	49(49)	171	1.90
Not enough knowledge on how to apply it	12(48)	12(36)	16(32)	50(50)	166	1.84
Grand mean						2.17

Source: Field Survey, 2024

Hypothesis Testing

The hypothesis which states that, there is no significant relationship between the socio-economic characteristics and the level of utilization of biochar fertilizer for regenerative agriculture was tested using Multiple regression analysis. (OLS).

Ordinary least square multiple regression results of the the socio-economic characteristics and the level of utilization of biochar fertilizer for regenerative agriculture.

Variable	Linear(+)	Exponential	Double-log	Semi-log
Constant	3.535 (6.556)***	1.272 (5.716)***	1.091 (9.355)***	2.559 (1.032)
Age (X_1)	-0.017 (-0.143)	-0.013 (-0.260)	-0.003 (-0.027)	0.011 (0.023)
Marital Status (X_2)	0.002 (0.019)	-0.009 (-0.181)	0.034 (0.773)	-0.315 (-1.134)
Household size (X_3)	-0.113 (-0.816)	0.034 (-0.600)	-0.084 (0.429)	0.011 (0.044)
Farming experience (X_4)	0.019 (1.800)	0.007 (1.542)	0.063 (0.998)	0.483 (1.519)

Annual income (X ₅)	0.034 (0.304)	0.021 (0.458)	0.006 (0.066)	0.423 (1.796)
Participation in cooperative (X ₆)	-0.441 (-3.586)***	-0.183 (-3.602)***	-0.310 (-3.400)	-0.222 (-0.369)
Religion (X ₉)	0.232 (1.104)	0.065 (0.685)	0.147 (0.295)	-0.376 (-0.554)
Major source of income (X ₇)	0.094 (0.570)	0.062 (0.906)	0.104 (0.339)	-1.363 (-1.590)
R²	0.223	0.207	0.185	0.653
Adj. R²	0.146	0.129	0.105	0.494
F-statistic	2.900	2.644	2.304	3.947

Source: Field survey, 2024

H0 reject at 5% level

Key: ns = not significant; ** = 5% significant; * = 1% significant; () = t-ratios; + = lead equation**

The four functional forms of the multiple regression model were tried and the Linear model was selected as the lead equation due to the highest number of significant variables and a significant F-value of 2.900 at $P < 0.05$ which shows the overall significance of the regression line and an R^2 value of 0.223 which implies that 22.3% of the total variation in the dependent variable was accounted for by the explanatory variables. From the result, at $P < 0.05$, Participation in cooperative (-3.586) was significant and negatively related to the level of utilization of biochar fertilizer for regenerative agriculture. This result implies that an increase in women participation in cooperative led to a decrease in their utilization of biochar. This result might imply that participation in cooperatives, which often promotes shared knowledge and resources, may focus on alternative farming inputs or practices, potentially limiting the adoption of innovative techniques like biochar fertilizer. It could also indicate that cooperatives in the study area have not sufficiently embraced or promoted biochar fertilizer, resulting in its underutilization among members.

CONCLUSION AND RECOMMENDATIONS

The study concludes that the level of utilization of biochar for regenerative agriculture among rural women in Umuahia Agricultural Zone of Abia State, Nigeria, though cost was identified as a major barrier to widespread production and use.

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

1. **Subsidizing the Cost of Biochar Production:** Government and agricultural development agencies should provide subsidies or financial support to rural women to reduce the cost of producing biochar. This will encourage its adoption by making it more affordable and accessible to women farmers.
2. **Strengthening Extension Services for Biochar Training:** Extension services should intensify efforts to not only raise awareness but also offer practical, hands-on training on biochar production and utilization. This will help rural women overcome practical challenges and increase its use for regenerative agriculture.
3. **Promoting Biochar within Cooperative Groups:** Cooperatives should incorporate biochar promotion and training into their activities to encourage its adoption among members. This will ensure that biochar receives adequate attention and is seen as a valuable practice within these groups.

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Theme: Agricultural Extension for Food Security and Community Empowerment

Determinants and Patterns of Health-Seeking Behaviour among Rural Households in Bende Local Government Area, Abia State, Nigeria

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ABSTRACT

This study examined the determinants of health-seeking behaviour among rural households in Bende Local Government Area, Abia State. Data were collected from 120 respondents through field surveys and analyzed using descriptive statistics and regression analysis. Results revealed that a greater proportion of the respondents were females (53.3%), married (63.3%), and within the active age bracket of 30–39 years, with a mean age of 40 years. Most households had 4–6 members, and the majority had attained secondary (48.3%) or tertiary (40.8%) education. The respondents' mean monthly income was ₦52,550, with artisan work (33.3%) and trading (26.7%) as major occupations. Health centres, hospitals, and radio were their primary sources of health information. Malaria/typhoid and cough were the most common ailments reported. In addressing health challenges, praying for God's healing and visiting hospitals ranked highest. Regression results showed that marital status, age, education, and income were significantly related to health-seeking behaviour ($p < 0.05$), with the model explaining 79.8% of the variation ($R^2 = 0.798$). The study concludes that socio-economic factors strongly influence rural health-seeking behaviour. It recommends strengthening health education programmes, enhancing household income through rural enterprise development, and improving access to quality healthcare services to promote timely and appropriate health-seeking behaviour among rural households.

Keywords: Health-seeking behaviour, Rural households, Abia State

INTRODUCTION

Health is among the basic capabilities that give value to life (Patience & Helen, 2020). In Sub-Saharan Africa, the situation is more alarming for the rural poor, as health delivery systems often ignore their needs, generating fewer benefits and imposing regressive cost burdens on households (Patience & Helen, 2020). In all developing countries, including Nigeria, disease burdens and health outcomes are greatly influenced by factors such as healthcare costs, illiteracy, poor healthcare funding, inadequate water and sanitation systems, cultural orientations, and knowledge of disease and wellbeing (Sarfo, 2015). Health-seeking behaviour studies often focus on specific diseases such as malaria and infectious diseases like tuberculosis and HIV/AIDS (Ojua, Ishor & Ndom, 2013). Consequently, there is limited knowledge regarding general health-seeking behaviour and the challenges rural households face in accessing quality health services. The decision to engage particular medical channels is influenced by various socio-economic variables, including sex, age, social status of women, type of illness, access to services, and perceived quality of service (Ogunlesi & Olanrewaju, 2010). Although the introduction of the National Health Insurance Scheme was expected to enhance healthcare utilization due to its affordability (Sarfo, 2015), the reverse is the case for many rural households. Many still rely on unstandardized methods such as herbal mixtures without prescribed doses, patronize patent drug sellers, and only consult qualified medical practitioners

when illnesses become critical. This aligns with findings by Eze et al. (2017), who observed continued reliance on informal healthcare in many rural Nigerian communities.

Ogunlesi and Olanrewaju (2010) further noted that choice and patronage of any healthcare system depend on cultural beliefs, income levels, educational status, age, gender, accessibility, quality of services, availability, and health workers' attitudes. However, there is limited empirical literature on the health-seeking behaviour of rural households in Bende LGA, Abia State.

The main objective of this study was to assess the health-seeking behaviour of rural households in Bende LGA, Abia State. Specifically, the study sought to:

- i. described the socio-economic characteristics of the rural households in Bende LGA, Abia State;
- ii. identify the sources of health information among the rural households.
- iii. ascertain the common ailment suffered by the rural households; and
- iv. examine the health seeking behaviour of rural households.

The study adopted one hypothesis. The hypothesis was stated in the null form.

H₀: There is no significant relationship between selected socio-economic characteristics of rural households and their health-seeking behaviour

METHODOLOGY

The study was conducted in Bende Local Government Area (LGA) of Abia State, located at longitude 7°30' East and latitude 5°30' North. Bende LGA comprises thirteen communities, including Alayi, Bende, Ezukwu, Igbera, Item, Itumbuzo, Nkpa, Ntalakwu, Ozuitem, Ugwueke, Umu-imenyi, Umuhu-Ezechi, and Uzuakoli.

The sample population of the study consisted of 120 rural household heads, purposively selected from seven communities (Ntalakwu, Ozuitem, Ugwueke, Umu-imenyi, Umuhu-Ezechi, and Uzuakoli) due to their proximity and familiarity to the researcher. With assistance from community leaders and extension staff, twenty household heads were randomly selected from each community, totaling 120 respondents.

Primary data were collected using well-structured questionnaires covering all objectives of the study. Data on socio-economic characteristics, sources of health information, common ailments, and health-seeking behaviour were obtained and analyzed using descriptive statistics (frequency, percentage, and mean) and inferential statistics.

Specifically:

Objective 1 (socio-economic characteristics) was analyzed with descriptive statistics.

Objectives 2, 3, and 4 (sources of health information, common ailments, and health-seeking behaviour) were analyzed using a Likert scale instrument. Objective 2 and 3 were analyzed using a three-point (3) Likert scale while objective four was analyzed using four (4) point likert scale instrument.

The hypothesis was tested using multiple regression analysis at a 0.05 significance level, with health-seeking behaviour as the dependent variable and socio-economic characteristics as independent variables.

The implicit form of the model is specified as follows:

$$Y = F(X_1 + X_2 + X_3 + X_4 + X_5 + X_6 + X_7 + X_n \dots E) \dots \dots \dots (1)$$

Where

Y = mean score of health seeking behaviour

X = socioeconomic characteristics

X₁ = gender (male =1 and female = 0)

X₂ = age (years)

X₃ = education level (years of schooling)

X₄ = family monthly income (Naira)

X₅ = distance to health care providers (km)

X₇ = house hold size (number of persons)

N = Error term.

RESULTS AND DISCUSSIONS

Table 1. Socioeconomic Characteristics of the Respondents

n = 120

Variable	Category	Frequency	Percentage	Mean
Gender	Female	64	53.3	5.1
	Male	56	46.7	
Household Size	1–3 persons	22	18.3	
	4–6 persons	73	60.8	
	7–9 persons	24	20.0	
	10 and above	1	0.8	
Primary Occupation	Farming	26	21.7	
	Artisan	40	33.3	
	Trading	32	26.7	
	Civil servant	22	18.3	

Source: Field survey, 2023

Table.1 shows that a greater percentage of the respondents (53.3%) were female, while 46.7% were male. This result implies that respondents were mostly female, aligning with the assertion of Oyekale (2017) that women are often at the forefront of seeking healthcare for their households. Traditionally, the healthcare of rural households is primarily sought by mothers, suggesting that women play a significant role in family health decisions (Uche, 2017)

It was also deduced from the table shows 60.8% of respondents had household sizes of 4–6 persons, 20.0% had 7–9 persons, while 18.3% had 1–3 persons, with a mean household size of approximately 5 persons. This indicates relatively large household sizes, which may lead to increased health needs and expenditures (Okafor et al., 2020). Conversely, smaller household sizes often facilitate better per capita health investment (Eze et al., 2017)

The table also shows that 33.3% were artisans, 26.7% traders, 21.7% farmers, and 18.3% civil servants. Active engagement in livelihood activities provides income to address health needs. However, farmers in rural areas have been reported to rely more on traditional medicine due to distance from healthcare centres (Adebayo et al., 2015).

The distribution of the respondents according to marital status in the study area is presented in figure 1

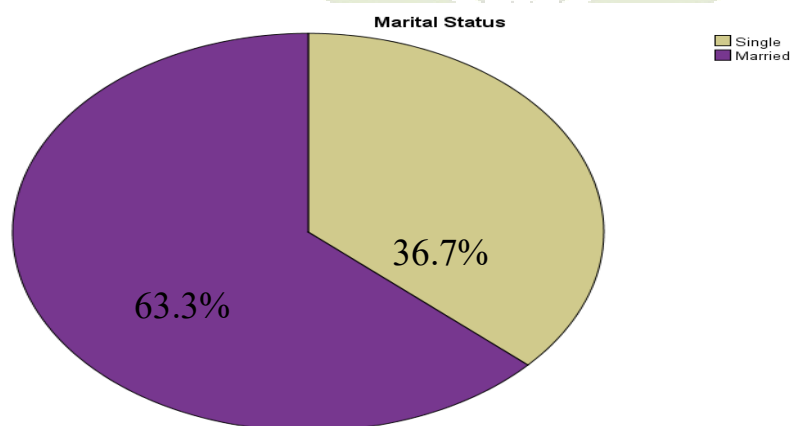


Fig .1: Pie chart representation of respondents according to their marital status

Figure 1. shows that the majority of respondents (63.3%) were married, while 36.7% were single. Married individuals are more likely to have dependents, necessitating frequent health-seeking actions for family members. This finding aligns with Anochie and Eke (2019), who found that marital status significantly influences healthcare utilization among rural dwellers.

The distribution of the respondents according to age in the study area is presented in figure 2.

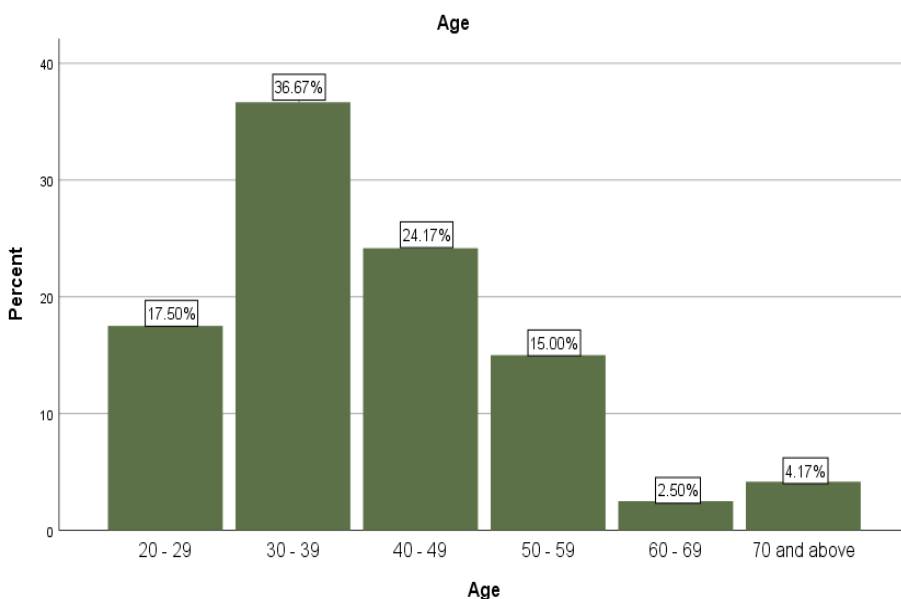


Fig 2: Bar chart representation of respondents' age

Figure 2 Results indicate that 36.7% of respondents were within 30–39 years, 24.2% within 40–49 years, 17.5% within 20–29 years, and 15.0% within 50–59 years, with a mean age of approximately 40 years. This suggests that respondents were predominantly within their active, energetic, and reproductive ages. According to Uche (2017), age plays a critical role in health-seeking behaviour, as younger and middle-aged individuals are more proactive in seeking health services, while older individuals tend to rely more on traditional remedies (Adebayo et al., 2015).

The distribution of the respondents according to the educational qualification in the study area is presented in figure 3.

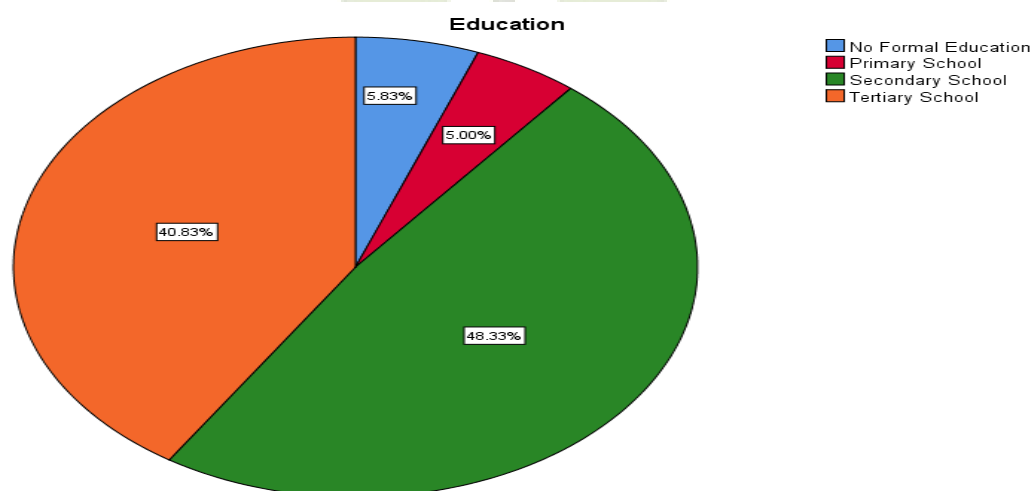


Fig 3: Pie chart representation of respondents' educational qualification

Figure 3 shows that 48.3% of respondents completed secondary school, 40.8% attended tertiary institutions, 5.8% had only primary education, and 5.0% had no formal education. The mean years of schooling was 13.5 years, implying high literacy levels. Egbunu and Yunusa (2022) stated that education promotes positive health behaviour, improves knowledge of preventive measures, and enhances access to health

information. Conversely, low literacy has been linked to reliance on traditional or informal healthcare services (Onah et al., 2009)

The distribution of the respondents according to the monthly income in the study area is presented in figure 4.



Fig 4: Bar chart representation of respondents' monthly income

Figure 4. shows that 42.5% of respondents earned ₦32,000–₦51,999 monthly, while 29.2% earned ₦52,000–₦71,999, with a mean income of ₦52,550. This income level suggests the ability to seek formal healthcare services. According to Egbunu and Yunusa (2022), poverty remains a barrier to accessing specialist healthcare, while higher income enhances utilization of modern healthcare services (World Bank, 2018)

Table 2: Sources of health information among respondents in the study area

Sources of health information	Always	Sometimes	Never	Mean	Std. Dev.
Health centers	237 (65.8)	58 (24.2)	12 (10.0)	2.56	0.671
Hospitals	228 (63.3)	68 (28.3)	10 (8.3)	2.55	0.646
Radio	213 (61.7)	46 (19.2)	23 (19.2)	2.43	0.796
Religious organization	180 (50.0)	90 (37.5)	15 (12.5)	2.37	0.699
Families/friends	144 (40.0)	116 (48.3)	14 (11.7)	2.28	0.663
Internet	189 (52.5)	48 (20.0)	33 (27.5)	2.25	0.862
Television	180 (50.0)	58 (24.2)	31 (25.8)	2.24	0.840
Books	159 (44.2)	68 (28.3)	33 (27.5)	2.17	0.833
Social organizations	171 (47.5)	44 (18.3)	41 (34.2)	2.13	0.898
Sharing personal experiences	120 (33.3)	106 (44.2)	27 (22.5)	2.11	0.742
Newspaper	144 (40.0)	44 (18.3)	50 (41.7)	1.98	0.907
Neighbours	75 (20.8)	118 (49.2)	36 (30.0)	1.91	0.710
Traditional houses	57 (15.8)	68 (28.3)	67 (55.8)	1.60	0.749
Grand mean				2.20	

Source: Field survey, 2023.

Table 2. reveals that health centres (mean=2.56), hospitals (mean=2.55), and radio (mean=2.43) were the foremost sources of health information. Religious organizations, families/friends, and the internet also played significant roles. This supports findings by Uche (2017) and Egbunu and Yunusa (2022) that health centres remain trusted information sources, while radio and religious organizations provide supplementary health knowledge. Conversely, Okereke et al. (2017) reported that in areas with poor media reach, neighbours and traditional houses remain dominant health information sources. The implication of this finding showed that the health seeking behaviour of rural households is on the positive side. This is represented with a grand Mean of =2.20.

Table 3: Distribution of respondents based on common ailment suffered

Common ailment suffered	Frequently	Occasionally	Never	Mean	Std. Dev.
Malaria/typhoid	297 (82.5)	18 (7.5)	12 (10.0)	2.72	0.635
Cough	210 (58.3)	62 (25.8)	19 (15.8)	2.43	0.752
Joint pain/arthritis	123 (34.2)	74 (30.8)	42 (35.0)	1.99	0.835
Sore throat	120 (33.3)	70 (29.2)	45 (37.5)	1.96	0.844
High blood pressure	117 (32.5)	72 (30.0)	45 (37.5)	1.95	0.839
Impaired Vision	90 (25.0)	64 (26.7)	58 (48.3)	1.77	0.827
Ulcer	66 (18.3)	76 (31.7)	60 (50.0)	1.68	0.767
Toothache	69 (19.2)	68 (28.3)	63 (52.5)	1.67	0.781
Diabetes	51 (14.2)	68 (28.3)	69 (57.5)	1.57	0.730
Ear pain	33 (9.2)	62 (25.8)	78 (65.0)	1.44	0.658
Piles	24 (6.7)	48 (20.0)	88 (73.3)	1.33	0.599
Grand mean				1.87	

Source: Field survey, 2023.

Table 3 shows that malaria/typhoid (mean=2.72) and cough (mean=2.43) were the foremost ailments suffered. Poor environmental sanitation favours the spread of malaria vectors, as supported by Nmeragini, Nzeakor, and Ekweanya (2019). Other ailments included joint pain/arthritis, sore throat, and high blood pressure. The relatively low prevalence of some ailments (grand mean=1.87) indicates a generally healthy population, although Eze et al. (2017) argued that self-treatment and underreporting could mask actual prevalence rates in rural studies.

Table 4: Distribution of respondents according to their behavior towards health challenges in the study area.

Behaviour towards health challenges	Always	Sometimes	Rarely	Never	Mean	Std. Dev.
Praying for God's healing	312 (65.0)	105 (29.2)	10 (4.20)	2 (1.7)	3.57	0.657
Visit the hospital	260 (54.2)	99 (27.5)	38 (15.8)	3 (2.5)	3.33	0.833
Visit patent chemist	268 (55.8)	72 (20.0)	32 (13.3)	13 (10.8)	3.21	1.044
Visit to primary health care center	240 (50.0)	108 (30.0)	22 (9.2)	13 (10.8)	3.19	0.998
Visit Pharmacy	252 (52.5)	54 (15.0)	52 (21.7)	13 (10.8)	3.09	1.085
Self-prepared herbal mixtures	196 (40.8)	72 (20.0)	36 (15.0)	29 (24.2)	2.77	1.219
Self-reliance and home remedies	144 (30.0)	117 (32.5)	44 (18.3)	23 (19.2)	2.73	1.090
Visit to traditional healers	64 (13.3)	87 (24.2)	56 (23.3)	47 (39.2)	2.12	1.078
Grand mean					3.00	

Source: Field survey, 2023

Table 4 shows that praying for God's healing (mean=3.57) and visiting hospitals (mean=3.33) were the foremost health behaviours. The reliance on prayer aligns with cultural and religious norms of rural Nigeria, as noted by Egbunu and Yunusa (2022), while hospital visits reflect increasing health awareness due to education. Other common behaviours included visiting patent chemists, primary healthcare centres, and pharmacies, with traditional healers ranking lowest (mean=2.12). This contrasts with findings by Afolabi et al. (2013), who reported higher patronage of traditional healers in southwestern Nigeria, suggesting regional differences. The result shows that respondents have positive behaviour toward seeking for solution to better their health and this is represented with a grand (mean of =3.00).

Hypothesis Testing

Table 5: OLS Regression analysis of the relationship between selected socio-economic characteristics and health seeking behaviour

Variables	Linear	Exponential	Semi-log	+Cob Douglas
Constant	2.944 (7.645) ***	0.856 (8.142) ***	2.540 (3.865) ***	0.912 (3.282) ***
Sex	0.043 (1.150)	0.007 (0.264)	0.103 (1.567)	0.042 (1.492)
Marital status	0.055 (1.779) *	0.019 (1.639)	0.071 (1.934) *	0.179 (2.160) **
Age	0.706 (1.310)	0.511 (2.443) **	0.743 (2.551) **	0.993 (2.644) **
Household size	0.032 (1.181)	0.014 (1.155)	0.305 (1.319)	0.127 (1.281)
Education	.015 (1.699) *	0.006 (1.728) *	0.270 (1.947) *	0.120 (2.013) **
Income	3.794E-8 (2.420) **	1.249E-8 (2.356) **	0.037 (2.236) **	0.019 (2.137) **
Distance	0.011 (0.499)	0.004 (0.399)	0.078 (1.251)	0.030 (1.120)
R-Square	0.583	0.569	0.794	0.798
Adjusted R-Square	0.454	0.437	0.652	0.657
F-ratio	6.430 ***	6.298 ***	7.849 ***	7.926 ***

Source: Field survey, 2023.

Table 5. shows that marital status, age, education, and income were significantly related to health-seeking behaviour ($p < 0.05$), with an R^2 of 0.798, indicating that 79.8% of the variation was explained by these variables. This supports Egbunu and Yunusa (2022), who found that education and income positively influence health-seeking behaviour. The hypothesis stating no significant relationship was therefore rejected.

CONCLUSION

The study concludes that in addressing health challenges in the study area, praying for God's healing and visiting hospitals were the foremost behaviours, highlighting the strong influence of religious beliefs alongside formal healthcare utilization. Overall, the study concludes that socio-economic factors remain critical determinants of health-seeking behaviour among rural households in Bende LGA. Although formal healthcare is utilized. Traditional practices and religious beliefs still play significant roles in health decisions.

RECOMMENDATIONS

Based on the findings, the following recommendations are made:

1. Enhance health education and awareness by leveraging on religious and community structures. Since religious organizations significantly influence health decisions, they should be engaged as platforms for health promotion campaigns to effectively reach rural households with health information and behavioral change messages.
2. Strengthen economic empowerment initiatives Government and development partners should implement income-generating and poverty reduction programs to improve household income, enabling them to afford timely and quality healthcare services.
3. Improve access to healthcare facilities, Establishment and equipping of more primary healthcare centers closer to rural communities should be prioritized to reduce distance barriers and encourage frequent utilization.

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Effect of Climate Change on Cassava Production in Ikwuano Local Government Area of Abia State, Nigeria

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ABSTRACT

This study investigated the effect of climate change on cassava production in Ikwuano Local Government Area (LGA) of Abia State, Nigeria. Specifically, it examined observable variations in weather parameters, assessed the effect on cassava production, determined adaptation strategies employed by farmers and identified constraints to adaptation. A multistage sampling technique was used to select 120 cassava farmers. Data were collected via structured questionnaires and analyzed using descriptive statistics and multiple regression analysis. Results showed significant observable variations in rainfall patterns, stormy weather, and temperature with a grand mean of 2.50, indicating farmers' awareness of climate variability. Climate change was perceived to increase erosion ($\bar{X}=3.20$), reduce cultivable land ($\bar{X}=3.11$) and raise pest and disease incidence (mean=3.06). Adaptation strategies included planting deeper, using drought-resistant varieties, and early planting, with a grand mean of 2.83. Constraints identified included high cost and inaccessibility of improved varieties ($\bar{X}=3.92$) and limited access to meteorological data (mean=3.72). Regression results showed that use of organic manure, cover crops, early maturing crops, and irrigation had positive and significant effects on cassava yield at 5% significance level. The study recommends improving farmers' access to improved varieties, meteorological information, and extension services to enhance adaptation capacity and sustain cassava production amidst climate change challenges.

Keywords: Climate change, Cassava production, Adaptation strategies, Ikwuano L.G.A

INTRODUCTION

Climate change remains a major global challenge with dire implications for agricultural production. In Nigeria, studies such as Nwafor (2007) and Nnaji et al. (2019) have documented significant shifts in temperature and rainfall patterns, leading to declining agricultural productivity and food insecurity. Cassava (*Manihot esculenta*) is a staple crop critical to food security and rural livelihoods in Nigeria, particularly in Abia State where it serves as a major income source and food item (Okoye *et al.*, 2016).

According to the Nigerian Meteorological Agency (NIMET, 2021), Southeastern Nigeria has witnessed increasing temperature trends and erratic rainfall over the past two decades, affecting planting schedules, crop growth, and yield. Nwaiwu *et al.*, (2021) observed that climate variability negatively influences cassava productivity through drought, flooding, and increased pest incidence. Furthermore, Ogunniyi *et al.*, (2022) reported that cassava farmers in Nigeria are vulnerable to climate risks due to limited adaptation capacity.

Understanding the specific effects of climate change on cassava production in Ikwuano is crucial for designing localized adaptation strategies. Therefore, this study assesses the effect of climate change on cassava production in Ikwuano LGA, Abia State, Nigeria. The specific objectives were to:

- i. ascertain the observable variations in weather parameters in the study area;

- ii. assess the effect of climate change on cassava production in the study area;
- iii. determine the adaptation strategies employed by the farmers to mitigate the adverse effects of climate change on cassava production and
- iv. ascertain the constraints to the climate change adaptation strategies among cassava farmers in the study area.

METHODOLOGY

The study was conducted in Ikwuano LGA of Abia State, located between Longitudes 04°45' and 06°17' N and Latitudes 07°00' and 08°10' E. The area lies within the rainforest belt, with an annual temperature range of 20°C–36°C and bimodal rainfall pattern conducive for cassava cultivation.

A multistage sampling technique was adopted. First, two clans (Oboro and Ibere) were purposively selected based on accessibility

and the fact that they cultivate cassava. Secondly, four autonomous communities were randomly selected from each clan. Finally, fifteen cassava farmers were randomly selected from each community, yielding a sample size of 120 respondents.

Data were collected using structured questionnaires covering, observable variation in weather changes, effect of climate change on cassava production, adaptation strategies, and constraints. Objective 1 which examines the observable variation in weather changes was achieved using 4-point Likert scale, Objective 2 which assess the perceived effects of climate change on cassava production was achieved with a 4-point Likert scale, where a mean score above 2.5 indicates a positive response. Objective 3 identify farmers' adaptation strategies to climate change effects. It was achieved with 4-point Likert ratings, while Objective 4 which identify the constraints to these adaptation strategies was also achieved with a 4-point Likert scale. Descriptive statistics (mean, frequencies) and inferential statistics (multiple regression analysis) were used for data analyses. The regression model estimated the relationship between adaptation strategies and cassava yield:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n + e$$

where Y = cassava yield; $X_1 \dots X_n$ = adaptation strategies; β_0 = intercept; $\beta_1 \dots \beta_n$ = coefficients; e = error term.

RESULTS AND DISCUSSION

This section presents and discusses the major findings of the study based on the research objectives. The results are organized around farmers' perception of climate change indicators, the effects of climate variability on cassava production, adaptation strategies employed, constraints to adaptation, and the regression estimates linking adaptation strategies to cassava yield.

Climate Change Indices

Table 1: Distribution of respondents based on their response on the observable variations in weather parameters in study area

Variables	Strongly agree	Agree	Disagree	Strongly disagree	Mean	Std. Dev.
Delayed onset of rains/ early cessation	108(24.5)	234(70.9)	6 (2.7)	2 (1.8)	3.18	0.561
Stormy weather	84(19.1)	255(77.3)	8 (3.6)	-	3.15	0.453
There is high rainfall	24 (5.5)	306(92.7)	4 (1.8)	-	3.04	0.268
There is high temperature	4 (0.9)	270(81.8)	36 (16.4)	1 (0.9)	2.83	0.425
Longer rainy season	4 (0.9)	264(80.0)	42 (19.1)	-	2.82	0.41
Excessive flooding of farm land	4 (0.9)	228(69.1)	66 (30.0)	-	2.71	0.476
Strong wind	8 (1.8)	36 (10.9)	188(85.5)	2(1.18)	2.13	0.431
There is low temperature	-	45 (13.6)	174(79.1)	8 (7.3)	2.06	0.455
There is low rainfall	-	18 (5.5)	208(91.8)	3 (2.7)	2.03	0.286
Drying soil surface	-	24 (7.3)	192(87.3)	6 (5.5)	2.02	0.358

Formation of hardpan in soil surface	-	9 (2.7)	208(94.5)	3 (2.7)	2.00	0.235
Intensive sunshine	-	21 (6.4)	186(84.5)	10 (9.1)	1.97	0.394
Grand mean ($\bar{x}$)					2.50	

Source: Field survey, 2023.

From the Table 1, farmers observed delayed rainfall onset (mean=3.18), stormy weather (mean=3.15), high rainfall (mean=3.04), and increased temperature (mean=2.83). The grand mean of 2.50 indicates awareness of climate variability. Similar observations were reported by Nwaiwu et al. (2021) in Imo State, while Nnaji *et al.*, (2019) noted that farmers perceived changes in rainfall pattern as the most significant climate indicator. However, Ogunniyi *et al.*, (2022) found that farmers in Southwestern Nigeria did not perceive intensive sunshine and soil hardpan formation as major issues, aligning with the low mean scores (1.97–2.03) in this study.

Perceived effect of Climate Change on Cassava Production

Table 2: Mean distribution of perceived effect of climate change on cassava production in the study area.

Effect of climate change	Strongly agree	Agree	Disagree	Strongly disagree	Mean	Std. Dev.
High rate of weed growth	116(26.4)	222(67.3)	14(6.4)	-	3.20	0.538
Increase incidence of disease	60(13.6)	279(84.5)	4(1.8)	-	3.12	0.377
Increased rate of erosion leading to reduction in cultivable land	84(19.1)	240(72.7)	18(8.2)	-	3.11	0.513
Increase pestilence of pest	60(13.6)	261(79.1)	16 (7.3)	-	3.06	0.455
Washing away of soil surfaces						
fertilizer applied	16(3.6)	285(86.4)	22 (10.0)	-	2.94	0.365
Change in the storage quality of arable crop	-	180(54.5)	100(45.5)	-	2.55	0.5
Damage/breaking of plants, due to windstorm	12(2.7)	150(45.5)	114(51.8)	-	2.51	0.554
Post-harvest losses	2(1.8)	147(44.5)	110(50.0)	2(1.8)	2.50	0.602
Losses of roots and tuber under storage	-	123(37.3)	138(62.7)	-	2.37	0.486
Losses of roots and tuber under storage	-	105(31.8)	150(68.2)	-	2.32	0.468
Poor crop yield	4(0.9)	66(20.0)	168(76.4)	3 (2.7)	2.19	0.479
Grand mean					2.72	

Source: Field survey, 2023.

The result from Table 2. Shows that Farmers perceived increased weed growth ($\bar{X}$ =3.20), higher disease incidence ($\bar{X}$ =3.12), erosion reducing cultivable land ($\bar{X}$ =3.11), and pest outbreaks (mean=3.06) as major effects of climate change. Poor crop yield had a lower mean of ($\bar{X}$ =2.19). These findings support Diallo *et al.*, (2020), who noted that climate change exacerbates pest and disease outbreaks, affecting cassava yields in West Africa. Conversely, Nnaji *et al.* (2019) argued that yield impacts may be minimal if adaptation measures are effectively implemented.

Adaptation Strategies being employed by the Farmers to Mitigate the Adverse Effects of Climate Change

Table 3: Distribution of the respondents based on the adaptation strategies being employed to mitigate the adverse effects of climate change

Adaptation strategies	Always	Sometimes	Rarely	Never	Mean	Std. Dev.
Planting deeper than the usual planting depth	208(47.3)	165(50.0)	6(2.7)	-	3.45	0.552

Planting draught resistant varieties	204(46.4)	150(45.5)	10(4.5)	4(3.6)	3.35	0.735
Early Planting	152(34.5)	177(53.6)	22(10.0)	2(1.8)	3.21	0.692
Use of organic manure	212(32.7)	63(19.1)	72(32.7)	-	3.15	0.89
Use of irrigation system	84(19.1)	210(63.6)	38(17.3)	-	3.02	0.606
Use of cover crops	72(16.4)	141(42.7)	90(40.9)	-	2.75	0.719
Use of early maturing crop varieties	68(15.5)	159(48.2)	70(31.8)	5(4.5)	2.75	0.771
Contour cropping across slopes	28(6.4)	156(47.3)	102(46.4)	-	2.6	0.609
Mulching	68(15.5)	93(28.2)	124(56.4)	-	2.59	0.746
Draining of wet land for crop cultivation	64(14.5)	108(32.7)	104(47.3)	6(5.5)	2.56	0.807
Listening to information about climate change	40(9.1)	72(21.8)	134(60.9)	9(8.2)	2.32	0.753
Use of chemical such as herbicide insecticide etc	24(5.5)	36(10.9)	140(63.6)	22(20.0)	2.02	0.729
Grand mean					2.83	

Source: Field survey, 2023.

Table 3 show the adaptation strategies employed by cassava farmers. The objective was achieved with a four point likert scale and a mean bench mark of ($\bar{X}=2.50$) was used to adjudge the response of respondents on the adopted strategies they employ to mitigate climate change effect in study area. The main strategies included deeper planting ($\bar{X}=3.45$), use of drought-resistant varieties (mean=3.35), and early planting ($\bar{X}=3.21$). Use of organic manure and irrigation also had means above the benchmark. However, listening to climate change information ($\bar{X}=2.32$) and chemical use ($\bar{X}=2.02$) were less practiced. Nwaiwu *et al.* (2021) emphasized that reliance on indigenous knowledge rather than formal information services limits adaptation effectiveness among Nigerian farmers.

Constraints to the Climate Change Adaptation Strategies

Table 4: Distribution of the farmers based on the constraints militating climate change adaptation strategies in the study area.

Constraints	Very Serious	Moderately serious	Less serious	Not constraint	Mean	Std. Dev.
High cost and inaccessibility of improved varieties	404(91.8)	27(8.2)	-	-	3.92	0.275
Non access to Meteorological Forecast/Data	356(80.9)	33(10.0)	20(9.1)	-	3.72	0.623
Lack of finance to purchase inputs	324(73.6)	57(17.3)	14(6.4)	3(2.7)	3.62	0.729
Scarcity of improved varieties	260(59.1)	129(39.1)	-	2(1.8)	3.55	0.599
Inefficient extension system	212(48.2)	159(48.2)	4(1.8)	2(1.8)	3.43	0.627
Irregular training on climate change	184(41.8)	156(47.3)	20(9.1)	2(1.8)	3.29	0.708
Pestilence	108(24.5)	237(71.8)	8(3.6)	-	3.21	0.49
Scarcity of organic manure	140(31.8)	183(55.5)	28(12.7)	-	3.19	0.642
Grand mean					3.49	

Source: Field survey, 2023.

This objective was also achieved with a four point likert scale and a mean bench mark of ($\bar{X}=2.50$) was used to adjudge the response of respondents on. Key constraints were high cost and inaccessibility of improved varieties ($\bar{X}=3.92$), lack of meteorological data ($\bar{X}=3.72$), and inadequate finance ($\bar{X}=3.62$). This aligns with findings by Ogunniyi *et al.* (2022) who reported that poor access to credit and improved inputs limits farmers' adaptive capacity.

Table 5 Multiple regression estimates of the relationship between climate change adaptation strategies and yield of cassava

Variables	Coefficients	Std. error	t-value	P-value
Constant	2413.881	816.550	2.956***	0.004
Use of organic manure	46.342	19.398	2.389**	0.021
Use of cover crops	399.927	167.187	2.392**	0.019
Mulching	243.037	190.945	1.273	0.206
Contour cropping across slopes	-231.744	162.825	-1.423	0.158
Planting deeper than the usual planting depth	426.352	187.129	2.278**	0.025
Planting draught resistant varieties	-150.352	122.611	-1.226	0.223
Use of chemical such as herbicide insecticide etc	130.308	74.552	1.748*	0.065
Listening to information about climate change	56.814	135.460	0.419	0.676
Use of early maturing crop varieties	320.210	149.421	2.143**	0.035
Use of irrigation system	286.812	129.458	2.215**	0.029
Early Planting	72.222	110.994	0.651	0.517
Draining of wet land for crop cultivation	35.320	134.801	0.262	0.794
R-Square	0.727			
Adjusted R-Square	0.621			
F-ratio	16.146***			

Source: Field survey, 2023.

Keys *significant at 10% **significant at 5%, ***significant at 1%,

The result in table 4.14 shows the regression estimates of the relationship between climate change adaptation strategies and yield of cassava. The result showed the coefficient of determination of 0.621 indicating 62.1% of the total variation observed in the dependent variable (Y) were accounted for. The coefficients of use of organic manure (46.342) $p < 0.05$, use of cover crops (399.927) $p < 0.05$, planting deeper than the usual planting depth (426.352) $p < 0.05$, use of early maturing crop varieties (320.210) $p < 0.05$, and use of irrigation system (286.812) $p < 0.05$ were significantly related with the yield of cassava farmers in the study area. at 5% significant level. This implied that as the use of manure, use of cover crop, use of early maturing crops and use of irrigation system increases, effect of climate change on cassava production will decrease.

confirming that these strategies enhance resilience and productivity (Diallo *et, al* 2020).

CONCLUSION AND RECOMMENDATIONS

The study therefore concludes that farmers are aware of the observable variation in climate and they adopt some mitigating strategies to reduce the effect of climate changes on cassava production. However, they are confronted with challenges such as pestilence, no access to metrological information, finance to purchase input, scarcity of improved varieties of cassava, lack of training on climate change, insufficient extension system. It was also opined that the use of organic manure, use of cover crops, use of early maturing crops, and use of irrigation system will assist cassava farmers to curtail the effect of climate on cassava production.

RECOMMENDATIONS

Based on the findings, it is recommended that:

1. Government and agricultural agencies should subsidize improved cassava varieties to enhance access and adoption.
2. Strengthen extension services to provide timely climate and agronomic information.
3. Facilitate access to credit facilities to enable farmers purchase necessary inputs.
4. Promote use of organic manure, cover crops, early maturing varieties, and irrigation, which were proven to significantly enhance cassava yield under changing climatic conditions.
5. Organize regular training and capacity building on climate-smart agriculture to improve farmers' adaptation strategies.

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**Production Performance of Broiler Chickens Fed Graded Levels of
Cassava Composite Meal**

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ABSTRACT

Feed stuff cost especially maize has been an age long challenge to poultry farmers. This research aimed at evaluating the performance of broiler chickens fed graded levels of cassava composite meal in replacement of costly maize. 150-day-old Abor acre strain broiler chicks were used for the experiment which lasted for eight weeks. The cassava root was harvested and processed into gari while the leaf and tender stems were chopped and sun dried. The cassava composite meal comprised of cassava roots, tender stem and cassava leaf meal in ratio 10:1:1. The experimental birds were randomly shared into five treatments of three replicates having 10 birds per replicate using completely Randomized Design. The five treatments tagged T1, T2, T3, T4 and T5 having the inclusion of the test ingredient at 0% (control), 10%, 20%, 30% and 40% respectively. There were no significant ($P>0.05$) differences in all the parameters considered in the growth performance, carcass characteristics, organ proportion and haematology. The serum bio-chemistry parameters like uric acid, alkaline phosphatase and total bilirubin increased with increase in the level of inclusion of the cassava composite meal. In all the replacement of the cassava composite meal has no deleterious effect on the performance of the broiler chicken, therefore cassava composite meal can replace up to 40% of maize in the broiler diet. Treatment T5 was then recommended.

Key words: broiler chickens, cassava composite meal, carcass characteristics, haematology

INTRODUCTION

Broiler chicken, like other non-ruminant animals rely on highly digestible feedstuffs, such as maize and soya bean meal, as energy and protein sources respectively (Edwin, 2019). Most conventional poultry feed ingredients particularly maize in the tropical countries are expensive as they are also in high demand for human consumption and may be used in the industry for bioethanol production (Edwin, 2019). Broiler chicken is also an important source of meat and protein to the diet of Nigerians especially the urban folk. Broiler meat is relatively cheap and of high quality. However, poultry production in Nigeria is constrained by high cost of feed. Feed cost accounts for up to 80% of the total cost of production and is a very important factor in determining the extent of poultry survival and profitability (Li, 2023). The use of maize as human food and industrial raw material couple with drought in some part of the country has sometimes caused relative scarcity of the ingredient and an attendant increase in poultry feed costs.

Cassava has been in use for a long time as an energy source in place of cereal grains for livestock (Ewa *et al.*, 2019). There is thus the likelihood of continued use of cassava in animal feed in the 21st century and beyond. Cassava appears to possess the potential to serving as an alternative to maize, cassava root meal is deficient in protein and essential amino acid. Cassava can be used as an energy source to replace maize without affecting growth performance of broiler chicken (Saroeun, 2010). Cassava root products

are also deficient in carotene and other carotenoids, consequently, one of the ways of addressing these deficiencies is the supplementation of cassava root meal with cassava leaf meal which is high in carotene and protein. Cassava leaf can produce very high amounts of protein even in the dry seasons in situation where no irrigation or fertilization is practiced (Montilla *et al.* 1976). Therefore, upgrading of cassava root meal with leaf meal could result in a product that could serve as a good substitute of maize. Suffice it to state that leaves and tender stems are under-utilized as they are often left to rot away on farms and homesteads in cassava producing areas (Oluyemi, 2006).

In view of the above, combining cassava tuber, which is high in energy content but low in crude protein, with cassava leaves which is rich in amino acids, vitamins and minerals to form cassava composite meal could potentially replace maize in the broiler diet. Processing cassava reduces feed wastage, improves its nutritional value and maximize poultry production.

The use of Cassava in feeds for broiler chickens could reduce the dependence on maize as a major energy source and could reduce feed costs for poultry farmers. This therefore, formed the basis of this study by assessing the production performance of broiler chickens fed graded levels of cassava composite meal.

MATERIAL AND METHODS

Experimental site

The research was conducted at the Poultry unit of the Teaching and Research Farm of Michael Okpara University of Agriculture, Umudike, Abia State. Umudike lies on latitude 05029' N and longitude 07033' E with an elevation of 122 m above sea level and is located in the tropical rainforest zone of Nigeria. This zone is characterized by annual rainfall of about 2177 mm, monthly ambient temperature range of 22°C - 36°C and relative humidity of 50-95 % depending on the season and location (NRCRI, 2024)

Procurement and Processing of Experimental Material.

Cassava Composite Meal

Freshly harvested cassava root, leaves and tender stems were collected from cassava farms in Orumba South Local Government Area. The roots were washed, peeled, grated and toasted into gari. The leaves, petioles and tender stem were collected also, separately at the point of harvest. They were chopped into smaller size and sundried before milling. They were mixed in ratio 10:1:1 of cassava root meal: cassava tender stem: cassava leaf meal.

Experimental Birds and management

A total of 150-day-old broiler chicks unsexed which were purchased from a reputable hatchery, the birds were placed on a commercial broiler starter diet for one week of brooding. After brooding, the birds were distributed into five treatments with 30 birds per treatment in three replicates of 10 birds each. The birds were fed and watered *ad-libitum*. Proper sanitation and routing medication were maintained to fore stall any outbreak of diseases. Proper hygiene and bio-security measure were observed throughout the period of the experiment. The starter phase lasted from the 2nd week to the 4th week. While the finisher phase was from the 5th week through to 8th week.

Experimental Diets

Five experimental diets were compounded with cassava composite meal at inclusion rate of 0%, 10%, 20%, 30% and 40% representing treatments T₁, T₂, T₃, T₄ and T₅, respectively.

The feed composition of the starter diets was as shown in Table 1.

Table 1: Feed composition of the starter diets

Ingredients	T1	T2	T3	T4	T5
Maize	53.10	47.79	42.48	37.17	31.86
CCM	0	5.31	10.62	15.93	21.24
Fishmeal	4.50	4.50	4.50	4.50	4.50
PKC	3.00	3.00	3.00	3.00	3.00
SBM	32.70	32.70	32.70	32.70	32.70
Wheat offal	3.00	3.00	3.00	3.00	3.00
Bone meal	3.00	3.00	3.00	3.00	3.00

Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100
Calculated composition					
ME(kcal/kg)	2956.40	2946.19	2936.02	2925.80	2915.58
CP(%)	23.03	22.68	22.34	22.00	21.66

CCM-Cassava Composite Meal; ME- Metabolisable Energy; CP- crude Protein; PKC-Palm kernel cake; SBM- Soya bean meal

Table 2: Feed composition of the finisher diets

Ingredients	T1	T2	T3	T4	T5
Maize	58.60	52.74	46.88	41.02	35.26
CCM	0	5.86	11.72	18.58	23.44
Fishmeal	4	4	4	4	4
PKC	3.5	3.5	3.5	3.5	3.5
SBM	25	25	25	25	25
Wheat offal	5.2	5.2	5.2	5.2	5.2
Bone meal	3	3	3	3	3
Lysine	0.1	0.1	0.1	0.1	0.1
Methionine	0.1	0.1	0.1	0.1	0.1
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100
Calculated Composition					
ME(KCAL/KG)	2975.09	2963.82	2952.54	2942.27	2929.99
CP (%)	20.47	20.10	19.72	19.35	18.97

CCM-Cassava Composite Meal; ME- Metabolisable Energy; CP- crude Protein; PKC-Palm kernel cake; SBM- Soya bean meal

Data Collection

Determination of growth parameters

The following parameters were measured:

Initial body weight: this was assessed by weighing the birds at the beginning of the experiment using single pan electronic balance (3 decimal places in grammes) to weigh the chicks.

Final body weight: this was assessed by weighing the birds at the end of the experimental period using triple beam balance (kg).

Feed intake/bird/day (g) = $\frac{\text{Quantity of feed given} - \text{Quantity not eaten}}{\text{No. of birds} \times 49 \text{ days}}$

Daily weight gain/bird (g) = $\frac{\text{Final live weight} - \text{Initial weight}}{\text{No. of birds} \times 49 \text{ days}}$

Feed conversion ratio = $\frac{\text{Quantity of feed consumed}}{\text{Weight gain}}$

% mortality = $\frac{\text{Number died}}{\text{No. Stocked}} \times 100$

Carcass characteristics and organ proportions

The carcass characteristics and organ proportions were determined by slaughtering three birds per treatment at the end of the feeding trial. The birds slaughtered were fasted for 24 hours to empty the digestive tract but water was supplied *ad-libitum*. Slaughtering was done by a clean cut across the jugular vein and the birds were allowed to bleed for at least three minutes. The birds were de-feathered by dipping into boiling water for one and a half minutes and then the feathers were removed. The carcass was cut into parts and

the organs separated according to the procedure described by Ojewola and Longe (1999). All parts (breast, drumstick, thigh, wings and backcut) were weighed and expressed as percentage dressed weight. Organs like liver, heart, gizzard, kidneys were also weighed and expressed as percentage of live weight.

Haematological parameters and serum chemistry

Blood samples were drawn from two birds per replicate through the jugular vein using a 12ml gauge (6cm) needle to draw 10ml of blood. The blood samples were divided into two; first lot (5ml) was emptied into heparinized packs containing about 40mg of anti-coagulant Ethyl diamine tetra acetic acid (EDTA) to determine the haematological components. The second lot (5ml) was emptied into anti-coagulant free bottles, and was used to determine blood biochemical components. Packed cell volume (PCV), the ratio of volume of cells to the volume of plasma, was determined by the capillary haematocrit centrifuge as described by Coles (1986). White blood cell (WBC) was determined by Wintrobe method (Coles, 1986). Haemoglobin (Hb) by Cyanomethaemoglobin method (Coles, 1986) and red blood cells (RBC) also by Cole (1986) method. These values were calculated:

Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH) and Mean Corpuscular Haemoglobin concentration (MCHC).

Biochemical components, like total protein, urea, creatinine, alkaline phosphatase, and albumin were determined using the method of Coles (1986).

Experimental design and statistical analysis

The experimental design was Completely Randomized Design using five treatments with three replicates of ten birds each. All data collected were subjected to analysis of variance (Steel and Torrie, 1980), and significant differences between treatments means were separated using Duncan's multiple range test (Duncan, 1955). The model of the design was:

$$Y_{ij} = \mu + T_i + e_{ij}$$

Where Y_{ij} = single observation ie j^{th} observation on the i^{th} treatment.

μ = overall mean

T_i = the effect of the i^{th} level of treatment

e_{ij} = experimental error.

RESULTS AND DISCUSSION

Table 3 showed the growth performance of broiler chicken fed graded levels of cassava composite meal. There were no significant ($P > 0.05$) differences in all parameters considered in the growth performance.

Table 3: Growth performance of Broiler Chicken Fed Cassava Composite Meal

Parameters	T1 (0%)	T2 (10%)	T3 (20%)	T4 (30%)	T5 (40%)	SEM
Initial Weight(g)	400	402.77	397.89	394.44	389.44	1.09
Final Weight(g)	2300	2116.7	2066.7	1950	1700	8.25
Total Weight gain(g)	1900	1713.93	1672.26	1552.11	1310.56	1.1
Daily Weight gain(g)	33.93	30.61	29.86	27.71	23.4	0.95
Total feed gain(g)	5199.6	5051.76	5012.56	4657.52	4024.16	2.15
Daily feed intake	92.86.	90.21	89.51	83.17	71.86	2.15
Feed Conversion ratio	2.73	2.94	2.99	3	3.07	0.15
Mortality (%)	2	1	2	0	0	0

SEM = Standard Error of Mean.

This was contrary to the report of Ironkwe and Ukanwoko (2019) who reported significant differences in daily feed intake, daily weight gain, final live body weight, feed conversion ratio and protein efficiency ratio. Adedokun *et al.* (2017) reported a significant difference in the final weight and total weight gain of broiler chickens fed cassava composite meal which was not in line with the report of this present study.

Table 4: Carcass Characteristics and organ proportion of Broiler Chicken Fed Cassava Composite

Parameters	T1(0%)	T2(10%)	T3(20%)	T4(30%)	T5(40%)	SEM
Live Weight(g)	2240	2166.7	2000	2060.7	1966.7	11.25
Dressed Weight(g)	1500	1450	1250	1200	1100	14.36
Dressing percentage	66.67	66.92	62.5	58.23	57.87	3.11
Cut-up arts expressed as percentage of live weight						
Drum stick	10.7	12.35	10.59	10.77	11.84	0.49
Thighs	12.05	13.87	12.42	12.22	11.04	0.86
Breast	21.96	20.05	21.83	20.17	21.22	0.67
Wings	8.52	7.77	7.74	7.88	7.6	0.54
Back cut	9.25	8.45	8.02	8.44	8.45	0.43
Neck	5.37	5.45	4.99	5.34	5.9	0.58
Thorax	4.38	4.43	4.5	4.21	4.9	0.61
Gizzard	2.31	1.82	2	2.9	2.41	0.25
Heart	0.36	0.29	0.32	0.33	0.34	0.05
Liver	1.12	0.95	1.33	1.62	0.91	0.2
Abdominal fat	0.65	0.56	1.15	0.5	0.66	0.23

SEM = Standard Error of Mean.

Table 4 revealed the carcass characteristics and the cut parts of broiler chickens fed the graded cassava composite meal. No significant ($P > 0.05$) difference was observed across the treatments of the birds fed the test diets. There were significant differences observed in the carcass characteristics and organ proportions of birds fed cassava composite meals as reported by Adedokun (2019). This view was not in line with the result of this study.

From table 5, the haematological characteristics of the birds fed the test ingredients did not show any significant ($P > 0.05$) difference across the treatment. All the measured parameters were within the normal range of haematological values for broiler chickens except the mean corpuscular volume (MCV).

Table 5: Haematological profile of Broiler Chicken Fed Cassava Composition Meal

Parameters	T1(0%)	T2(10%)	T3(20%)	T4(30%)	T5(40%)	SEM
Packed Cell Volume (%)	23.67	23.09	22.67	22.66	22.54	0.28
Haemoglobin (g/dl)	10.55	10.17	9.75	10.05	10.37	1.18
RBC($\times 10^6 \text{mm}^3$)	2.75	2.6	2.59	2.61	2.63	0.02
WBC ($\times 10^6 \text{mm}^3$)	2.35	2.3	2.25	2.2	2.18	0.03
MCV (%)	86.07	88.46	87.53	86.86	85.7	0.12
MCH (%)	39.45	39.12	37.64	38.51	39.42	0.26
MCHC (%)	45.84	44.21	43.89	44.33	45.01	0.13

SEM = Standard error of the mean, WBC = White blood cell, Hb = Haemoglobin, RBC = Red blood cell, PCV = Packed Cell Volume, MCH = Mean Cell Haemoglobin, MCHC = Mean Cell Haemoglobin Concentration

This was in line with the work of Adedokun *et al.* (2017) who reported that all parameters were within the normal range. MCV helps in measuring the size of the red blood cells and when it is too much in the blood stream it means there is deficiency of folic acid and vitamin B12.

Observable significant ($P < 0.05$) differences were found in the following serum biochemical parameters: uric acid alkaline phosphate, alanine amino acid transferase, aspartate amino acid transeferase and total bilirubin.

Table 6: Serum Biochemical Values of Broiler Chicken Fed Cassava Composite Meal

Parameters	T1(0%)	T2(10%)	T3(20%)	T4(30%)	T5(40%)	SEM
Total Protein (g/dl) 4.70	4.77	4.70	4.66	3.39	3.37	0.28NS
Albumin (g/dl)	2.31	2.33	2.40	2.70	2.10	0.34NS
Globulin (g/dl)	2.46	2.37	2.26	1.22	1.27	0.67NS
Uric Acid (mmol/l)	8.92 ^c	9.95 ^b	9.12 ^b	9.78 ^b	10.01 ^a	0.04
Serium Sodium (mmol/l)	142.00	142.00	142.00	141.33	142.01	0.04
Serium Calcium (mmol/l)	10.18	10.09	10.17	9.98	9.92	0.04
Serium Potassium (mmol/l)	3.35	3.41	3.40	3.27	3.32	0.04
Alkaline Phosphatase (μ/l)	10.33 ^c	10.33 ^c	11.60 ^b	11.33 ^b	13.00 ^a	0.28
ALAT (μ/l)	4.67 ^a	5.00 ^b	5.67 ^b	6.67 ^{ab}	7.00 ^a	0.45
ASAT (μ/l)	5.00 ^b	5.00 ^b	5.00 ^b	5.33 ^b	6.33 ^a	0.25
Total Bilirubin (mmol/l)	12.00 ^c	13.09 ^b	13.42 ^b	14.00 ^{ab}	15.00 ^a	2.25

^{a,b,c} = Means in the same row with different Superscript are Significantly different ($P < 0.05$), NS = Not Significantly ($P > 0.05$), SEM = Standard error of the mean, ALAT = Alanine amino transferase, ASAT = Aspartate amino transferase.

Uric acid, alkaline phosphate and total bilirubin increased with increase in the level of inclusion of cassava composite meal while ASAT was the opposite. ALAT has no particular pattern. There were significant ($P > 0.05$) differences in the values of total protein, albumin and globulin in the study Adedokun (2017) when broiler chickens were fed cassava composite meal.

CONCLUSION AND RECOMMENDATION

From the foregoing it could be concluded that cassava composite meal can replace maize in broiler chickens feed without deleterious effect on their performance. The haematological profile also showed that the health status of the birds was not negatively affected. The inclusion of cassava composite meal at 40% was recommended for poultry farmers.

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**SOCIETY FOR COMMUNITY & COMMUNICATION DEVELOPMENT RESEARCH
CONFERENCE PROCEEDINGS**



4th Biennial Conference, 2025

12 – 14 Aug. @ Michael Okpara University of Agriculture, Umudike, Abia State
Theme: Agricultural Extension for Food Security and Community Empowerment

**Participation Level of Sweet Potato Farmers in National Root Crops
Research Institute's Capacity Building Programmes in Abia State,
Nigeria**

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ABSTRACT

The study was carried out to assess participation level of sweet potato farmers in National Root Crops Research Institute's (NRCRI) capacity building programmes in Abia State. Data were collected from a sample of 120 farmers with the use of structured questionnaire. Frequencies, percentages, means and OLS were used for data analysis. The result showed that majority of the participants (31.7%) were still at their productive stage, (84.2%) of the participants were married, majority have farm size of (1.1-1.5h), (25.0%) of the participants had farming experience of 21-30 years, (42.5%) of the participants had secondary education. The result also revealed that sweet potato participants in Abia State recorded high level of participation in the following capacity building programmes; strengthening corporation and linkage capacity($\bar{x} = 3.01$), farm management practices on sweet potato enterprises($\bar{x} = 2.81$), conducting farmers through guided tours($\bar{x} = 2.78$), technical knowledge on improved technologies of sweet potato production, processing and value addition($\bar{x} = 2.72$) and sweet potato marketing and financial management($\bar{x} = 2.70$), such as monitoring and evaluation of farmers' field activities($\bar{x} = 2.48$), providing information for accessing inputs($\bar{x} = 2.35$), guiding farmers through demonstration($\bar{x} = 2.30$), providing access to recommendations materials for sweet potato($\bar{x} = 2.16$), also exhibit moderate level of participation. The study concluded that there were moderate levels of farmers' participation in NRCRI's capacity building programme in Abia State. It was recommended that there is need for NRCRI to implement more capacity building programmes in Abia State so that its aim of empowering sweet potato farmers to increase their productivity, improve their livelihoods and income will be fully attained.

Key words: Farmers' participation, capacity building, NRCRI, Sweet potato

INTRODUCTION

Sweet potatoes are the perfect crop for rural poor farmers because of their high photosynthetic efficiency, high potential energy yield per unit area per time, and early maturity, they are high in pro-vitamin A, vitamins B and C, and minerals like calcium, iron, potassium, and salt, the tips and leaves of the vine make great human vegetables and healthy green cow feed. (Nwankwo *et al.*, 2021).

One crop that rural women process to generate revenue is sweet potatoes. The potential for it to supply human food is enormous. It is eaten as a snack or as a component of the main meal. They are either roasted as entire roots or fried as chips. Sweet potatoes have a high calorific value and can be processed into flour, fortified with wheat flour, and fried into puff-puff, chin-chin, cake and buns, as well as industrial alcohol, vinegar, yeast, and acetone (Aneneokeakwa *et al.*, 2021). As a result, they have the potential to play a

significant role as a food security crop and provide a variety of human food, animal feed, and industrial products for empowering the low-income women producers. There is a great deal of variation in sweet potatoes' physical traits and yield. In order to make bread, cakes, and biscuits, the roots can be reconstituted into fufu or combined with other forms of carbohydrate flour, like wheat (Bassey, 2021).

The process by which individuals, groups, and institutions enhance their performance and gradually develop, fortify, and adjust their ability in response to evolving conditions is known as capacity building. It involves both individual and group learning and is very context-specific and adaptive, (Ogunjobi *et al.*, 2022). Farmers may be able to voice their technological demands and take part in the development, testing, and distribution of suitable technologies through a variety of local methods. Conferences, workshops, consultations, study tours, participatory research and extension, on-the-job training, demonstration plots, coaching, and mentoring are some examples of capacity building techniques, (Ikoyo-Eweto *et al.*, 2023). Improving agriculture's resilience to external shocks and climate change is a crucial component of capacity building. Capacity building programs can assist farmers in adapting to changing climatic circumstances and lessening the effects of climate change on their livelihoods by training them in climate-smart agricultural practices, such as drought-resistant crops and water conservation methods, (Klerkx and Rose, 2020).

There is insufficient empirical evidence on the actual **level of farmers' participation** in these capacity building programmes provided by the National Root Crops Research Institute particularly in the context of sweet potato cultivation in Abia State. Without this understanding, efforts to scale or redesign such programmes may not achieve their intended results. Therefore, the specific objective of this work is to ascertain the level of participation in NRCRI'S capacity building programme by sweet potato farmers in Abia State.

METHODOLOGY

This study was conducted in Abia State. The state has three Agricultural Zones with 38 extension blocks and 27 circles. It occupies a landmass of about 6,320 square kilometers. The projected population of Abia state in 2025 is approximately 4.5 million (world population Review, 2025). Two agricultural zones (Umuahia, Ohafia,) of the state were involved in this study. A total of 120 respondents was randomly selected using multi stage random sampling technique. Two blocks in each zone purposively because they have received Capacity building Services under Sweet potato programme of NRCRI Umudike and their active involvement in sweet potato farming giving a total number of four blocks. Three circles from each block were purposively selected for the same reason. Ten (10) participants were randomly selected giving total of 120 farmers

RESULTS AND DISCUSSION

Table 1: showed that the majority (31.7%) of the sweet potato participants in Abia State were within the age bracket of 41-50 years old, while 27.5% were within the age bracket of 51-60 years. The mean age of the participants was 49 years. This implies that the participants in Abia State were still in their active stages in life and it might have influenced their involvement in sweet potato production and participation in the NRCRI capacity building programme. This finding is in agreement with Nwaneri, Chukwu, Anyanwu, Ezeolua and Chukwu (2022) reporting a mean age of 49 years among sampled farmers in Imo State.

The result also showed that the majority (56.7%) of the sweet potato participants in Abia State were females while 43.3% of the farmers were males. This implies that the majority of the participants in the State are females. This is in consonance with the findings of Nwokocha, Anyaegbunam, Igwe and Nwakor (2019) that female farmers dominated sweet potato farming in Abia and Anambra States.

The result for marital status showed that the majority (84.2%) of the sweet potato participants in Abia State were married, while 7.5% were single, and 5.8% widowed. This implies that the majority of the participants in Abia State were married. Marital status is an important predisposing factor to improve food production and enhance increased farm income. Married individuals are likely to be more involved in the NRCRI capacity building programme in order to cope with the responsibilities of catering for the household needs of their families. This is in agreement with findings of Okeke, Mbah, Madukwe and Nwalieji (2020) that the majority (85.0%) of sampled small-scale sweet potato farmers in South-east Nigeria were married.

Majority (51.7%) of the respondents in the sweet potato participants in Abia State had a household size of 4-6 persons per household, while 0.8% of them had a household size of at most 15 persons per household. The mean household size of the participants was 6 persons. This implies that the participants in Abia State had large household size. These large household sizes can supply the labour required for sweet potato production but can consume a lot of food. This finding is similar to that of Agoh, Chukwuemeka and Ekeledo (2024) showing a mean household size of 5 persons among orange fleshed sweet potato farmers in Ebonyi State.

The result also revealed that the mean years of schooling for the participants in Abia State were 12.8 years. This implies that the majority of the sweet potato participants in the State were literate and could facilitate their participation in capacity building programmes.

The result showed that the mean farm sizes of the participants in Abia State were 1.9 hectares. The result clearly indicated that participants in Abia State had larger farm sizes.

Farming experience of the participants in Abia State indicated that 33.3% of the respondents had farming experience of 21-30 years, 31.7% had an experience of 11-20 years, 23.3% had farming experience of 1-10 years, 11.7% had an experience of 31-40. This implies that the majority of the participants in Abia State have been into farming for several years and may be considered quite experienced. Farming experience could influence farmers' participation in capacity building programmes and adoption of improved farming techniques for sweet potato production, this is in consonance with the findings of Abudu *et. al.* (2023) that indicated a mean farming experience of 18.5 years among sampled participants of the Farmer Field School (FFS) in Edo State.

The result revealed that the majority (53.3%) of participants in Abia State were non-members of cooperative societies while 46.7% were members of cooperative societies. This finding is similar to that of Okore (2023) reporting that 51.2% of sampled farmers in Enugu State were non-members of cooperative societies.

The result also showed that the sweet potato participants in Abia State had an average of three extension visits per year. This implies that the frequency of extension contact with farmers in the State was poor. This is not encouraging as extension contact is essential in facilitating farmers' participation in agricultural extension programmes and driving adoption of improved agricultural innovations. This finding is in agreement with that of Nzeakor and Nwokocha (2023) reporting that the majority (65.8%) of sampled orange fleshed sweet potato farmers had irregular contact with extension agents in Ebonyi State

Table 1. Distribution of participants according to their socioeconomic characteristics **n = 120**

Socioeconomic characteristics	Frequency	Percentage	Mean
Age (years)			
20-30	8	6.7	
31-40	26	21.7	
41-50	38	31.7	
51-60	33	27.5	
61-70	15	12.5	
Mean			49
Sex			
Male	52	43.3	
Female	68	56.7	
Marital status			
Single	9	7.5	
Married	101	84.2	
Widowed	7	5.8	
Divorced	3	2.5	
Household size (number of persons)			
1-3	7	5.8	
4-6	62	51.7	
7-9	35	29.2	

10-12	15	12.5	
13-15	1	0.8	
Mean			6
Level of education (years)			
No formal education	30	25.0	
Primary education	51	42.5	
Secondary education	19	15.8	
Tertiary education	20	16.7	
Mean			12.8
Farm size (hectares)			
0.5 -1.0	30	25.0	
1.1 - 1.5	15	12.5	
1.6 - 2.0	14	11.7	
2.1-2.5	16	13.3	
2.6-3.0	2	1.7	
3.1-3.5	2	1.7	
3.6-4.0	41	34.2	
Mean			1.9
Farming experience (years)			
1-10	28	23.3	
11-20	38	31.7	
21-30	40	33.3	
31-40	14	11.7	
Mean			19.0
Membership of cooperative society			
Yes	56	46.7	
No	64	53.3	
Frequency of extension contact (number of visits)			
0 – 5	120	100.0	
6 – 10	-	100.0	
Mean			3

Source: Field survey data, 2023

The result in Table 2: revealed that NRCRI sweet potato participants in Abia State recorded high level of participation in the following capacity building programmes; strengthening corporation and linkage capacity($\bar{x} = 3.01$), groups dynamics and conflicts resolution($\bar{x} = 2.91$), farm management practices on sweet potato enterprises($\bar{x} = 2.81$), conducting farmers through guided tours($\bar{x} = 2.78$), organizing farmer-to-farmer exchange visits to project sites($\bar{x} = 2.77$), technical knowledge on improved technologies of sweet potato production, processing and value addition($\bar{x} = 2.72$) and sweet potato marketing and financial management($\bar{x} = 2.70$). This finding is agreement with Sa'idu and Lawal (2020) who reported a high level of beneficiaries' participation in the FADAMA III capacity building, communication and information support programme in Kaduna and Sokoto States.

The result also showed that the participants in Abia State recorded moderate level of participation in the following capacity building programmes; monitoring and evaluation of farmers' field activities($\bar{x} = 2.48$), providing assistance for accessing fund($\bar{x} = 2.36$), providing information for accessing inputs($\bar{x} = 2.35$), guiding farmers through demonstration($\bar{x} = 2.30$), enrolment/registration into sweet potato group membership($\bar{x} = 2.19$), providing access to recommendations materials for sweet potato($\bar{x} = 2.16$), establishment of skill plots($\bar{x} = 2.13$) and providing platform for accessing certain facilities/services($\bar{x} = 2.11$). The result further revealed that the sweet potato farmers in Abia State generally had moderate levels of participation in NRCRI's capacity building programme with grand mean scores of 2.19. The implication

is that There is need for the NRCRI to encourage more farmers to participate in the capacity building programme and implement more capacity building programmes in Abia State so that its aim of empowering sweet potato farmers to increase their productivity, improve their livelihoods and income will be fully attained.

Table 2: Level of participation in NRCRI's capacity building programme by sweet potato farmers

S/N	Capacity building	Abia (n =120)		
A	Technical trainings on subject areas about sweet potato	$\sum f(x)$	$\bar{x}$	SD
1	Technical knowledge on improved technologies of sweet potato production, processing and value addition	326	2.72	0.48
2	Technical skills in use of improved technologies of sweet potato production, processing and value addition	250	2.08	0.36
3	Farm management practices sweet potato enterprises	337	2.81	0.53
4	Sweet potato marketing and financial management	324	2.70	0.47
B	Access, use and sharing of sweet potato related Information			
1	Social media use for access and share of sweet potato information	198	1.65	0.26
2	Access, use of printed resource material on sweet potato	223	1.86	0.43
3	Availability of electronic materials (photo, video etc.) on sweet potato	190	1.58	0.35
4	Availability of sweet potato project documents	188	1.57	0.53
C	Networking/partnership/corporation with other stakeholders			
1	Integration into National/local sweet potato networking group	172	1.43	0.17
2	Involvement in sweet potato projects	198	1.65	0.52
3	Membership of national/local association of sweet potato growers	230	1.92	0.43
4	Groups dynamics and conflicts resolution	349	2.91	0.65
5	Linking up with relevant support institutions	244	2.03	0.47
6	Strengthening corporation and linkage capacity	361	3.01	0.64
D	Facilitation of production activities			
1	Enrolment/registration into sweet potato group membership	263	2.19	0.62
2	Providing platform for accessing certain facilities/services	253	2.11	0.57
3	Providing information for accessing inputs	282	2.35	0.54
4	Providing access to recommendations materials for sweet potato	259	2.16	0.49
5	Providing assistance for accessing fund	283	2.36	0.51
E	Coaching/Mentorship in technology utilization			
1	Conducting farmers through guided tours	334	2.78	0.55
2	Organizing farmer-to-farmer exchange visits to project sites	332	2.77	0.73
3	Guiding farmers in participatory research	162	1.35	0.72
4	Establishment of skill plots	256	2.13	0.48
5	Guiding farmers through demonstration	276	2.30	0.59
6	Farmers' Small plots adoption techniques (SPATs)	233	1.94	0.35
7	Monitoring and evaluation of farmers' field activities	298	2.48	0.53
	Grand mean		2.19	

Source: Computed from field survey data, 2023

Note: $\sum f(x)$ indicates sum total for nominal Likert values multiplied by frequencies; $\bar{x}$ = Mean responses; SD = Standard deviation; 0.00 – 1.33 = low participation; 1.34 – 2.67 = moderate participation; and 2.68 – 4.00 = high participation.

Table 3 shows the ordinary least square (OLS) multiple regression result of the significant influence of selected socio-economic characteristics of smallholder sweet potato farmers on their level of participation in NRCRI capacity building programme in Abia State. The result revealed that the exponential model was selected based on the magnitude of the coefficient of multiple determinations (R^2), the signs of the regression coefficients as they conform to *a priori* expectation and the number of significant variables. The computed F-statistic (11.306***) was also statistically significantly at 1% level of significance implying that there was significant influence of selected socio-economic characteristics of farmers on their participation in NRCRI capacity building programme in Abia State.

The result shows that the coefficient of age (2.862***) was statistically significant at 1% and positively related to the level of farmers' participation in NRCRI capacity building programme in Abia State. This implies that as the age of farmers increase, their level of participation in NRCRI capacity building programme also increases. This finding is in agreement with Nwaobiala, Odoemelam and Dybia (2020) who reported that age (2.42**) influenced farmers' participation in sweet potato farming practices in Imo State. The coefficient of level of education (3.081***) was significant at 1% and positively related to the level of farmers' participation in NRCRI capacity building programme in Abia State. This result is similar to those of Ogunjobi, Ojo and Adebambo (2022) who reported that educational status influenced farmers' participation in the USAID MARKETS II agricultural project in Southwest Nigeria.

The coefficient of farming experience (2.453**) was significant at 5% and positively related to the level of farmers' participation in NRCRI capacity building programme in Abia State.

The coefficient of extension contacts (2.847***) was significant at 1% and positively related to the level of farmers' participation in NRCRI capacity building programme. This implies that an increase in extension contact leads to a corresponding increase in the level of participation in NRCRI capacity building programme in Abia State. This finding is similar to those of Abdullahi, *et.al* (2015) who reported that extension contact significantly influenced smallholder farmers' participation in IFAD-Community Based Agricultural and Rural Development Project in Katsina State at 1% level of probability

Table 3: Ordinary Least Square (OLS) regression result of the significant influence of selected socioeconomics characteristics of smallholder sweet potato farmers on their level of participation in NRCRI capacity building programme in Abia State.

Variable	Linear	Exponential+	Double-log	Semi-log
Constant	1.676 (4.910)***	4.573 (8.938)***	1.210 (5.879)***	3.995 (10.732)***
Age	0.467 (0.773)	0.002 (2.862)***	0.006 (2.257)**	0.928 (1.052)
Sex	0.051 (3.645)***	0.008 (2.811)***	0.179 (2.344)**	0.402 (3.109)***
Marital status	-0.062 (-0.034)	0.014 (1.325)	0.004 (2.421)**	0.036 (0.130)
Level of education	0.676 (0.278)	0.026 (3.081)***	0.021 (3.424)***	0.215 (1.775)*
Household size	0.323 (2.965)***	0.055 (3.137)***	0.126 (4.008)***	0.916 (2.991)***
Farm income	-0.197 (3.112)***	-4.116E-7 (-1.099)	-1.160E-8 (-1.210)	-2.767 (-4.225)***
Farming experience	0.057 (1.842)*	0.080 (2.453)**	0.006 (0.008)	0.055 (2.836)***
Farm size	0.120 (4.195)***	0.005 (2.391)**	0.005 (4.473)***	-0.435 (-2.894)***
Frequency of extension contact	0.405 (2.331)**	0.024 (2.847)***	0.116 (3.970)***	0.008 (2.533)**
R ²	0.671	0.712	0.643	0.608
Adjusted R ²	0.650	0.689	0.625	0.587
F-statistic	5.921***	11.306***	6.388***	9.442***

Source: Computed from field survey data, 2023

Note: ***, **, and * indicates statistically significant at 1%, 5% and 10% levels of significance respectively.

+ = Lead equation

CONCLUSION AND RECOMMENDATIONS

The study investigated the Level of participation in NRCRI's capacity building programme by sweet potato farmers in Abia State. The result revealed that majority of sweet potato farmers in the study area were relatively young, educated, married, experienced in sweet potato farming and had relatively large household sizes. However, farmers generally had poor contact with extension agents in the study area. There were moderate levels of farmers' participation in NRCRI's capacity building programme in Abia State. It was

recommended that, there is need for the NRCRI to implement more capacity building programmes especially in Abia State so that its aim of empowering sweet potato farmers to increase their productivity, improve their livelihoods and income will be fully attained.

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Theme: Agricultural Extension for Food Security and Community Empowerment

**Utilization of Plastic Materials by Selected Agro-Enterprise Owners in
Cross River State, Nigeria**

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ABSTRACT

This research assessed plastic agricultural development in Cross River State. It examined plastic materials and the level of usage by enterprise owners in the study area, highlighting the most utilized plastic materials among selected enterprises in the study area and postulated practical measures as prospects for plastic agricultural development for Cross River State. Both Primary and Secondary data were used, a researcher structured questionnaire was used to collect data. Data were obtained from 150 respondents from five selected agro-enterprises which were; processing and packaging enterprises, Vegetable farms/Gardens, Poultry farm enterprise, Nursery/horticultural enterprises, and Agro-marketing enterprises by simple random and purposive sampling technique. Result revealed that Plastic products that are most inclusive in the agricultural activities of vegetable farmers included; Plastic Basin ($\bar{x} = 1.92$), Jerry Can ($\bar{x} = 1.72$), Poly-ethyneBag and Table ($\bar{x} = 1.70$). The use of Tapolyne Bags ($\bar{x} = 1.92$), Poly-ethyne Bags and Chair ($\bar{x} = 1.86$), Cup and Egg Crate ($\bar{x} = 1.80$) among agro-marketers, Egg Crates and Tapolyne Bags ($\bar{x} = 1.94$), Plastic Tanks ($\bar{x} = 1.92$) and Plastic Jerry Cans ($\bar{x} = 1.80$) among poultry enterprises. The study showed that Tapolyne was the most used materials in the study with three 1st rankings in Agro-market, Poultry and Processing/packaging enterprises and one 2nd ranking for Nursery/Horticultural Enterprise (A³B). The study recommended among others, that government should provide tax relief, subsidies and educational support through agricultural extension to farmers through the implementation of sustainable plastic models, practices and technologies.

INTRODUCTION

In Africa, Nigeria is Africa's largest importers of plastics in primary forms (Fairtrade, 2019). With about 70% of raw materials imported (mainly from the Middle East, Europe and Asia) and only 30% produced locally, the Nigerian market has great prospect for export of plastics in primary forms. In the years 2008 to 2015, imports of plastic raw materials improved annually by 7.2% from 464 kt to 754 kt, +62.5% (Fairtrade, 2019). This makes Nigeria and Algeria, Africa's largest importers of plastics in primary forms. Several studies have undermined the efficacy of plastic in agricultural development (Muhammad (2014); Giuliano, Rosa, Ileana, Giacomo, and Evelia, (2015) while others uphold the beneficial impact of the utilization of plastic materials in agriculture (Science Direct, 2015).

Many types of plastic materials have been used in agriculture over the years in Cross River State, some of which finds application in the poultry farms as; Flexible plastics (Used for packaging feed, vaccines, and other products), Non-flexible plastics (used for equipment, infrastructure, and egg packaging), Plastic bags (used for packaging feed, disposing of waste, and covering floors), Plastic cups (used for vaccinations and medication administration) and Plastic containers (used for storing feed, water, and other supplies). Plastic materials are also used for; Greenhouse covers (Plastic films or sheets are used to cover greenhouses, providing a controlled environment for plant growth), Mulch films (Plastic mulch films are used to

retain moisture, suppress weeds, and regulate soil temperature), Irrigation pipes and fittings (Plastic pipes and fittings are used for irrigation systems), Pots and containers (Plastic pots and containers are used for seedlings, transplants, and plant sales), Packaging materials (Plastic bags, wraps, and boxes are used to package plants, flowers, and produce), Trellises and supports (Plastic trellises and supports are used for plant training and support), Ground covers (Plastic ground covers are used to control weeds and retain moisture), Hydroponic systems (Plastic materials are used in hydroponic systems for nutrient delivery and plant support), Labeling and tagging (Plastic labels and tags are used for plant identification), and Protective covers (Plastic covers are used to protect plants from frost, wind, and pests) in horticultural enterprises (Agricultural Plastic Recycling and Producers Survey Final Report, 2012; Ntui et al., 2022a; Ntui et al., 2022b; Nkang & Effiong, 2015; Ijioma et al., 2024; Etim & Effiong, 2022 and Etim et al., 2022). Most of the benefits of the utilization of plastic materials in agricultural development among agro-enterprises include; Water conservation through efficient irrigation systems, Increased yields by protecting crops from pests, diseases, and harsh weather conditions, leading to increased yields, Reduced post-harvest losses by protecting produce during transportation and storage, Improved efficiency in agricultural production, processing, and marketing, Cost-effective than alternative materials, Soil temperature regulation since mulch films can warm the soil in cooler climates, promoting early seed germination and growth, Weed control which reduces competition for water and nutrients, Crop protection from frost, hail, and pests, reducing damage and increasing yields, Extended growing season, Improved crop quality, and Reduced soil erosion (American Chemistry Council, 2017; Etim, 2018; Effiong, 2013, Effiong, 2012; Effiong & Aboh, 2024; Effiong & Aboh, 2019; Aboh & Effiong, 2019). Some of the plastic materials used in agricultural development include; Polyethylene (PE) (used for mulch films, greenhouse covers, and tunnel covers), Polypropylene (PP) (used for nursery pots, trays, and irrigation pipes), Polyvinyl Chloride (PVC) (used for pipes, fittings, and greenhouse covers), Bags and pouches (Plastic bags and pouches are used to package seeds, fertilizers, pesticides, and other agricultural inputs). Containers and tubs (Plastic containers and tubs are used to package and store agricultural products, such as grains, nuts, and dried fruits), Bottles and jugs (Plastic bottles and jugs are used to package and store liquids, such as pesticides, herbicides, and fertilizers), Wraps and films (Plastic wraps and films are used to cover and protect agricultural products, such as hay, silage, and cotton), Crates and boxes (Plastic crates and boxes are used to transport and store agricultural products, reducing damage and spoilage), and Pallets and trays (Plastic pallets and trays are used to transport and store agricultural products, improving efficiency and reducing costs) (Bernard, 2015; Effiong & Aboh, 2018; Effiong et al., 2021; Effiong & Asikong, 2013 and Effiong et al., 2016). Different policies and global concerns have sought to scrap out the use of plastic materials which is highly essential and utilized in Agricultural value chain activities. This is the knowledge gap this study intends to field by; examining the plastic materials used in the study area, and the level of usage by enterprise owners in the study area, highlighting the most utilized plastic materials among selected enterprises in the study area and postulated practical measures as prospects for plastic agricultural development for Cross River State.

RESEARCH METHODOLOGY

The research was conducted in the Southern Agricultural Zone of Cross River State which lies between latitudes 5°32' and 4°27' North and longitudes 7°50' and 9°28' East of the Greenwich meridian. It has a tropical humid climate with wet and dry seasons and average temperature ranging between 15°C – 30°C and annual rainfall between 1300 – 3000mm. It has three major ethnic groups with their dominant languages as the Efiks, Bekwarra and Ejagham (www.Kekerete.tripod.com/CRSG). Cross River State is bounded in the North by Benue State, in the South West by Akwa Ibom State, in the west by Ebonyi and Abia States (CRS LEEDS 2 (2016)). The Southern Agricultural Zone has seven blocks which are; Calabar South, Akampka, Calabar Municipality, Biase, Akpabuyo, Bakassi, and Odukpani. The vegetation are; Mangrove, Swamp, and Rainforest. Major crops produced in the area includes; Cocoa, Rice, Cassava, Oil Palm, Rubber, Banana and Pineapple among others. Occupation is mostly farming, marketing and civil services. The population of study included owners of agricultural enterprises that uses plastic for their production, processing, packaging, marketing or storage needs in the southern agricultural zone of Cross River State. Enterprise category measured in this study included; processing and packaging agricultural enterprises,

Vegetable farms/gardens, Poultry enterprises, nursery/horticultural enterprises and agro-marketing enterprise.

Table 1 represent the sampling procedure and sample size for the study. A simple random sampling technique was used in the selection of five blocks in the zone which were; Akpabuyo, Calabar South, Calabar Municipality, Odukpani and Akamkpa. This is because they share similar developmental features in proximity, agriculture and presence of farm enterprises that make use of plastic. Also, a purposive sampling technique was used in the selection of five agricultural enterprises that makes use of plastic materials in their agricultural production in the five blocks. They are; processing and packaging enterprises, Vegetable farms/Gardens, Poultry farms, Nursery/horticultural enterprises, and Agro-marketing enterprises. This enterprise comprises of the cells in this study. Primary data was gotten through a through a researcher structured questionnaire. Descriptive statistics was adopted. Secondary data was gotten from the Cross River State Ministry of Agriculture on the population of registered Agricultural Enterprises in the Southern Agricultural Zone. The available plastic in agricultural production was measure by multiple response on variables such as; plastic bags, containers, buckets, bottles, cans, and plastic crates using frequency, mean and percentages on charts and tables.

Table 1. Sampled Enterprises from the population of Agricultural Enterprises in the Southern Agricultural Zone as Registered by the State Ministry of Agriculture.

Enterprises	Calabar South	Calabar Municipality	Akamkpa	Akpabuyo	Odukpani	Total	Total Sample
Poultry	27	30	71	39	60	227	35
Nursery/Horticulture	21	26	27	40	30	144	25
Processing/Packaging	20	25	12	13	27	97	25
Vegetable/Garden	79	40	15	10	80	224	30
Agro-marketing	40	50	27	23	31	171	35
Total	187	171	152	125	228	863	150

Source: Field Survey, 2024

RESULTS AND DISCUSSIONS

Fig. 1

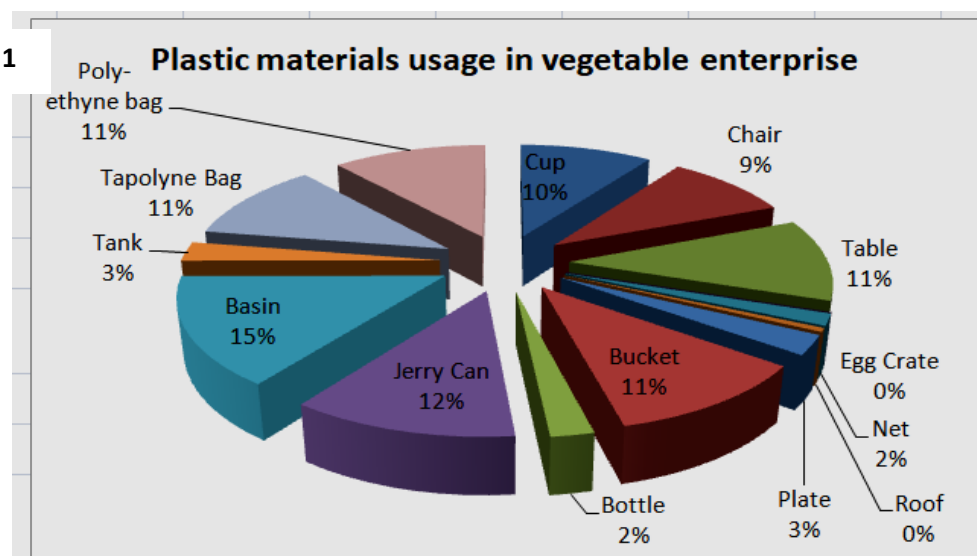


Fig. 2 Use of plastic materials among Agro Markets Enterprises

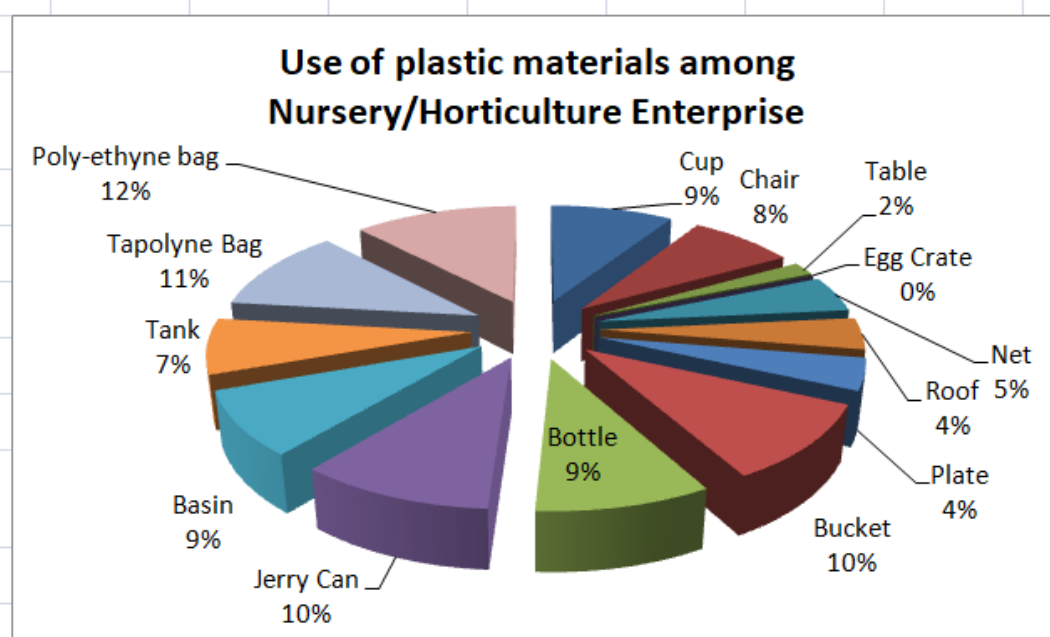
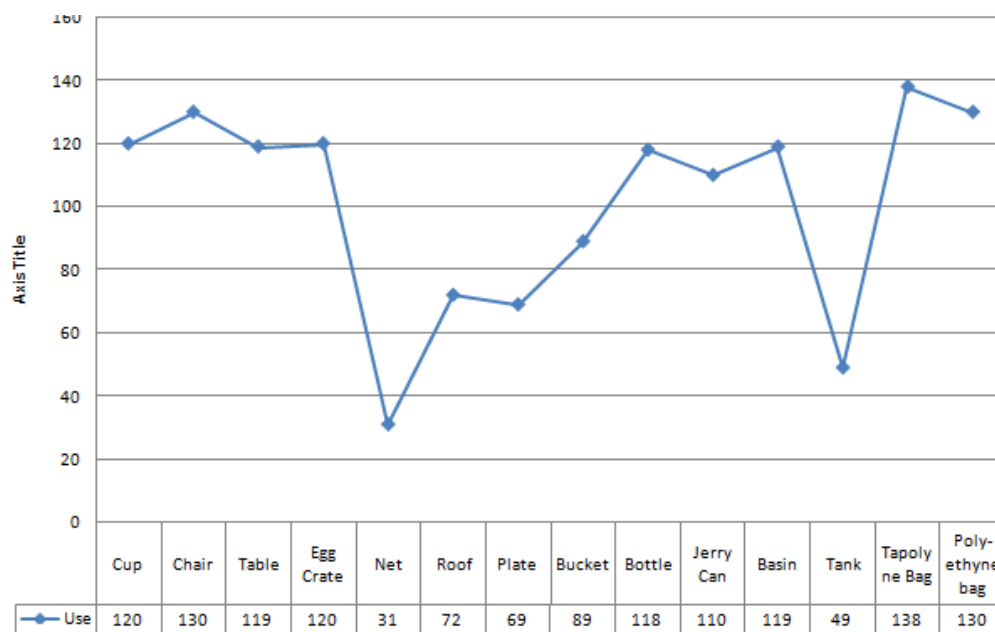
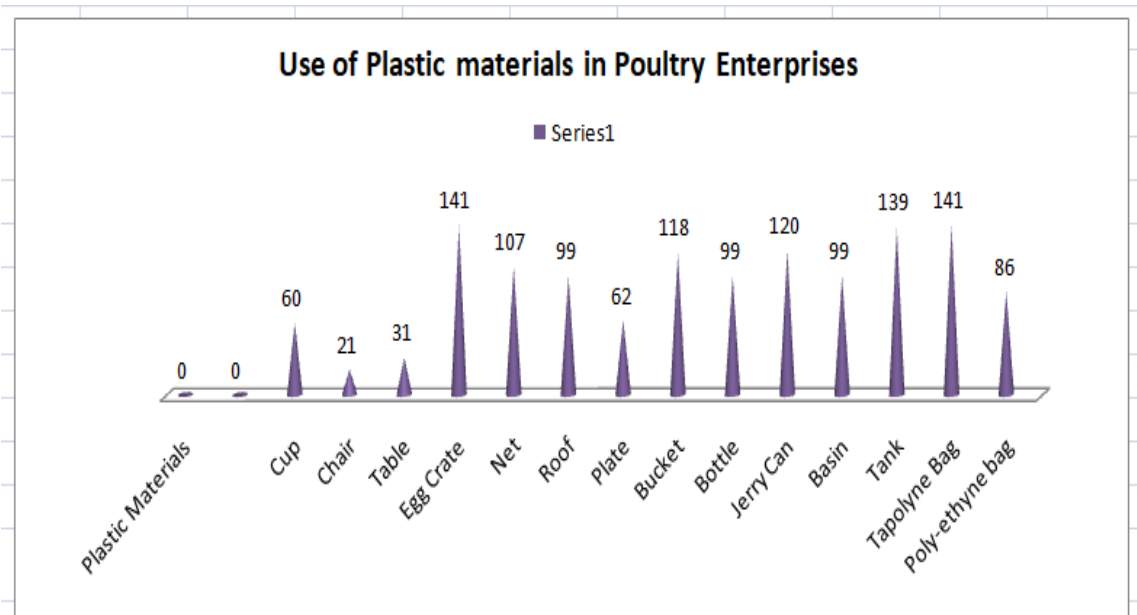


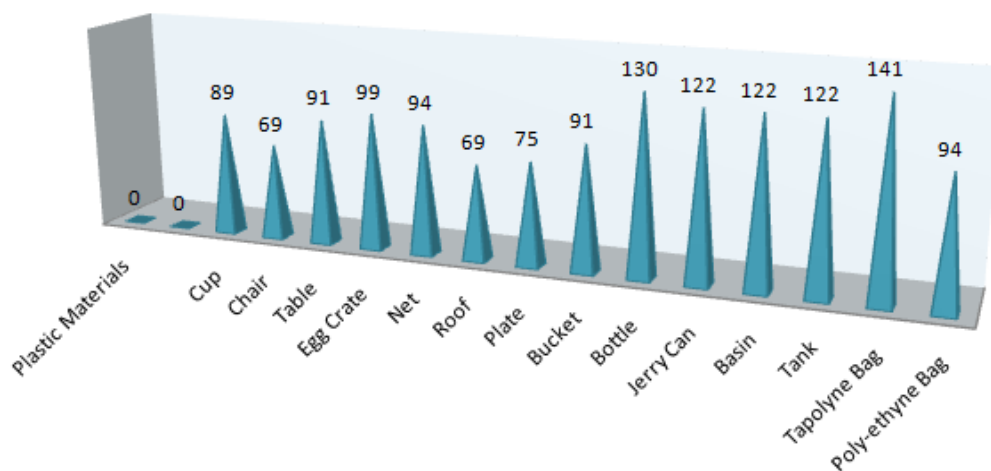
Fig. 3

Fig. 4



Use of plastic material in Processing/Packaging Enterprises

Fig. 5



DISCUSSION

1. MOST USED PLASTIC MATERIALS AMONG AGRO- ENTERPRISES

Vegetable/Garden Enterprises

Figure 1 showed the distribution of respondents based on their ratings on plastic products used in vegetable/garden enterprises. Most frequently used plastics in the agricultural activities of vegetable

farmers included; Plastic Basin ($\bar{x} = 1.92$), Jerry Can ($\bar{x} = 1.72$), Poly-ethyne Bag and Table $\bar{x} = 1.70$). This shows the relevance of these materials in haulage, and serving for placement of farm produce.

Agro-Marketing Enterprise

Figure 2 showed the distribution of respondents based on the ratings of plastic products used in agro-marketing enterprise. According to the findings, highly incorporated plastic materials/products among agro-marketers and their marketing enterprises includes; the use of Tapolyne Bags ($\bar{x} = 1.92$), Poly-ethyne Bags and Chair ($\bar{x} = 1.86$), Cup and Egg Crate ($\bar{x} = 1.80$). Low ranked plastic products include; plastic plate ($\bar{x} = 1.46$), Plastic Tank ($\bar{x} = 1.32$), Plastic Net ($\bar{x} = 1.20$). This implies that respondents have need for plastic to spread their farm produces, wrap same, and use them for storage. The chair is mostly use for convenience at stationed market points.

Horticultural/Nursery Enterprise:

The utilization of plastic materials such as; Poly-ethyne Bag ($\bar{x} = 1.94$), Tapolyne Bag ($\bar{x} = 1.86$), Plastic Bucket and Jerry Can ($\bar{x} = 1.78$) showed a hug prospect in horticultural enterprises as indicated in Figure 3. The use of plastic bags or polyethene bags promote transplanting of seedlings while roots of nursery plants are intact. Buckets and Jerry Can serve for watering and conveyance of material inputs.

Poultry Enterprises:

Figure 4 showed that poultry enterprises mostly utilize plastic materials such as; Egg Crates and Tapolyne Bags ($\bar{x} = 1.94$), Plastic Tanks ($\bar{x} = 1.92$) and Plastic Jerry Cans ($\bar{x} = 1.80$). This implies that most poultry farmers use Tapolyne for brooding purposes and Egg Crate for collection, storage and transportation of eggs.

Packaging and Processing Enterprises:

Figure 5 revealed that plastic materials mostly used by agricultural processors for their processing and packaging needs includes; Tapolyne Bags ($\bar{x} = 1.94$), Plastic Bottles ($\bar{x} = 1.86$), Jerry Cans, Plastic Basins, and Plastic Tanks ($\bar{x} = 1.81$). Packaging and Processing Enterprises most often utilize polybags such as Tapolyne for packaging farm produces, milled produce, as well as bye produce for waste collection. Other plastic materials identified are mostly used for containment and storage purposes.

Several authors have indicated the relevance of plastic materials to agricultural development in the study area. Etim and Effiong (2022), evaluated the benefits of the use of flexible and non-flexible plastic materials among Agro-Enterprise Owners in the Calabar Agricultural Zone of Cross River State, Nigeria. Studies on Climate Change impact on the use of Plastic Products Among Agro-Marketers and Horticultural Enterprises in Calabar Agricultural Zone of Cross River State (Etim, Effiong, Okoi, and Ntui, 2022), Rubber Production Technologies and the related socioeconomic environments (Effiong, and Aboh, 2018) and the assessment of the factors inhibiting the use of plastic materials among selected Agro-Enterprises and farmers in Calabar Agricultural Zone of Cross River State, Nigeria (Ntui, Effiong, Etim, and Okoi, 2022), are studies that support the findings of this study and further stressed the benefits of a plastic agro-economy as a prospect for agricultural development in Cross River State, Nigeria.

Most Used Plastic Materials Among the Selected Enterprises

Table 2 – Distribution of plastic materials mostly ranked among the selected enterprises

PLASTIC MATERIAL	VEGETABLE	AGRO-MARKET	ENTERPRISES			CODE
			NURSERY/HORTICULTURE	POULTRY	PROCESSING/PACKAGING	
Plastic Basin	A	-	-	-	C	AC
Jerry Can	B	-	C	C	C	BC ³
Plastic Table	C	-	-	-	-	C

Poly-ethyne Bag	C	-	A	-	-	CA
Tapolyne Bag	-	A	B	A	A	A ³ B
Plastic Bucket	-	-	C	-	-	C
Plastic Bottle	-	-	-	-	B	B
Plastic Tank	-	-	-	B	C	BC
Plastic Chair	-	B	-	-	-	B
Plastic Cup	-	C	-	-	-	C
Plastic Egg Crate	-	C	-	A	-	CA

Field Survey, 2024

KEY: 1st – A; 2nd – B; 3rd – C

From the above representation and coding in Table 2, various plastic materials were evaluated based on their level of usage between enterprises for the most used plastic materials among the selected enterprises. Indications proved that Tapolyne Bags have the highest prospect of agricultural usage among all other plastic materials with three 1st rankings in Agro-market, Poultry and Processing/packaging enterprises and one 2nd ranking for Nursery/Horticultural Enterprise (A³B). This is followed by Jerry Can which have one 2nd ranking for Vegetable enterprise and three 3rd rankings for Nursery/Horticultural, Poultry and Processing/packaging enterprises (BC³). This shows that these two plastic materials (Tapolyne Bags and Jerry Can) have a very high prospect for agricultural development among these enterprises.

Tapolyne Bags are very useful in spreading, packaging, and barricading farm stead to conserve heat as commonly used in poultry during brooding. Jerry Can is a veritable material for the storage, collection and transportation of water, oil, or all liquid/fluid inputs. It is mostly used in any activity that has to do with the provision/supply of water to the farm and in the enterprise. This finding supports the assertion of the Agricultural Plastic Recycling and Producers Survey Report, (2012) that majority of farmers in Alberta use one or more types of agricultural plastic in their farm activities.

Practical Measures and Prospects for Plastic Agricultural Development for Cross River State

Better policies for improved environmental management as formulated by Etim, (2018) brought forward a framework that can support best environmental management and reduction of plastic waste and pollution while enhancing rural development through employment, industrialization and expansion. There are;

1. There must be effective collaboration of all stakeholders such as the government, the plastic companies, plastic users across every sector, the enforcement agencies and NGOs.
2. There should be a policy framework that stipulates that every plastic producing company must own a plastic recycling plant.
3. Every plastic producing company must have a collection point for all its plastics at incentives to the users to motivate them to rid the environment of plastic waste. This will open more economic opportunity for plastic vendors.
4. There should be an adequate enforcement of environmental laws by environmental bodies
5. Environmental NGOs such as Safety Awareness and Environmental Support Initiative (SAESI) needs to be incorporated and inaugurated to support the government to ensure total cleanliness in the State, and Nigeria.
6. Adequate awareness must be created to increase the consciousness of the people to their environment to improve environmental sanitation.
7. There should be a participatory role of all stakeholders especially in the consumer sector. All restaurants, shops, super markets, beer parlour must have a collection bin or waste bin to collect all plastic materials at all times in their vicinity.
8. Entrepreneurs should be encouraged to explore the opportunities of an emerging industry in plastic recycling.

9. Development of environmental policies that attract investors through tourism and Leisure Park.
10. The government of Cross River State should encourage the production and use of plastic materials in agriculture
11. More agricultural plastic industries can be developed to further the expansion for a plastic driven agricultural economy.
12. The production of customized plastic products for farm shed, doors, housing, roofs, walls, among others should be encouraged.
13. Investment into plastic technologies to boost agricultural productivity through large scale industrial farming should be encouraged and practiced within the state.

CONCLUSION

The study therefore concludes that plastic materials have improved the value of agro-enterprises in the study area by serving as productive resources for their development, use and productivity of farmers while also enhancing their income and performance. The problem of plastic utilization in agriculture has been on pollution and sanitation concerns. The study has developed a framework for policy makers to harness the plastic opportunities in Agro-plastic waste initiatives, electricity generation, low input supply and the development of industries for the production of special, biodegradable and environmentally friendly agro-plastics in Cross River State.

RECOMMENDATION

From the findings of the study, the following recommendations were made;

1. Most used plastic products identified in this study implies that the materials have a very high economic value and prospect in agricultural development among these enterprises. Such plastic products should be reform to have more unique characteristics and produced in various patterns that meet the unique needs of each agro-enterprise.
2. The government of Cross River State should adopt the practical measures formulated by this study to improve on her environmental policy and increase her developmental prospect through harnessing the potentials of a plastic driven agricultural ecology for the economic development of the state. Government should also provide tax relief, subsidies and educational support (through agricultural extension) to farmers through the implementation of sustainable plastic models, practices and technologies.

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Theme: Agricultural Extension for Food Security and Community Empowerment

**Assessment of Post-Harvest Losses Reduction Strategies among
Pawpaw and Banana Merchants in Kano Metropolis, Kano State,
Nigeria**

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ABSTRACT

The study assessed post-harvest losses reduction strategies among pawpaw and banana merchants in kano metropolis. Specifically, the study described the socio-economic characteristics of pawpaw and banana merchants in selected markets of Kano metropolis, described strategies used by the merchants to reduce post-harvest losses in the marketing of pawpaw and banana at different stages in the study area. The specific markets selected for the research included the Yan Lemo fruit market, Yankaba market and Yankura. Descriptive statistics such as frequency counts, percentages, mean were used to realize the two objectives. The age distribution shows that majority of wholesale merchants have a mean age of 48.50 years, while retail pawpaw merchants fall within the 31-40 age group (51.7%). Wholesale banana merchants have a mean age of 42.95 years and Banana Retail Merchants are primarily in the 31-40 age range (36.5%). choice of good trucks (35%) and use of a good J5 bus (37.5%) and use of pickups (22.5%).with strategies such as advertisement (30% frequency), attractive packaging (22.5%), persuasion of buyers (32.5%), and price reduction (20%) being used to enhance marketability and stimulate demand and help to clear inventory, thus reducing losses associated with unsold produce Wholesalers and retailers should be trained on new management skills to improve post-harvest management practices

Key words; post-harvest losses, strategist, Retail, Wholesale.

INTRODUCTION

Quantitative food loss can be defined as a reduction in the weight of edible grain or food available for human consumption. This reduction in weight can be caused by factors such as spoilage, consumption by pests, and physical changes in temperature, moisture content, and chemical changes. However, it's important to note that reduction in weight due to drying, a necessary post-harvest process for all grains, should not be counted as loss since it does not result in a loss of food value.

Qualitative loss can occur due to insect pests, rodents, poor handling, physical changes, or chemical changes in fat, carbohydrates, and protein, and contamination of mycotoxins, pesticide residues, insect fragments, or excreta of rodents and birds. When this qualitative deterioration makes food unfit for human consumption and is rejected, it contributes to food losses. Post-harvest losses in tropical fruits vary widely from 10 percent to 80 percent in both developed and developing countries (Trostle, 2015; James *et al.*, 2018 Paredes, *et al.*, 2020). These losses occur across the supply chain and along the value addition chain (WFLO, 2015). In most developing countries, these losses are mainly due to poor infrastructure and logistics, poor farm practices, lack of post-harvest handling knowledge, and a convoluted marketing system (WFLO, 2015; FAO, 2016). Approximately 40 to 50 percent of horticultural products, including fruits and vegetables, are

lost before they reach consumers due to high rates of bruising, water loss, and subsequent decay during post-harvest handling (FAO, 2016). Fruits and vegetables in sub-Saharan Africa suffer considerable post-harvest losses, affecting their quality, quantity, aesthetic appeal, and nutrition (Aloka, *et al.*, 2023).

Controlling and preventing post-harvest losses is less costly than producing a similar amount of fruit loss. Post-harvest management not only determines the quality and safety of food but also its competitiveness in the market. However, fruit supply chains in developing countries lack sustainable post-harvest management systems. Despite global progress in increasing food production, approximately half of the population in the Third World does not have access to adequate food supplies, with food losses during the post-harvest and marketing system being a contributing factor. These losses tend to be highest in developing countries, Shiru *et al.*, (2023). It is against this background this study was design to determine the following objective;

The main objective of the study is to determine strategies used by merchants to reduce post-harvest losses in pawpaw and banana marketing in selected markets in Kano Metropolis of Kano State. The specific objectives were to;

- i. describe the socio-economic characteristics of pawpaw and banana merchants in selected markets of Kano metropolis
- ii. describe strategies used by the traders to reduces post-harvest losses in marketing of pawpaw and banana in the study area.

METHODOLOGY

Study Area

The research study was conducted in Kano State, which is situated in the Northern region of Nigeria. According to the 2006 population census, Kano State had an estimated population of 9,383,068. Taking into account an annual growth rate of 3.3%, it is anticipated that the population of Kano State could potentially reach 15,462,200 by the year 2022. Kano State is comprised of 44 Local Government Areas. The specific markets selected for the research include the Yan Lemo fruit market, located in Kumbotso Local Government Area along Na'ibawa Zaria Road and opposite Sa'adatu Rimi College of Education. Additionally, Yankaba market is situated along Hadeja road in Nasarawa LGA, and Yankura is positioned in Fagge LGA, bordering Sabongari market to the north and Singa market to the west.

Sampling Technique

A multistage sampling technique was used in selecting the sample for the study In the first stage three key markets where pawpaw and banana are commonly sold were purposively selected: These include Yankura Market, Na'ibawa Yanlemu, and Yankaba Market. These markets have been chosen due to the high number of pawpaw and banana sellers operating within them.

The second stage of sampling, the traders was categorized based on their sales volume, namely wholesalers and retailers. This categorization was done for each of the three markets.

Following this, in the third stage, a census for each category of sellers was conducted to determine the appropriate sample size, an online sample calculator called Qualtrics was use, which was updated on August 14, 2023. This tool enables to calculate the minimum number of samples required to meet statistical needs.

Table 1a; sample frame and sample size for pawpaw sellers.

Market	Sampling Frame Whole seller	Retailer	Sample size Whole seller	Retailer
Namibia 'Yan lemo	39	110	36	86
'yankaba	1	14	1	14
'yankura	2	20	2	20
Total	42	144	39	120

Source; Nigeria Fruits Sellers Association Kano Chapter 2024.

Table 1b; sample frame and sample size for banana merchants.

Market	Sampling Frame Whole seller	Retailer	Sample size Whole seller	Retailer

Na'ibawa 'Yan lemo	16	90	16	76
'yankaba	1	13	1	13
'yankura	2	12	2	12
, Total	19	115	19	101

Source; Nigeria Fruits Sellers Association Kano Chapter 2024.

Analytical Tools

The analysis of the data for this study involved using descriptive statistics, such as frequency counts, percentages, mean, coefficient of variability, and standard error were used.

RESULTS AND DISCUSSION

4.1 Socio-Economic Characteristics of the Pawpaw and Banana Merchants

Table 1a: Distribution of Pawpaw and Banana merchants according to their socio-economic variables (Qualitative)

					BANANA				
		Wholesale		Retail		Wholesale		Retail	
Class Interval	Freq	Perc	Freq	Perc	Freq	Perc.	Freq	Perc.	
Age									
18-30	-	-	32	26.7	5	26.3	34	29.6	
31-40	13	32.5	62	51.7	9	47.4	42	36.5	
41-50	12	30.0	19	15.8	4	21.1	30	26.1	
51-60	12	30.0	7	5.8	1	5.3	8	7.0	
61-70	3	7.5	-	-	-	-	1	.9	
Total	120	100	120	100	19	100.0	115	100.0	
Minimum	34		19		28		22		
Maximum	68		66		59		65		
Std Dvts	9.443		9.014		9.107		10.373		
Mean	48.50		35.88		42.95		37.63		
House hold size									
1-10	2	5	23	19.5	15	78.9	34	29.6	
11-20	11	27.5	53	44.2	2	10.5	54	47.0	
21-30	17.0	42.5	36	30.0	1	5.3	15	13.0	
31-40	10	100	8	6.7	1	5.3	12	10.4	
Total	40	100	120	100	19	100.0	115	100.0	
Minimum	6.00		3.00		6.00		4.00		
Maximum	113.00		32.00		22.00		24.00		
Std Dvts	16.29		5.91		4.46		4.2745		
Mean	18.42		11.650		12.15		8.9913		
Trade Exp.									
1-10	1	2.5	13	10.8	5	26.3	71	61.7	
11-20	9	22.5	28	23.3	3	15.8	12	10.4	
21-30	11	27.5	51	42.5	8	42.1	14	12.2	
31-40	19	47.5	28	23.3	3	15.8	18	15.7	
Total	40	100	120	100	19	100	115	100	
Minimum	12		5		11.00		6.00		
Maximum	29		60		35.00		38.00		
Std Dvts	4.883		14.10		7.23		9.1761		
Mean	21.47		7.179		21.63		17.6261		

Source: Field Survey, 2024

The result in table 1a; above reveals that wholesale pawpaw merchants have a mean age of 48.50 years, while retail pawpaw merchants have a mean age of 35.88 year. Wholesale banana merchants have a mean age of 37.63 year and Banana Retail Merchants It was also revealed in a study conducted by Oyewo *et al*, (2023) in Oyo State, Nigeria that Pawpaw and banana merchants are relatively young and within the working age. This suggests that they are energetic and able to deal with the demands of the business. These age groups were more physically and mentally ripe for taking marketing risks and uncertainties and were more likely to be saddled with the responsibilities of managing resources earmarked for marketing activities.

It was revealed from the results that Retail pawpaw merchants predominantly have a household size of 11-20 persons (44.2%), with a mean of 11.65. Wholesale pawpaw merchants have a larger mean household size of 18.42. Banana retail merchants mostly have a household size of 1-10 (29.6%), with a mean of 8.99, while wholesale merchants have a mean household size of 12.15. A large household size can provide family labor for lively wood activities (Lowder, *et al*, 2016; Adenso *et al*, 2017).

The table 1b, presents the distribution of pawpaw and banana merchants based on gender, marital status, level of education, and membership in marketing associations. It was categorized in to wholesale and retail merchants for both pawpaw and banana. The results include frequencies and percentages for each variable.

Table 1b: Distribution of Pawpaw and Banana merchants according to their socio-economic variables (Quantitative)

PAWPAW				BANANA				
variable	Wholesale frequency	%	Retailer Frequency	%	Wholesale frequency	%	Retailer frequency	%.
Gender								
Male	40	100.0	5	4.2	18	94.7	113	98.3
Female	-	-	115	95.8	1	5.3	2	1.7
Total	40	100	120	100.0	19	100.0	115	100.0
Marital Status								
Married	1	2.5	126	96.7	15	79	77	67.0
Single	39	97.5	4	3.3	4	21	38	33.0
Total	40	100.0	120	100.0	19	100.0	115	100.0
Education								
Quaranic	16	40.0	52	43.3	1	5.3	20	17.5
Primary	20	50.0	56	46.7	4	21.1	10	8.5
Secondary	4	10.0	12	10.0	7	36.9	73	62.6
Tertiary	-	-	-	-	7	36.8	12	10.4
Total	40	100.0	120	100.0	19	100.0	115	100.0
Membershi p of Coop.								
Yes	39	97.5	111	92.5	10	52.6	76	66.1
No	1	2.5	9	7.5	9	47.4	39	33.9
Total	40	100.0	120	100.0	19	100.0	115	100.0

Source: Field Survey, 2024

Result in table 1b; shows that wholesale pawpaw merchants were female (100%), while Retail pawpaw merchants are predominantly male (95.8%). And for the banana it was revealed that wholesale banana merchants were also male (94.7%). Retail banana merchants are overwhelmingly male (98.3%), this suggests males dominating retail pawpaw marketing and wholesale pawpaw marketing, as well as both retail and wholesale banana marketing (Kwamboka, 2018). Differences in gender preferences might stem

from the different roles that women and men play in the banana value chain, such as cooking for women and beer production for men (Balana, *et al*, 2022)

Table 1b, Retail pawpaw merchants are almost evenly split between Quranic (43.3%) and primary education (46.7%), while wholesale pawpaw merchants have Quranic (40%) and primary education (50.0%). Banana wholesale merchants have primary (21.1%), secondary (36.9%), and tertiary education (36.8%). While Retail banana marketers have a mix of Quranic (17.5%), primary (8.5%), secondary (62.6%), and tertiary education (10.4%). Banana merchants generally have higher levels of formal education than pawpaw merchants, which may influence their marketing strategies and access to information (Mateows *et al*, 2015). Higher education levels among banana merchants may lead to better adoption of new cultivars and marketing strategies (Flarian *et al*, 2018)

It was revealed that wholesale (97.5%) pawpaw merchants belong to a marketing association while a larger number (92.5%) are retailers. Result also shows that wholesale banana merchants have a membership of 52.6%, while banana retail merchants show lower membership (66.1%) compared to pawpaw merchants. Membership in marketing associations can provide access to resources, market information, and collective bargaining power, which may explain the higher participation rates among pawpaw merchants. Encouraging membership in marketing associations can empower merchants, improve their access to resources, and enhance their bargaining power (Ma, *et al*, 2023).

Table2a; strategies used by the wholesalers to reduced post -harvest losses during marketing pawpaw.

Actors	Causes of PHL	Strategies used to reduce PHLs	Freq.	Perc.
Pawpaw Wholesalers	poor market patronage	Advertisement of the produce	12	30
		attractive packaging	9	22.5
		persuasion of buyers	13	32.5
		Price reduction	8	20
	Bad transportation facility	choice of good trucks	14	35
		Use of good J5 bus	15	37.5
		use of pickup	9	22.5
	Bad road	Night travel	6	15
		Use of good J5 bus to deliver fast	16	40
		Use of good truck for fast deliver	22	55
		spreading under shade	20	50
	outdated storage facility	use of jut bags	14	35
		spreading in open	16	40
		Use of good J5 bus for fast deliver	17	40.5
		Use of good truck for fast deliver	14	35
	Larger distance	Purchase of unripe fruit	15	37.5
	Inadequate post-harvest management skill	training on new management skill	20	50
		Adopting new management skill	20	50
		Purchase of healthy fruit.	18	45
	Pest attack and Disease Infestation	use rat killer	9	22.5
	Time of marketing	persuasion of buyers	15	37.5
		Purchase of healthy fruit	18	45
		attractive packaging	15	37.5

Weather condition			
	use of jut bags	17	40.5
	spreading under shade	16	40

Source: field survey 2024.

The findings in table 2a, indicates that Poor Market Patronage is identified as a significant cause of PHLs, with strategies such as advertisement (30% frequency), attractive packaging (22.5%), persuasion of buyers (32.5%), and price reduction (20%) being used to enhance marketability. Effective marketing can stimulate demand and help to clear inventory, thus reducing losses associated with unsold produce (Saha *et al.*, 2021). Inadequate transportation facilities contribute to losses where strategies employed include choice of good trucks (35%) and use of a good J5 bus (37.5%) and use of pickups (22.5%). The emphasis on advertising and attractive packaging indicates a proactive approach by wholesalers to enhance visibility and appeal in a competitive market. A study in Cameroon reported that 30-50% of bananas are lost at post-harvest stages due to inadequate handling and poor infrastructure¹. This aligns with the findings regarding Pawpaw, where transportation and storage issues are prevalent.

One of the notable strategies is the emphasis on improving transportation facilities, particularly the use of trucks (55% frequency) and J5 buses (40% frequency), which are critical for ensuring fast and reliable deliveries. This aligns with findings from other studies that highlight the importance of efficient transportation in mitigating spoilage and maintaining produce quality (Jansen & van der Lans, 2018). Outdated Storage Facilities where inadequate storage methods increase spoilage risks. Strategies which include spreading under shade (50%), using jute bags (35%) and spreading in the open (40%).

It was also revealed from the result that longer transport distances exacerbate losses. Strategies include using good J5 buses for fast delivery (40.5%), using good trucks for fast delivery (35%) and purchasing unripe fruit to reduce spoilage during transit (37.5%). The focus on using better vehicles highlights the importance of reliable logistics in reducing damage during transit. Inadequate Post-Harvest Management Skills where lack of skills in post-harvest management leads to higher losses. Strategies include training on new management skills (50%), adopting new management techniques (50%).

The emphasis on purchasing healthy fruit (45%) as a preemptive strategy against pest attacks and disease infestation demonstrates an understanding that quality at the point of purchase can mitigate losses later in the supply chain. This aligns well with agricultural best practices that advocate for the selection of high-quality produce to minimize risks (FAO, 2018).

The timing of sales can impact fruit quality, with strategies including persuasion of buyers (37.5%), purchasing healthy fruit (45%), and attractive packaging (37.5%). The adoption of training programs signifies an acknowledgment of the need for improved skills in post-harvest management, which is crucial for minimizing losses. Research has shown that training farmers on post-harvest management techniques can significantly reduce losses. This is reflected in the strategies used by Pawpaw wholesalers who prioritize skill development.

Adverse weather can affect fruit quality, leading to strategies like using jute bags for protection during transport (40.5%) and spreading under shade to prevent spoilage (40%). The strategies addressing weather conditions reflect an understanding of the external factors affecting fruit quality, suggesting that wholesalers are adapting their practices accordingly.

Post-harvest losses in the banana supply chain can be substantial, occurring at various stages from harvesting to consumption. Banana is a climacteric perishable fruit and therefore, its postharvest losses are relatively high and occur mainly during handling and transportation in the supply chain. Addressing those issues is essential for minimizing losses and enhancing the efficiency of the banana supply chain.info@naae.org.ng

Table: 2b: Strategies used by the wholesaler to reduced post-harvest losses during marketing Banana.

Actor	Causes of PHL	Strategies to reduced PHLS	Freq.	Perc.
Banana Wholesalers	poor market patronage	Advertisement of the produce	13	62.42
		attractive packaging	7	36.84
		persuasion of buyers	9	47.37

Bad mode transportation facility	Price reduction	11	57.89
	choice of good trucks	15	78.95
	Use of good J5 bus	10	52.63
Bad road	Night travel	11	57.89
	Use of good J5 bus to deliver fast	12	63.16
	Use of good truck for fast deliver	10	52.63
outdated storage facility	spreading under shade	16	82.21
	use of jut bags	17	89.47
	spreading in open	10	52.63
Larger distance	Use of good J5 bus for fast deliver	11	57.89
	Use of good truck for fast deliver	14	73.68
	Purchase of unripe fruit	15	78.95
inadequate post-harvest management skill	training on new management skill	16	84.21
	Adopting new management skill	13	68.42
Pest attack and Disease Infestation	Purchase of healthy fruit.	13	68.42
	use rat killer	7	36.84
Time of marketing	persuasion of buyers	12	63.16
	fruit Purchase of healthy	15	78.95
	attractive packaging	8	42.11
Weather condition	use of jut bags	14	73.68
	spreading under shade	15	78.95

Source: field survey 2024.

The strategies used by wholesalers to reduce post-harvest losses (PHL) in the marketing of bananas, as outlined in Table 2b; reveal a multifaceted approach to addressing various challenges. The highest frequency strategy is the use of jut bags (89.47%), which highlights the importance of proper packaging in preserving fruit quality during storage and transport (Table 2). Additionally, the need for good transportation facilities is underscored by the high percentages for choosing suitable trucks (78.95%) and using J5 buses (52.63%). These findings align with existing literature that emphasizes the significance of robust transport and storage solutions in mitigating post-harvest losses (Oluoch *et al.*, 2020; FAO, 2019). The prominent strategies addressing poor market patronage, such as advertising (62.42%) and attractive packaging (36.84%), suggest an understanding among wholesalers of the need to enhance consumer interest and perceptions about the product. These tactics are supported by research showing that effective marketing strategies can significantly influence consumer behavior and reduce unsold inventory (Kumar *et al.*, 2021). Wholesalers also recognize the impact of environmental factors, as indicated by their strategies to address weather conditions (73.68%, spreading under shade) and time management in marketing (63.16%, persuasion of buyers). This awareness aligns with studies indicating that environmental challenges, like extreme weather, can significantly affect agricultural outputs and market access (Morris *et al.*, 2018). Moreover, the dimensions of training and skill development (84.21% for training on new management skill) are vital, suggesting that enhancing the capabilities of wholesalers can contribute significantly to the reduction of PHL. This finding resonates with other research advocating for capacity building as a mechanism to improve post-harvest management practices (Kehinde *et al.*, 2022).

The findings from this study are consistent with previous research indicating that effective post-harvest management strategies can significantly reduce losses. Furthermore, the integration of technology, such as temperature-controlled storage and transport solutions, has been identified as a game-changer in minimizing losses and enhancing market access (World Bank, 2021).

The implications of these findings suggest that to effectively reduce post-harvest losses, stakeholders within the banana supply chain must invest in both physical and human capital. This may include ensuring that wholesalers are equipped with the right vehicles and training to optimize handling practices while simultaneously focusing on marketing strategies that enhance consumer engagement. Additionally, collaborative approaches among farmers, wholesalers, and policymakers are essential to address infrastructural gaps and improve overall supply chain efficiency.

Table 2c; strategies used by the retailers to reduced post -harvest losses during marketing pawpaw.

	Causes of PHL	Strategies to reduced PHLs	Freq.	Perc.
Pawpaw Retailers	poor market patronage	Advertisement of the produce	55	45.83
		attractive packaging	63	52.50
		persuasion of buyers	39	32.50
		Price reduction	40	33.33
	Bad transportation facility	Choice of good kekenep for transport	34	28.33
		use of good wheel barrow	68	56.67
		use of taxi	35	29.17
	Outdated storage facility	Spreading under shade	92	76.67
		use of jut bags	112	93.33
		spreading in open	100	83.33
	Inadequate post-harvest management skill	Training on new management skill	68	56.67
		Adopting new management skill	51	42.5
	Pest attack and Disease Infestation	Fruit Purchase of healthy.	87	72.50
		use rat killer	20	16.67
	Time of marketing	Persuasion of buyers	66	55.00
		Fruit of Purchase of healthy	76	63.33
		attractive packaging	48	40.00
	Weather condition	use of jut bags	110	91.67
		spreading under shade	100	83.33

Source: field survey 2024.

The strategies used by retailers to reduce post-harvest losses (PHL) in the marketing of pawpaw, as shown in Table 2c, indicate a comprehensive approach to overcoming the challenges faced in maintaining fruit quality and enhancing consumer appeal. Notably, the use of jut bags (93.33%) and the practice of spreading under shade (76.67%) stand out as paramount strategies, which signify an emphasis on effective storage and handling in preserving fruit quality during transportation and storage. These findings resonate with existing studies that underscore the importance of appropriate packaging and environmentally controlled storage in minimizing post-harvest losses (Alonso et al., 2020; FAO, 2019).

Retailers also recognize the criticality of improving market visibility and consumer engagement. Strategies such as attractive packaging (52.50%) and promotional activities (45.83% for advertisement of the produce) underscore the need for retailers to invest in marketing initiatives that enhance the perceived value of

pawpaw. Research supports that effective marketing can significantly influence consumer purchasing decisions and help reduce inventories of unsold products (Simpson et al., 2021).

Additionally, the focus on training for improving post-harvest management skills (56.67%) emphasizes the importance of equipping retailers with the necessary knowledge to adopt modern practices for managing pawpaw effectively. This aligns with similar findings that advocate for capacity-building initiatives within the agricultural sector to help mitigate post-harvest losses (Kehinde et al., 2022).

Retailers' strategies also reflect addressing transportation challenges, with the use of good wheelbarrows (56.67%) as a prominent tactic, emphasizing the need for suitable transport means to minimize mechanical damage and losses. This insight is supported by existing literature that asserts the significance of proper transportation facilities in maintaining produce quality during supply chain operations (Jansen & van der Lans, 2018).

The strategies used by retailers to reduce post-harvest losses (PHL) in banana marketing, as summarized in Table 4. The analysis reveals that retailers employ a variety of strategies to combat post-harvest losses in bananas, therefore, this table outlines strategies used by retailers to reduce post-harvest losses (PHLs) during the marketing of bananas.

Table: 2d: strategies used by the retailers to reduced post- harvest losses during marketing Banana.

Actors	Causes of PHL	Strategies to reduce PHLs	Freq.	Perc.
Banana Retailers	poor market patronage	Advertisement of the produce	68	67.33
		attractive packaging	80	97.21
		persuasion of buyers	94	93.07
		Price reduction	45	44.55
	Bad transportation facility	Choice of good kekenep for transport	76	75.25
		use of good wheel barrow	98	97.03
		use of taxi	82	81.19
	Outdated storage facility	Spreading under shade	95	94.06
		use of jut bags	90	89.11
		spreading in open	80	79.21
	inadequate post-harvest management skill	Training on new management skill	85	84.16
		Adopting new management skill	90	89.11
	Pest attack and Disease Infestation	Purchase of healthy fruit.	97	96.04
		use rat killer	46	45.54
		Covering	80	79.21
	Time of marketing	Persuasion of buyers	85	84.16
		Fruit of Purchase of healthy	68	67.33
		attractive packaging	95	94.06
	Weather condition	Use of jut bags	90	89.11
		spreading under shade	90	89.11

Source: field survey 2024.

This result in table 2d; demonstrate a broad understanding of the challenges associated with maintaining banana quality throughout the distribution process. The findings reveal that attractive packaging (97.21%) and the use of good wheelbarrows (97.03%) are among the most frequently used strategies. This indicates

a strong correlation between effective presentation and physical handling of the product in reducing losses. These results align with research showing that appealing packaging not only enhances consumer interest but also minimizes mechanical damage during transportation and display (Laga, et al., 2017). Additionally, these findings imply that retailers should prioritize investments in both logistics and training to enhance their operational effectiveness. This could lead to a more efficient supply chain that not only lowers losses but also improves profit margins and consumer satisfaction.

The high frequency of strategies emphasizing persuasion of buyers (93.07%) and advertisement of the produce (67.33%) highlights the importance of marketing efforts in facilitating consumer engagement. This aligns with studies that reveal how promotional activities can enhance market demand and reduce unsold inventory (Saha et al., 2022). Moreover, the strategies employed by retailers reinforce the position of comprehensive supply chain management as a critical factor in reducing losses. According to the International Fund for Agricultural Development (IFAD, 2020), successful post-harvest loss mitigation combines effective storage, improved logistics, and robust marketing strategies.

In addition, a significant focus on improving transportation methods is evident, with options such as choosing good transportation means (75.25%) and using taxis (81.19%) being used. This emphasis on transportation strategies indicates that retailers recognize the detrimental effects of poor transport on banana quality (Jansen & van der Lans, 2018). Ultimately, stakeholders across the supply chain from producers to retailers must collaborate to develop comprehensive strategies that encompass marketing, transportation, and storage solutions. Collaborative efforts can lead to improved techniques, infrastructure, and practices that ensure the preservation of banana quality and affordability in the marketplace.

The results also reflect a commitment to improving storage conditions, as indicated by the widespread use of shadows for storage (94.06%) and jut bags (89.11%). These strategies are crucial to maintaining fruit quality and reducing decay rates, consistent with literature highlighting proper storage conditions as essential for minimizing post-harvest losses (Alonso et al., 2020). These findings similar with a previous study that emphasized the multi-dimensional approach required to reduce post-harvest losses effectively. For instance, studies by Kader (2005) have shown that combining proper handling techniques, optimal packaging, and marketing can significantly decrease losses in various fruit crops, including bananas.

The emphasis on training and adopting new management skills (84.16% and 89.11%, respectively) demonstrates the recognition of the importance of human capital in managing post-harvest processes effectively. This resonates with findings from Kehinde et al. (2022), which advocate for training programs to enhance retailer skills in post-harvest management.

CONCLUSION AND RECOMMENDATIONS

The study highlights the significance of post-harvest losses in pawpaw and banana marketing in Kano Metropolis, Nigeria. The results demonstrate that post-harvest losses are substantial and occur at various stages of the supply chain. The study also identifies the need for effective strategies to reduce post-harvest losses, including improving transportation facilities, using jute bags for packaging, spreading under shade for storage, training on new management skills, and adopting new management techniques. it is recommended that governmental and non-governmental organizations encourage female participation in pawpaw and banana enterprises to reduce the possible imbalance in the supply chain of pawpaw and banana in the study area. it is recommended that there should be an improvement in transportation facilities to reduce post-harvest losses during transportation.

Wholesalers and retailers should be trained on new management skills to improve post-harvest management practices

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**Assessing the Utilization of Climate Change Adaptation Information
among Maize Farmers in Akwa Ibom State, Nigeria for Enhanced
Climate Resilience**

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ABSTRACT

Climate change poses significant threats to maize production in Nigeria, necessitating the development of effective adaptation strategies. The availability of climate change information does not necessarily lead to more successful adaptation; even when climate change adaptation information is available, there are still obstacles to its efficient use. The study investigated the utilization of available climate change adaptation information among maize farmers in Akwa Ibom State, Nigeria: Implication for climate resilience approach. The study employed a mixed-methods approach, combining surveys, interviews, and focus group discussions. Data for the study were obtained from 150 maize farmers, using a multi-stage sampling procedure and analyzed using descriptive statistics. Result shows that most of the information is always conveyed by fellow farmers (29.3%), friends/neighbours (16.7%) and radio (14.0%). The findings reveal that planting multiple crops to spread risk and optimize yields (91.3%), information on preparation for pest and disease outbreaks (86.7%), rotating maize with legumes to maintain soil fertility and reduce pest and disease pressure (82.1%) and information on preservation of seeds for planting (62.1%) were the climate change adaptation information mostly available. A grand mean of $\bar{X}=2.38$ indicated that 72% of the climate change adaptation information were utilized by farmers. Access to information and utilization were hindered by several factors, including inadequate information on climate change adaptation ($\bar{X}=2.52$) and high cost of improved maize resistance varieties ($\bar{X}=2.46$). The study concluded that, dissemination of climate information to end-users for successful adaptation is ineffective and the channels for communication have received less attention. The study recommends the development of targeted climate change information dissemination strategies, capacity building for extension agents, and the promotion of climate-resilient agricultural practices.

Key Words: Climate Change Adaptation Information, Utilization, Maize farmers

INTRODUCTION

Agriculture is the major source of livelihood in many developing African countries. The World Bank estimated that 2.5 out of 3 billion rural inhabitants in developing countries are involved in agriculture, with 1.5 billion in smallholder households (Musandiwa, 2024). In Nigeria, large proportion of the rural populace depend on agriculture as their major source of livelihoods. Approximately 90% of rural households are involved in farming activities, which is largely dependent on rainfall patterns. Therefore, any disruption in these patterns is likely to negatively impact rural livelihoods. Rural farmers have observed an unpredictable rainfall pattern which have led to not planting at all in some seasons because they would have to wait for the right rainfall frequency and until then, it is too late to plant. Also, consecutive drought years had now discouraged them from planting at all.

Climate change is emerging as a significant contributor to food insecurity in Nigeria, as it continues to affect the pattern and intensity of rainfall, which in turn poses a threat to agricultural production. When rainfall exceeds the soil's capacity for absorption, it leads to flooding. According to researchers at the World Weather Attribution, flooding an annual occurrence in Nigeria, is now 80 times more likely to take place in the country due to the climate crisis (Ekpali, 2023). Climate change continues to be a pressing global issue, with significant impacts on agriculture, food security, and rural livelihoods. The most susceptible or vulnerable are developing countries, especially Nigeria. The country situation is worsening the fragility of its ecosystems and human societies leading to increased vulnerability (Zadawa and Omran, 2020; Rathoure and Patel, 2020). Extreme weather conditions, fierce longer dry seasons, and shorter, more intense rainy seasons exacerbate the challenges (Nwankpa, 2022). This negative impact is directly associated with agriculture and its productivity.

Maize (*Zea mays* L.) is one of the most widely cultivated crops in Nigeria, accounting for over 33 million tons annually (FAO, 2020) produced by smallholder farmers on over 6.5 million hectares of land across diverse agroecological zones of the country (Onumah et al., 2022). As a quick maturing crop, it has become the most consumed staple food (USDA, 2020) for rural families when food reserves are depleted before the root crops, sorghum, millet, and other native crops are harvested. It is by far the largest cereal crops in terms of area and production volume (Onumah et al., 2022). In Sub-Saharan Africa (SSA), maize is a vital crop, providing livelihoods for millions of farmers. Maize is a crop of notable interest for food security in many parts of sub-Saharan Africa (SSA) (Van Ittersum et al., 2016). In developing countries especially Nigeria, many households depend mostly on maize as their preferred grain to other crops such as sorghum and millet.

In Nigeria, maize contributes to food security, provides job opportunities and promotes Nigeria economic development, as is valued at around \$6 billion, providing employment and income for millions of people (FAO, 2017; Adeogbo, Ojo & Adetoro, 2021). Apart from human consumption, maize is also used in animal feed, pharmaceutical industries, food manufacturers, breweries, flour mills and other industries. Nearly 80 percent of the maize grain is used for human consumption and animal feed with the remaining 20 percent utilized for industrial processing of diverse products (Onumah et al., 2022). With a per capita consumption of about 35 kg per person per year, maize accounts for an estimated 10% of the daily calorie intakes in the country. The crop is also an important source of cash income for farmers and contributes significantly to agro-industrial development particularly in the livestock feed industry (Wossen et al., 2017).

Maize has become an invaluable crop fitting into the existing diverse farming systems because of its broad adaptation to varying growing conditions, ease of processing and resistance to pre-harvest bird damage that plagued sorghum millet and rice (Fakorede et al., 2022). However, maize production is highly vulnerable to climate change, with rising temperatures, changing precipitation patterns, increased frequency of extreme weather events and pests and diseases (Sato et al., 2020). Climate change poses significant challenges to maize production in Nigeria, particularly in Akwa Ibom State. Rising temperatures, erratic rainfall patterns, and increased frequency of extreme weather events threaten food security and the livelihoods of smallholder farmers (Obot and Obiekwe, 2020). The most threatening issue of climate change is that experienced farmers cannot predict when to plant their maize due to irregular seasons and this has caused a general decline in the yield of maize thereby resulting in hunger.

However, effective information dissemination and utilization of climate change information by the farmers can play a crucial role in enhancing climate resilience in maize production (Arimi, 2021). Climate resilience in this context refers to the farmers to anticipate, absorb, and adapt to the impacts of climate change, while also transforming and thriving in the face of climate-related shocks and stresses. Climate resilience involves; understanding and preparing for potential climate-related hazards and impact; withstanding and coping with the impacts of climate-related events, such as droughts, floods, and heatwaves; adjusting practices, policies, and systems to respond to changing climate conditions and reduce vulnerability and embracing opportunities for sustainable development, innovation, and growth in the face of climate change. Climate resilience is essential for reducing the risk of climate-related disasters and protecting human well-being; maintaining ecosystem services and promoting biodiversity in the face of climate change and building resilient economies and infrastructure to withstand climate-related shocks. In recent years, great

emphasis has been placed on the need to make information on climate resilience both valuable and beneficial to decision-makers (Vincent et al., 2020).

PROBLEM STATEMENT

Several research activities have resulted in the availability of climate data at various temporal and regional scales (Arimi and Adebayo, 2024) and such data is becoming more widely available (Hewitson, 2017). This, however, has not always resulted in more successful adaptation (Arimi and Adebayo, 2024). Even when information is available, there are still barriers to its efficient application in decision-making. Perhaps most of the climatic information providers do not always have the knowledge and skills in transmitting the right information to end users (Vincent et al., 2020), who need the information in transforming their production activities. Farmers' adaptation to climate change requires the use of timely and relevance information transmitted or communicated to them and good communication depends on the techniques used by the extension agents in reaching out to the farmers. Maize farmers face a lot of climate change challenges as their access to information have not translated into effective adaptation which makes most of the farmers vulnerable to extreme events of climate change.

In Akwa Ibom State, evidence shows that rural farmers, knowingly or unknowingly have been adapting to the changing climatic conditions over time, through their traditional knowledge, innovations, and practices (Nkeme et al., 2023). They have been experiencing shortage of rainfall in farming season which have resulted in late farming activities and consequently low yield recorded during the harvest time. Shortage of rain fall is predictable, so what went wrong? Mounting aggressive awareness campaign and providing adaptation information on climate change is very possible but using the information is entirely different. Studies have revealed that utilization of climate change adaptation information would certainly help in mitigating and or adapting the effects of this menace and enhances food security (IImam and Babuga 2021; Nkeme et al., 2023). Therefore, the need for effective utilization of climate adaptation information among maize farmers in Akwa Ibom State, has become necessary. It is on this note that this study intends to investigate the climate change adaptation information utilization among maize famers in Akwa Ibom State, Nigeria: an implication for climate resilience.

OBJECTIVES OF THE STUDY

The broad objective of the study is to assess the climate change adaptation information utilization among maize famers in Akwa Ibom State, Nigeria: Implications for climate resilience.

The specific objectives of the study are to;

- i. describe the socio-economic characteristic of maize farmers in the study area;
- ii. examine the climate adaptation information available in the study area;
- iii. identify the most effective channels for disseminating climate adaptation information to maize farmers in the study area;
- iv. determine the extent of utilization of climate adaptation information in the study area;
- v. identify the constraints to utilization of climate change adaptation information in the study area;

HYPOTHESIS OF THE STUDY:

H0: There is no significant relationship between the socio-economic characteristic of the respondents and the utilization of climate change adaptation

METHODOLOGY

Study area: Akwa Ibom State is located in south-south Nigeria with an elevation of 42.58 m (139.7 feet) above sea level and having a tropical monsoon climate. The city's yearly temperature is 28.47°C (83.25°F) and it is -0.99% lower than Nigeria's averages. Akwa Ibom typically receives about 342.56 mm (13.49 inches) of precipitation and has 294.37 rainy days (80.65% of the time) annually.

Method of data collection

The data were collected with the aid of a structured questionnaire using interview schedule. The questionnaire was administered in the English language but was interpreted to the respondents in their local language through trained enumerators who were fluent in the local languages.

Sampling procedure

The study employed a multi-stage sampling technique in selecting 150 respondents in the study area. Three Agricultural Zones, Abak, Ikot Ekpene and Uyo, out of the 6 Agricultural Zone in the State were randomly selected in the first stage. The second stage involved the random selection of 5 farming communities in the selected zones. In the final stage, 10 maize farmers were randomly selected from the list of maize farmers in each of the chosen community. In all, 150 maize farmers were used for the study.

Data analysis

The data collected were analyzed using descriptive and inferential statistics.

Regression analysis was used to examine the relationship between the socioeconomic characteristics of respondents and the use of climate change adaptation information.

Model specification

The independent variables are the socio-economic characteristics of maize farmers while the dependent variable is utilization of climate change adaptation information.

The equation was stated in the linear, exponential, double log and semi-log forms. The variables comprise age, sex, education, marital status, farming experience, house hold size, income and size of farm.

The implicit form of the linear regression model is

$$Z = f((X_1, X_2, X_3, X_4, X_5 \dots X_n) + e$$

Where Z represents the utilization of climate change adaptation information by maize farmers in Akwa Ibom State (used=1, not used 0)

X₁ represents the sex of the maize farmers (male = 1, or female = 2),

X₂ represents the age of the maize farmers (in years),

X₃ represents farming experience of maize farmers (in years)

X₄ represents the level of education of the farmers (in years spent in school),

X₅ represents marital status of farmers (Single =1, or Married = 2)

X₆ represents the household size (number of persons),

X₇ represents the farm size (number of hectares), while

X₈ represents the monthly income of the maize farmers (in Naira).

e is the error term

The relationship between the dependent and the independent variable(s) was examined using the four functional forms: Linear, semi-log, exponential and double log functions.

Linear function $Z = a_0 + a_1X_1 + a_2X_2 + a_3X_3 + a_4X_4 + a_5X_5 + e$ Semi-log function $Z = a_0 + a_1 \log X_1 + a_2 \log X_2 + a_3 \log X_3 + a_4 \log X_4 + a_5 \log X_5 + e$

Exponential function $\log Z = a_0 + a_1X_1 + a_2X_2 + a_3X_3 + a_4X_4 + a_5X_5 + e$

Double log function $\log Z = a_0 + a_1 \log X_1 + a_2 \log X_2 + a_3 \log X_3 + a_4 \log X_4 + a_5 \log X_5 + e$

Where, a₀ represents the intercept a₁ to a₅ represents the estimated coefficients.

The criteria used in selecting the functional equation that is best fit for regression, is equation with the highest R² value, highest number of significant variables, and conformity to the a priori expectations.

RESULTS

Distribution of the Respondents Based on Socio-Economics Characteristics

The results in Table 1 shows a mean age of 43.25 years. This implies that the farmers were young, vibrant and in their productive ages which will enable them to easily adopt and adapt to new and better strategies of climate change effects. This aligns with the findings of Mohammad et al (2020) who found out that the

farmers in Northern Guinea Savannah of Kaduna State, who involved in maize production were young and in their productive ages. More than half (58.7%) of the maize farmers were female while only 41.3% were male. However, the marital status of the respondents showed that 89.3% of the respondents were married with a mean household size of approximately 7 persons. The implication is that having a great number of married farmers with large family size will reduce the cost of labour in maize productivity. Educational status reveals that 10.7% of the respondents had no formal education, about (16.0%) attended tertiary while 29.3% and 44% attended primary and secondary schools, respectively. This indicates that the respondents attained different forms of education, especially formal education. Also, findings show a mean farming experience of 21 years cultivating on an average of 1.7 hectares with an average annual income of N43,126.67. This implies that maize farmers in the study area are experienced with increased knowledge that could influence adoption of improved technologies in farm practices but are financially incapacitated to successfully cope with the scourging effects of climate change. The major source of land acquisition was inheritance (48.7%) followed by purchase (32.3%) and rent (19%). More than half (58%) of the framers had no contact with extension services.

Table 1: Distribution based on their socio-economic characteristics

	Frequency	Percentage	Mean
Age (Years)			
≤ 30	16	10.7	43.25
31	38	25.3	
- 40	57	38.0	
41- 50	39	26.0	
≥51			
Sex			
Male	62	41.3	43.25
Female	88	58.7	
Marital Status			
Single	12	8.0	43.25
Married	134	89.3	
Widowed	3	2.0	
Separated	1	0.7	
Household Size			
0-4	21	14.0	6.83
5-10	126	84.0	
>10	3	2.0	
Educational Status			
No Formal Education	16	10.7	21.3
Primary Education	44	29.3	
Secondary Education	66	44.0	
Tertiary Education	24	16.0	
Farming Experience			
1-10	27	18.0	21.3
11- 20	44	29.3	
21-30	52	34.7	
31-40	19	12.7	
>40	8	5.3	
Annual Income (₦)			
≤ 30,000	52	34.7	43,126.67
31-60,000	74	49.3	
61,000-90,000	11	11.3	
91,000-120,000	9	6.0	
≥ 121, 000	4	2.7	
Method of Land Acquisition			

Inheritance	73	48.7	
Purchase	48	32.0	
Rent	29	19.3	
Farm size (hectare)			
<1	92	61.3	
1-5	51	34.0	1.7
≥ 6	7	4.7	
Freq. of extension visit			
Often	15	10.0	
Not Often	48	32.0	
Never	87	58.0	

Climate Adaptation Information Available

Table 2 shows climate adaptation information available for farmers in the study area. All the information presented were available in the study area but 6 out of the 11 were identified “mostly available” for the farmers as reflected in the grand mean of 72.8. These statements included planting multiple crops to spread risk and optimize yields (91.3%), Information on mulching to retain soil moisture/reduce erosion (87.3%), information on preparation for pest and disease outbreaks (86.7%), rotating maize with legumes to maintain soil fertility (82.1%), information on expected rainfall amount and distribution (76.2%) and planting maize resistance varieties to withstand drought conditions (74.8%). The implication is that farmers are much familiar with this information since they have been practicing these activities over the years.

Table 2: Distribution of Climate Adaptation Information available in the study area (N >150)
remove lines from tables

Climate Adaptation Information	Available (%)	Not Available (%)
Accurate/timely forecasts on rainfall onset, duration, and intensity	64.7	35.3
Information on expected rainfall amount and distribution	76.2	23.8
Knowledge of potential dry spells and droughts	52.7	47.3
Information on preparation for pest and disease outbreaks	86.7	12.3
Rotating maize with legumes to maintain soil fertility	82.1	17.9
Information on trees planting to prevent wind outbreaks	65.4	34.6
Information on early harvesting	57.4	42.6
Information on preservation of seeds for planting	62.7	37.3
Information on mulching to retain soil moisture/reduce erosion.	87.3	12.7
Planting multiple crops to spread risk and optimize yields.	91.3	8.7
Planting maize resistance varieties to withstand drought conditions.	74.8	25.2
Grand Mean	72.8	26.1

Source: Field survey, 2024

Communication channels for receiving climate adaptation information

Table 3 shows various communication channels for receiving climate adaptation information by maize farmers in the study area. This finding shows that most of the information is always conveyed by fellow farmers (29.3%), followed by friends/neighbours/family (16.7%), radio (14%), and Television (10%). This implies that extension workers are inactive in the study area. Also, frequent power failure, poor communication networks, poorly funded research and high poverty rate may explain low responses to social media (6%)., Extension workers (6%), research (4.7%). and input dealers (4%). However, this result agrees with the findings of Muhammad et al. (2020) who found fellow farmers to be the main source through which farmers elicit farm information.

Table 3: Distribution of the various communication channels on climate adaptation information available to maize farmers in the study area. (n= >150)

Frequency	Percentage	Rank

Friends/family/Neighbours	25	16.7	2 nd
Fellow farmers	44	29.3	1 st
Farmers association	13	8.6	5 th
Television	16	10.7	4 th
Extension officers	9	6.0	6 th
Social media	9	6.0	6 th
Radio	21	14.0	3 rd
Researchers	7	4.7	7 th
Input dealers	6	4.0	8 th

Source: Field survey, 2024

Utilization of climate adaptation information in the study area

Table 4 shows the extent of utilization of climate adaptation information in the study area. Findings revealed a grand mean of 2.38, indicating that 64% of the information on climate adaptation were utilized by farmers in the study area. They were: included information on preservation of seeds for planting ($\bar{x}$ = 2.64), information on preparation for pest and disease outbreaks ($\bar{x}$ = 2.56), rotating maize with legumes to maintain soil fertility and reduce pest and disease pressure ($\bar{x}$ = 2.53), information on trees planting to prevent wind outbreaks ($\bar{x}$ = 2.52) and planting multiple crops to spread risk and optimize yields ($\bar{x}$ = 2.52), information on early harvesting ($\bar{x}$ = 2.50), and information on mulching to retain soil moisture/reduce erosion ($\bar{x}$ = 2.47). The high extent of utilization must have been evidence that farmers have been using most of this information for over a decade even before the concept of climate change became a topical issue in development policy discourse.

Table4: Distribution of extent of utilization of Climate Adaptation Information in the study area (N =150)

Climate Adaptation Information	Total Score	Mean Score	Decision
Accurate/timely forecasts on rainfall onset, duration, and intensity	251	1.67	Not Significant
Information on expected rainfall amount and distribution	284	1.89	Not Significant
Knowledge of potential dry spells and droughts	278	1.85	Not Significant
Information on preparation for pest and disease outbreaks	384	2.56*	Significant
Rotating maize with legumes to maintain soil fertility	380	2.53*	Significant
Information on trees planting to prevent wind outbreaks	378	2.52*	Significant
Information on early harvesting	375	2.50*	Significant
Information on preservation of seeds for planting	397	2.64*	Significant
Information on mulching to retain soil moisture/reduce erosion.	371	2.47*	Significant
Planting multiple crops to spread risk and optimize yields.	378	2.52*	Significant
Planting maize resistance varieties to withstand drought conditions.	353	2.35	Significant
Grand Mean		2.38	

Source: Field survey, 2024 Decision rule: $X \geq 2$. indicates significant (utilized) while $x < 2$ indicates 'Not significant' (Not utilized) * (Mostly utilized)

Constraints to Utilization of Climate Change Adaptation Information

Table 5 shows constraints to utilization of climate change adaptation information in the study area. The result revealed that all the statements representing constraints to use climate adaptation information were identified as severe constraint with a mean score of $\bar{x}$ =2.0. However, a grand mean of 2.33 indicated that 55% of the statements reflected very severe constraints militating against utilization of climate change adaptation information in the study area.

Table 5 Mean Score Distribution of Constraints to Utilization of Climate Change Adaptation Information (N >150)

Constraints	Total Score	Mean Score	Decision

Inadequate information on climate change adaptation	378	2.52*	Severe
Financial difficulties in coping with climate change	345	2.30	Severe
Insufficient funds to purchase/use some of the adaptation measures	365	2.43*	Severe
High cost of manure/ fertilizer	368	2.45*	Severe
Limited knowledge of adaptation measures	314	2.09	Severe
High cost of improved maize resistance varieties	369	2.46*	Severe
Poor government attention to climate problems	366	2.44*	Severe
Lack of Knowledge on weather information and forecasts	356	2.37*	Severe
Inability to access extension services	309	2.06	Severe
Lack of basic training on how to interpret climate information	333	2.22	Severe
Lack of access to timely weather information and forecasts	347	2.31	Severe
Difficulty in understanding climate information	339	2.26	Severe
Grand mean		2.33	

Source: Field survey, 2024 **Decision rule:** $X \geq 2$ indicates severe constraints while $x < 2$ indicates Not severe. * (Very severe)

Relationship between socioeconomic characteristics and use of climate change adaptation information

The lead equation for the regression result was the exponential function as it met the criteria; having a high R² value and the highest number of significant values at 5% level. The model (independent variables) used, accounted for below 23% of the variability of the dependent variable. From the table, it can be seen that educational level and farming experience were significant at 1%, however, farming experience is negative. This implies that as educational level of the respondents' increases, their use of climate adaptation information is likely to increase, on the other hand, as the farming experience of the respondents' increases, their use of climate change adaptation information decreases. Thus, farmers with more farm experience are less likely to use climate change adaptation information. The age and sex of the respondents were significant at 5%, the age of the respondents was negative, while the sex was positive. Thus, the use of climate change adaptation information by the respondents decreases as the farmers get older. In addition, with regards to sex, this implies that male maize farmers are likely to use climate change adaptation information compared to their female counterparts. Thus, maize female farmers should be encouraged to use climate change adaptation information to mitigate the effect of climate on their maize production.

Table 6: Relationship between socioeconomic characteristics and use of climate change adaptation information

Variables	Exponential	Double log	Semi-log	Linear
Constant	1.708 (38.802)	1.577 (12.802)	38.134 (2.453)	53.516 (9.652)
Sex	0.026 (2.220) **	0.078 (1.912)***	10.806 (2.094)**	3.476 (2.388)**
Age	-0.014 (2.266)**	-0.053 (-1.139)	- 6.308 (- 1.066)	-1.660(2.135)**
Farming experience	-0.007 (-1.942)*	-0.055 (1.791)***	-5.710 (-1.476)	-0.680 (-1.567)
Educational level	0.024 (4.001)*	0.182 (4.831)*	20.331 (4.282)*	2.743 (3.579)*
Marital status	-0.011(-1.287)	-0.033 (-0.653)	- 5.030 (-0.789)	-1.358 (-1.254)
Household size	0.001 (0.160)	-0.045 (-1.052)	-5.855 (-1.095)	-0.084 (-0.072)
Farm size	0.007 (0.861)	0.043 (1.207)	2.995 (0.670)	0.391 (0.387)
Income	2.243E 8(1.312)	0.028 (1.462)	3.281 (1.152)	2.497E-6 (1.160)
R ²	0.22	0.23	0.20	0.19
f-ratio	7.729	8.300	6.869	6.455

Figures in parenthesis are t-ratio; ** $P \leq 0.05$ * $P \leq 0.01$

CONCLUSION

In order to enhance farmers' resilience, boost crop yields, and facilitate adaptation to erratic climate conditions, the Akwa Ibom Agricultural Development Programme (AKADEP) has introduced climate-smart agriculture (CSA) practices through the dissemination of agriculture-related information, that could

help them manage the harmful effects of climate change. Farmers, on the other hand, did not rely solely on the information provided by extension professionals; instead, they strategically sought information that could increase adaptation skills from a variety of sources. The information sought improved their adaptation skills on their farming business, resulting in a sustainable yield due to some resilience; however, most of the maize farmers were not able to use the information due to challenges faced, such as inadequate information on climate change adaptation and high cost of improved maize resistance varieties.

RECOMMENDATIONS

1. As a result of threat posed by climate change to humanity in the area of food scarcity, there is urgent need for adequate and timely provision of information on climate change to the public, as this will allow people to build capacity for adaptation or mitigation of the effects of the phenomenon
2. Also, extension personnel should be equipped with the necessary resources to help increase their day-to-day interactions with farmers and disseminate information to farmers.
3. Farmers should be encouraged to join various farmer-based organizations (FBOs) in their communities since these organizations also serve as good platforms for disseminating agricultural information, which is very important to use during production and others.
4. Agricultural Extension Agents should educate maize farmers on measures to control and manage pest and disease that affect maize crops -Farmers should also be updated on newly improved varieties that have been certified by research institute since most of the maize farmers needed information on pest and disease management and information on newly improved seed varieties. Relevant and actionable

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Theme: Agricultural Extension for Food Security and Community Empowerment

**Participation of Women Farmers in Rice Production Value Chain in
Cross River State, Nigeria**

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ABSTRACT

This study assessed the participation of women in the rice production value chain in Cross River State, Nigeria. The research was conducted across the three agricultural zones of the state. A multi-stage sampling procedure was employed to select a total of 284 women from various blocks and cells within the zones. The study ascertained the level of women's participation in rice production and highlighted the factors hindering their participation. Findings revealed that most women sourced rice seeds from local markets (56.1%) and previous harvests (39.2%), and had limited access to improved seed varieties or extension services. Additionally, women primarily engaged in manual rice production activities, with very few using mechanized methods. The study further identified key constraints affecting women's participation, including the high cost of fuel ($\bar{x} = 4.75$ ranked 1st), poor access to credit (2nd), illiteracy (3rd), inadequate training (4th), and limited access to extension services (5th). These constraints were found to significantly impede their ability to engage in large-scale rice production. The lack of mechanization and insufficient technical support were particularly limiting factors. The results highlighted the critical role of fuel and credit access in improving women's productivity and participation in the rice value chain. The research concludes that addressing these barriers through targeted interventions, such as affordable fuel, improved access to credit, enhanced mechanization, and expanded extension services, are essential to increasing women's involvement in rice production. The study calls for policy reforms to improve women's access to landed resources to ensure their sustainable participation in agricultural value chains.

Keyword: *Women Participation, Rice Value Chain, Rice Production Constraint*

INTRODUCTION

West African women participate in significant ways at each stage in rice production programmes; from production to value addition, distribution to food utilization. Women play significant roles to build resilience and adaptability to uncertainty and shocks including the effects of climate change (Quilter, 2022; Aboh & Effiong, 2019a). A study by Food and Agriculture Organization (FAO, 2018) showed that women were responsible for about 50 percent of global food production; rising to 60-80 percent of production for household food consumption in Nigeria and other sub-Saharan Africa countries. The study further stated that women in south-western Nigeria account for up to 90 percent of labour used in rice production. These findings underscored the fundamental importance of women in rice value chain. The women were responsible for half of the world's food production, yet women continue to be regarded as home producers or assistants on the farm, and not as farmers and economic agents on their own merit (USAID, 2023). Another study on participation of women in planning and implementation of agricultural practices in north-eastern Nigeria (Abdulummini *et al.*, 2022; Aboh & Effiong, 2019b), revealed a low level of women

participation in planning agricultural practices while implementation of agricultural practices among women had high-level participation. Other researchers also highlighted that women make significant contribution to agriculture (Buehren *et al.*, 2019), and are also involved in all aspect of farming activities necessary for food production (Okwu and Umoru, 2018). In another independent study involving 273 rural women on the role of women in rice value chain in Northern Agro-ecological zone of Cross River State (Alawa *et al.*, 2015), the result showed that the women contributed significantly to the production of rice by being responsible for farm activities such as planting, weeding, and harvesting of rice etc., tending to livestock. Women are also responsible for choice of variety of rice seed as reported in a paper by Abohet *al.*, (2019b), which explored the causal relationship between high-yielding rice variety, rice productivity, farm income and household nutrition (Etim, Effiong, Okoi, & Ntui, 2022; Etim & Effiong, 2022; Ijioma, et al., 2014; Nkang & Effiong, 2015; Ntui et al., 2022). Women also contribute to farmland preparation, farm management such as pesticide and fertilizer application. In spite of the numerous activities; women often have limited access to farmland due the land use system in Nigeria (Effiong & Aboh, 2018; Effiong & Aboh, 2019; Effiong & Aboh, 2024). Besides insecurity, land rights also hamper Nigerian women's efforts in rice value chain (Udegbumam, 2021). Similarly, many Nigerian communities still operate the traditional and family inheritance system of land ownership that gives preference to male children. A 2012 gender policy report by the Federal Ministry of Agriculture and Rural Development (Udegbumam, 2021), revealed that in rural Nigeria, only 8.5 percent of the women own land compared to 38.1 percent of men. In the relatively poor rural areas, 10.1 percent of women have access to land against 46.1 percent men. While in urban centers, 4.5 percent of the women have access to land while 49.5 percent of men own land. Amongst the urban poor population, 5.9 percent of the women have land compared to 28 percent of their male counterparts. Women also manage other aspects of the farm and provide household income. One of the farm management practices assessed in this study is the scarecrow technique. A work on scarecrow technique by Ejikoet *al.*, (2023) showed that the scarecrow technique requires high level of sound with speedy response to prevent birds from devouring farm plants. However, available source of labour to women in rice value chain is often not sufficient for intense scarecrow involvement. Women's inclusion in broad sectors is a fundamental prerequisite for gender equality and genuine democracy. Women need to be given consideration in policy issues as it affects capital assets that can positively motivate their participation in agriculture value chain. The inclusion of women in policy issues facilitates women's direct engagement in public decision-making and ensures better accountability to women (Hossain and Fischer, 1995; Effiong, 2013; Effiong, 2024a; Effiong, 2024b).

Series of studies have been carried out on women participation in rice value chain in Nigeria. For instance, (Ben, 2015) carried out a study on the role of women in rice value chain in Cross River State, Nigeria. Assessment of women participation in rice value chain programme and the effects and influence on rice output and income has been bedeviled by several challenges in Cross River State like other states in Nigeria (Effiong & Asikong, 2013; Effiong, Etu & Iyamah, 2023; Effiong, Ijioma, & Effiong, 2016; Effiong, Aboh, & Aya, 2021). Also, Akano *et al.*, (2023) conducted a research on contributions of women to livelihood in rice value chain in Northern agro-ecological zone of Cross River State, Nigeria. Findings from the study revealed that women were not given full recognition in agricultural provision. Ejike *et al.*, (2018) conducted another study on Gender Dimension in Agricultural Food Value Chain Development in Nigeria; the Women Perspective; the aggregate data on this study also showed that large percentage of women (43 percent labour force globally) while (60 to 80 percent in developing countries) contributed to total farm and non-farm task (Effiong, & Effiong, 2012; Effiong, & Etim, 2024; Effiong, and Iheme, 2024; Effiong et al., 2023). Granted, that series of studies have been carried out on women participation in rice value chain and the gender dimension in some parts of Cross River State as well as other states in Nigeria and the world at large, none of the studies focused on the assessment of women participation in rice value chain in the study area; hence, this study was conducted to fill the gap in literature by making the findings available to relevant stakeholders. The specific objectives of the study were to; ascertain the participation of women in rice production, and identify the constraints to women participation in rice production value chain

METHODOLOGY

This research was carried out in the three agricultural zones of Cross River State, located in the South-South region of Nigeria. Cross River State, which spans 20,156 square kilometers, is situated within the Niger Delta and lies along the Atlantic coastline. The state is bordered by Benue State to the north, Akwa Ibom State to the southwest, Ebonyi and Abia States to the west, and Cameroon to the east. Cross River is known as "the People's Paradise" and is located in the tropical rainforest belt, with an average temperature range of 15°C to 30°C. According to the National Bureau of Statistics (2023), the estimated population of Cross River State was over 3.8 million as of 2016. The population for the study comprised women participating in the rice production value chain programme in Cross River State. A multi-stage sampling procedure was employed to ensure a representative sample. In the first stage, all three agricultural zones of the state were considered for inclusion due to their involvement in rice value chain activities. The second stage involved, purposively selecting, one block from each agricultural zone based on the level of rice value chain activities. In the third stage, purposive sampling was used again to select three cells from each block, with the selection based on the volume of rice value chain activities in those cells. This approach ensured that the most relevant areas for the study were included. In the final stage of sampling, a list of registered women groups involved in the rice value chain activities was obtained from the Cross River Agricultural Development Programme (CRADP). Random sampling was then applied to select 40% of the women from each group in the chosen cells. This resulted in a total sample size of 284 women, who were the participants in the study. The multi-stage sampling procedure allowed for a detailed and targeted representation of women in rice value chain in Cross River State. A set of semi-structured questionnaire was used to elicit information from the women in rice production value chain programme in the study area. Participation of women in rice value chain production activities: were analyzed using descriptive statistics such as frequencies, percentages, mean and ranking, while Constraints to women participation in rice value chain production activities were analyzed using mean and ranking. A list of constraints was obtained from literature and presented to the randomly selected women in rice value chain. These were weighed using a five-point Likert scale as follows: Strongly Agreed (SA) = 5, Agreed (A) = 4, Uncertain (UC) = 3, Disagreed (D) = 2, and Strongly Disagree (SD) = 1.

Table 1: Sampling procedure and Sample size

Zones	Selected Blocks	Selected Cells	No. of selected rural women group	No. of members in the group	40 percent Sample size
Calabar	Biase	Abini	3	65	26
		Apket 1	3	60	24
		Adim	3	75	30
Ikom	Obubra	Obubra	3	90	36
		Urban			
		Obubra	3	80	32
Ogoja	Yala	Ababene	3	75	30
		Ugaga	3	80	32
		Ijegu	3	80	32
		Okpoma	3	105	42
Total	3	9	27	710	284

Source: Field Survey, 2023

RESULTS AND DISCUSSIONS

A summary of respondents' socioeconomic characteristics showed that; in age distribution, majority of the women fell in the range of 30-39 years (35.9 percent) and 40-49 years (35.2 percent) with mean age of 43. It also revealed that active participation of the women began to decline from age 50 and above in the study area. Majority of the women (71.1 percent) were married. Majority of the women (76.8 percent) had no access to extension service. A good number of the women had secondary education (40.8%), household size of 5 – 9 (56.7%), farming experience between 5-9 (57.0%), among others. Several authors have

indicated the low level of women access to agricultural resources and extension (Effiong, Aboh, & Azu, 2024; Effiong, Asuquo, Azu, & Ajao, 2025; Effiong, Azu, Ekpenyong, & Etim, 2025).

Table 2: Participation of women in rice value chain (production)

Variables	Frequency	Percentage
Choice of sources of rice seed*		
Previous harvest	100	39.2
ADP	0	0
Research institutes	4	1.6
Markets	143	56.1
Others	8	3.1
Choice of seed		
Yes	160	100.0
No	0	0.0
Land preparation*		
Choice of land	160	31.9
Manual clearing and tillage	158	31.4
Use of tractor	2	0.4
Use of chemical	127	25.2
Bush burning	56	11.1
Farm weeding		
Yes	160	100.0
No	0	0.0
Pesticide application		
Yes	72	45.0
No	88	55.0
Farming cycles per year		
One	120	75.0
Two	40	25.0
Fertilizer application		
Yes	131	81.9
No	29	18.1
Scarecrow		
Yes	7	4.4
No	153	95.6
Harvesting		
Yes	160	100.0
No	0	0.0

*= Multiple response

Source: Field survey data, 2023

Results in table 2 showed the frequency and percentage distribution of participation of women in rice value chain (production). The results of the women in rice value chain (production) showed that the women decided on which sources to get rice seed for planting. Majority (56.1%) got rice seeds from the markets while 39.2% got rice seeds from previous harvest. None of the women indicated they got rice seed from ADP while only 1.6% said they got rice seed from research institutes. This position did not encourage the use of improved rice seed that can contribute favourably to increased rice output. The study also showed that the women carried out most of the rice production activities manually as 31.4% were involved in manual clearing and tillage while only 0.4% said they used tractor for farm land preparation. This finding was supported by (Okwu and Umoru, 2018) where it was reported that women in rice production were involved in all aspect of farming activities necessary for food production.

Table 3: Constraints to women participation in rice value chain (production) n = 284

Variables	A	U	UC	D	SD	Mean	Ranking

	(5)	(4)	(3)	(2)	(1)		
High cost of fuel	233	43	0	5	3	4.754	1 st
Poor access to credit facilities	189	77	3	8	7	4.525	2 nd
Illiteracy level of women producers	201	53	5	15	10	4.461	3 rd
Inadequate trainings on relevant skills	188	62	12	14	8	4.437	4 th
Inadequate access to extension service	189	65	2	17	11	4.420	5 th
Inadequate access to improved seeds	192	54	4	29	5	4.405	6 th
Poor access to land	163	97	2	16	6	4.391	7 th
Poor mobility	158	87	21	16	2	4.349	8 th
Poor access to improved production equipment	156	86	6	21	15	4.222	9 th
Inadequate knowledge of post-harvest technology	148	86	9	34	7	4.176	10 th
Inadequate storage facilities	134	71	13	43	23	3.880	11 th
Poor implementation of policies on rice value chain programme	78	92	86	19	9	3.743	12 th
Inadequate support from private and public sectors	69	88	85	30	12	3.606	13 th
Effect of climate change	89	74	48	52	21	3.556	14 th
Frequency of flooding	58	80	46	85	15	3.285	15 th
Frequency of communal clashes	47	66	70	88	13	3.162	16 th

n = 284, Weighted arithmetic mean (m) = 15/5 = 3.00, (m ≥ 3.00 = Very significant constraints, m < 3.00 = Insignificant constraints). **Source:** Field survey data, 2023.

DISCUSSION

Results in table 3 showed the mean rating and ranking of the constraints to women participation in rice value chain production activities. The results of the constraints to women participation in rice value chain production in the study area, were significant as the mean values were all greater than the benchmark of 3.0. However, the most significant constraints were high cost of fuel ($\bar{x}$ = 4.75) which ranked 1st; poor access to credit facilities ($\bar{x}$ = 4.53) ranked 2nd; illiteracy level of women producers ranked 4.461; inadequate trainings on relevant skills 4.437; followed by inadequate access to extension service which ranked 4.420 respectively amongst other constraints as shown in table 3. Without fuel for regular power supply; motorized rice production equipment cannot function for large scale rice production. Similarly, mobility for rice product transportation will also be high thereby increasing cost of production. The significant rating of inadequate access to extension service could be attributed to poor ratio of extension agents to farmers (rice producers) that has continued to decrease in Nigeria with the ratio rated between 1:5000 and 1:10000 (Davis *et al.*, 2019). This hinders improved technological knowhow of the women in rice value chain production programme.

CONCLUSION

Women participate significantly in rice production value chain in the study area. Women also play significant role to build resilience and adaptability to uncertainty and shocks in the rice production value chain. The research concludes that addressing these barriers through targeted interventions, such as affordable fuel, improved access to credit, enhanced mechanization, and expanded extension services, is essential in increasing women's involvement in rice production. These changes could lead to greater economic empowerment, improved productivity, and better socioeconomic outcomes for women in Cross River State (Effiong & Iyamah, 2022).

RECOMMENDATIONS

Based on the findings, the following recommendations were made;

1. Women association in rice value chain programme should network appropriately with Agricultural Development Programme (ADP) to enable them access improved seeds from research institute to enhance a profitable participation in rice production.
2. To enable increased effects and influence of women participation in rice value chain production in Cross River state and Nigeria as a whole; women access to land should be reviewed by policy makers on land tenure system to enhance women land holding right for enhance output and income.

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**Technology Adoption and Its Impact on Rural Women's
Entrepreneurial Activities in the Cassava Value Chain: A Review**

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ABSTRACT

The study presents a review of technology adoption and its impact on rural women's entrepreneurial activities within the cassava value chain. It provides conceptual clarifications on key terms such as technology adoption, cassava value chain, and rural entrepreneurship, and also emphasized on the interconnectivity among these concepts. Furthermore, the review examines the various activities involved in the cassava value chain, highlighting the critical roles played by rural women in enhancing the value of cassava products. The study identifies and discusses the challenges these rural women face, including limited access to technology, inadequate training, and socio-cultural barriers that hinder their entrepreneurial efforts. Through a synthesis of existing literature and empirical evidence, the paper offers recommendations aimed at fostering technology adoption among rural women, thereby enhancing their entrepreneurial capabilities and contributing to the overall development of the cassava value chain, especially at the grassroots level. The findings underscore the need for targeted interventions that support rural women in overcoming barriers and leveraging technology for sustainable entrepreneurship.

Keywords: Adoption, technology, rural women, cassava, value-chain.

INTRODUCTION

The adoption of technology in the cassava value chain has emerged as a critical factor in enhancing productivity and fostering entrepreneurship, particularly among rural women. In Nigeria, the cassava value chain presents significant opportunities for economic empowerment and food security. Cassava (*Manihot esculenta*) is a staple crop that contributes to the livelihoods of millions and serves as a vital source of income for rural households (Nwafor et al., 2018). However, despite its potential, the full benefits of cassava production are often hindered by traditional practices and limited access to modern technology (Ogunniyi, 2020).

Studies have shown that rural women play a pivotal role in the agricultural sector, yet they face unique challenges that impact their ability to adopt innovative technologies (Aker et al., 2016). Factors such as limited access to information, financial resources, and training opportunities can impede their entrepreneurial efforts in the cassava value chain (Mogaji et al., 2021). Consequently, understanding the dynamics of technology adoption among rural women is essential for developing targeted interventions that enhance their entrepreneurial capacities and overall contributions to the agricultural economy.

Previous studies have highlighted the importance of integrating gender perspectives in agricultural technology adoption frameworks (Doss, 2018). Research indicates that empowering women through technology can lead to improved productivity and increased income levels, thereby promoting sustainable development (Kabeer, 2016). In the context of rural communities in Nigeria, exploring how technological innovations are adopted by women entrepreneurs in the cassava value chain provides valuable insights into

the barriers they face and the strategies needed to overcome them. Thus, this study aims to give some conceptual clarification on technology adoption, entrepreneurship, cassava value chain and their interconnectivities. Furthermore, factors influencing technology adoption among rural women entrepreneurs on the cassava value chain were also reviewed. Conclusion and recommendations were made based on the findings.

Conceptual Clarifications

Rural entrepreneurship

Rural entrepreneurship refers to the process of creating and managing small businesses in rural areas, which are often characterized by limited resources, lower population densities, and unique socio-economic challenges. It is as a means to stimulate economic development, reduce poverty, and enhance the quality of life in rural communities. It refers to the creation and management of businesses in non-urban regions that primarily serve local needs and utilize local resources. According to Peredo and Chrisman (2006), rural entrepreneurship is characterized by its reliance on local resources, social networks, and community engagement. Entrepreneurs in rural settings often face distinct challenges compared to their urban counterparts, including limited access to capital, markets, and infrastructure (Morrison, 2008). It plays a critical role in job creation, income generation, and the overall economic vitality of rural areas. According to Bosworth (2015), rural entrepreneurship plays a key role in diversifying local economies, thereby decreasing reliance on conventional sectors like agriculture and mining. The author further stated that the diversification is essential for building resilience against economic downturns. Moreover, rural entrepreneurship can lead to social benefits, including enhanced community cohesion and empowerment. As highlighted by Kauffman (2010), successful rural entrepreneurs often engage in community development activities, fostering a sense of belonging and shared purpose among rural residents.

Technology adoption

Technology adoption is the process by which individuals or organizations integrate new tools, techniques, or practices to improve their productivity and efficiency (Rogers, 2003). In agriculture, technology adoption can include the use of improved seed varieties, mechanization, irrigation systems, and information and communication technologies (ICTs) (Aker, 2015). The adoption of modern agricultural technologies is essential for increasing crop yields, reducing labor costs, and ensuring sustainable farming practices (Davis et al., 2012). Technology adoption facilitates value addition in the cassava value chain through the production of various processed products such as flour, chips, and ethanol. The introduction of innovative processing technologies can lead to higher quality products that meet market demands. As noted by Otegbayo et al. (2019), value-added products from cassava can fetch higher prices in local and international markets, thereby increasing farmers' profitability.

Cassava value chain

The cassava value chain encompasses all activities involved in the production, processing, distribution, and marketing of cassava products (Nwafor et al., 2018). Cassava (*Manihot esculenta*) is a major staple food crop in Nigeria and serves as a vital source of income for millions of rural households (Ogunniyi, 2020). The cassava value chain involves multiple participants, such as farmers, processors, traders, and consumers. Each segment of the chain presents opportunities for entrepreneurship and innovation. The potential for value addition in the cassava value chain is significant. Processing cassava into products such as flour, chips, and starch can enhance income generation for rural women entrepreneurs (Adebayo et al., 2019). The economic value of cassava is further enhanced by its versatility. It can be processed into various products such as flour, chips, and starch, which are in high demand both locally and internationally. As noted by Otegbayo et al. (2019), the global market for cassava products has expanded, providing farmers with opportunities to increase their income through value addition. Processing is a critical stage in the cassava value chain that significantly enhances its market value. The transformation of fresh cassava roots into processed products not only reduces post-harvest losses but also increases profitability for farmers. Afolabi et al. (2018) emphasize that improved processing techniques, such as mechanized peeling and

drying, can reduce waste and enhance product quality. Value addition through processing enables the creation of diverse products, including cassava flour, which is recognized as a gluten-free alternative for baking and cooking, and has become increasingly popular in both local and international markets (Maziya-Dixon et al., 2006; Adeyemi, 2022). Cassava Chips are used as snacks that can be produced with minimal investment and have a growing market demand (Nwosu, 2019). Cassava starch is extensively utilized in the food industry for thickening and stabilizing purposes, and it is also employed in various non-food applications, including textiles and paper (Ogunniyi et al., 2018).

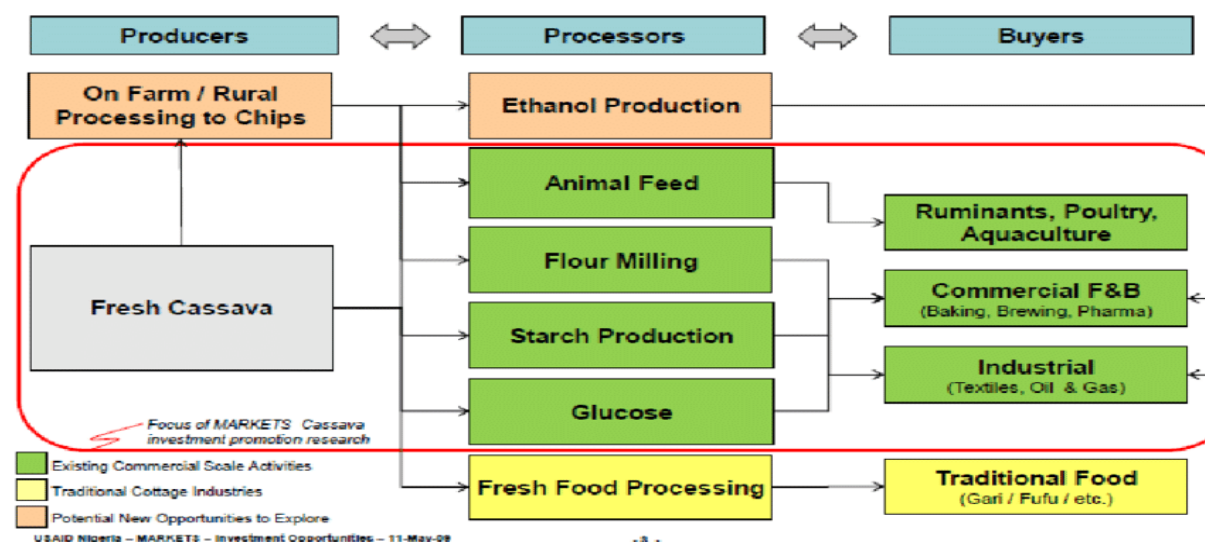


Fig. 1: Cassava value chain
Source: Onwualu, (2016)

Interconnection of entrepreneurship, technology adoption, and the cassava value chain

The interplay between entrepreneurship and technology adoption is particularly evident in the cassava value chain. Entrepreneurial women who adopt modern technologies can improve their production practices and processing methods. This not only increases their productivity but also enhances their competitiveness in local and regional markets (Davis et al., 2012). Furthermore, the integration of ICTs into the cassava value chain can facilitate access to information about market prices, best practices in cultivation and processing, and potential buyers (Aker, 2015). Such access empowers women entrepreneurs to make informed decisions that can lead to better economic outcomes. Thus, fostering entrepreneurship among rural women in the cassava value chain through technology adoption can significantly contribute to economic development and food security.

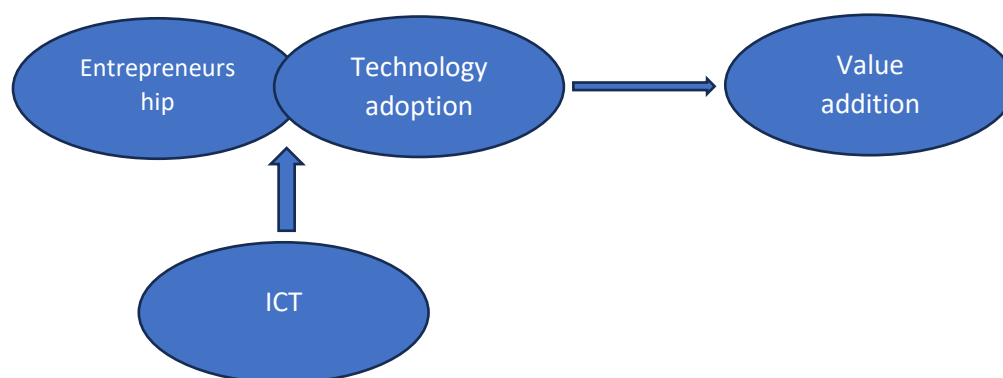


Fig. 2: Typology of the interconnection between entrepreneurship, technology adoption and value addition in cassava

Source: Author's concept.

Roles of rural women in cassava value addition and the technologies applied

The cassava value chain encompasses various activities crucial for the production, processing, and marketing of cassava. Rural women play a significant role in this value chain, engaging in activities that contribute to food security and economic development. According to Akinwumi and Adeyemo (2020), rural women are often involved in the cultivation of cassava. They participate in land preparation, planting, weeding, and harvesting. The authors further observed that their knowledge of local agricultural practices and varieties contributes significantly to the productivity of cassava farms. Following the harvest, women play a significant role in processing cassava into a variety of products, including garri, fufu, and tapioca. This processing not only adds value to the raw cassava but also creates employment opportunities for women (Osei and Osei-Agyemang, 2021). Women are essential to the marketing of cassava products. They often take on the responsibility of selling processed cassava in local markets, managing sales, and negotiating prices (Nwafor and Ogbodo, 2022).



From top left: Plate 1: hydraulic pressing machine; Plate 2: indigenous press; Plate 3: Automated garri sieve; Plate 4: Manual sieve; Plate 5: Automated garri frier; Plate 6: Manual frier

Source: Adeyemi, (2022)

Table 1: Processing activities and the technology application employed by rural women

Processing activities	Indigenous Technology	Improved Technology
a. GARRI		
1. Peeling	Knife made of bamboo, flint, or metal	Mechanical peeler, Motorized peeler,
2. Washing	Local Calabash bowl	Hand peeler, hand rasper Aluminum tank

3. Grating	Rough Stone, prickly trunk of palms, sheet/tin iron pierced with nail on one side	Mechanized Grater, Motorised Grater, Hammer mill, disk grater, hand grater.
4. Fermentation	Heavy stone on a heavy-weighted cloth or nylon bag	Batch fermentation in an aluminum tank, locally made, hydraulic or mechanical
5. Dewatering Pressing	Heavy stone on heavy-weighted nylon bag (for several days)	Hydraulic jack press, screw press, parallel board press, upgraded trad. Press for a few minutes.
6. Sieving	Woven baskets, suspended cloth pieces holding mash	Improved pulverizer e.g. drum sieve, rotating sieve
Frying / Recasting	Cast Iron pan over a wood fire	Upgraded roaster, solar dryer, kiln-type dryer
8. Sifting	Woven basket	Improved pulverizer and sifter
B. LAFUN	Knife made of bamboo, flint, or metal	Mechanical peeler, motorized peeler, hand rapper
1. Peeling		Aluminum tank
2. Soaking	Local Calabash	Improved pulverizer
3. Pulverizing	Woven basket	Hydraulic press, Mechanical press
4. Dewatering	Heavy stone on heavy-weighted cloth or nylon bag	Drum dryer, solar dryer
5. Drying	Cast iron pan over wood fire	Mechanical, peeler, cassava filter, Motorized peeler
C. STARCH	Knife made of bamboo	Aluminum tank
1. Peeling		Power grater, motorized grater, Disc grater
2. Washing	Calabash bowl	Hydraulic press, screw press
3. Grating	Sheet or tin iron pierced with nail on one side	Engraved fryer, solar dryer
4. Dewatering	Heavy stone on heavy weighed cloth or nylon bag	Scaled polythene bags
5. Drying	Cast iron pan over wood fire	
6. Packaging	Local jute bag	
D. FUFU		
1. Peeling	Local Knife	Hand peeler – (mechanized)
2. Washing	Local Calabash bowl	Aluminum tank
3. Grating	Rough Stone	Motorized grater, Rotary grater
4. Dewatering	Heavy Stone on heavy-weight cloth	Mechanized press, Hydraulic press
5. Packaging	Local Jute bag	Hydraulic polythene bag

Source: Author' concept

EMPIRICAL REVIEW

In her investigation of the processing technologies utilized by cassava processors and the array of products that can be derived from cassava processing, Mgbakor (2015) found that respondents employed various modern equipment in their operations. The study revealed that a significant majority (98.2%) of the surveyed cassava processors used cast iron frying pots for frying. Additionally, other commonly used processing equipment included drying on platforms, tarpaulins, or mats (77.9%); aluminum or plastic basket sieves (73.8%); grating machines (72.9%); and hydraulic presses (71.5%). In contrast, milling machines were utilized by only 34.1% of the processors.

Notably, a substantial proportion of cassava producers and processors reported never having used several mechanical devices: 92.3% had never employed a mechanical peeler, 98.2% had not used a washing machine, 99.1% had no experience with steeping tanks, 99.4% had never used sieving machines, and 100% reported never using motorized fryers or electric sealers. Furthermore, 99.7% had not used hammer mills, and 97.1% had never employed pulverizing machines. Furthermore, the author attributed this lack of usage to the prohibitive costs of these processing technologies, which are often beyond the financial reach of local processors, and noted that many cassava processors operate on a small scale and therefore cannot afford advanced processing equipment. Consequently, cassava processing in the study area faces significant challenges due to low productivity and limited technological applications.

Mgbakor (2015) also highlighted that while a majority of processors (77.4%) employed upgraded technology, 22.6% still relied on conventional methods. This suggests that most rural women farmers are utilizing improved technologies, though not uniformly across all operations. The coexistence of both advanced and traditional techniques can be described as "mixed technology," representing a progressive shift away from traditional cassava processing practices.

In a related study, Achem (2017) explored the mechanization of cassava processing operations in Kwara State. The author found that nearly all peeling, washing, drying, frying, and chipping tasks were performed manually. However, he noted significant advancements in the mechanization of grating and milling processes, which were powered by diesel engines in 90.1% and 87.4% of cases, respectively. Despite these advancements, the majority of cassava processing tasks remain labor-intensive and time-consuming due to their manual execution. The dependence on manual method presents significant challenges for rural women entrepreneurs engaged in cassava value addition, particularly at the grassroots level.

FACTORS AFFECTING TECHNOLOGY ADOPTION AMONG RURAL WOMEN ENTREPRENEURS IN THE CASSAVA VALUE CHAIN

Analyzing the challenges faced by cassava processors and the adoption of improved processing technologies, Ewebiyi et al (2020) discovered that significant majority of respondents identified several key constraints such as insufficient cash (91.5%), lack of technical knowledge (88.6%), inadequate information (84.1%), high purchasing costs (83.0%), and a shortage of qualified engineers (80.1%) as major barriers to the implementation of enhanced processing technologies. Additionally, political instability, natural disasters, and low levels of computer literacy were noted as minor obstacles by 64.2% and 60.8% of respondents, respectively. This underscores that the limitations experienced by respondents represent substantial impediments to their ability to adopt and utilize advanced processing technologies.

In another study, Awoyemi et al. (2020) discovered that the significant expenses associated with machinery (2.98) and maintenance (2.97) were the primary barriers preventing the adoption of cassava processing technology in the region. This suggests that most surveyed individuals were unable to afford the necessary machinery for cassava processing, and those who could often struggled with maintenance expenses. The study also noted that intermittent power supply (1.79) posed a challenge to the utilization of these technologies. Although, as noted by the authors, its impact was not deemed significant.

Additionally, in her analysis of women's participation in cassava production and processing, Onyemauwa (2012) identified and ranked the key obstacles that limit women's engagement in cassava cultivation, processing, and the adoption of technological innovations. These barriers included the lack of land ownership among women, their engagement in domestic responsibilities, insufficient farm size, and the high cost of technological cassava processing machines.

In a study carried out by Emokaro and Ogbebor (2020) on gender dynamics in agricultural technology adoption, it was discovered that cultural expectations and traditional gender roles often restrict women's participation in technology adoption processes. Studies have shown that societal norms can limit women's mobility and decision-making power, impacting their ability to engage with new technologies. In another study on infrastructure and technology adoption in rural Nigeria, implications for women in cassava value chains by Ibrahim et al (2021); it was discovered that inadequate infrastructure, such as poor roads and lack of electricity, poses significant challenges for rural women in adopting value-added technologies for cassava.

CONCLUSION AND RECOMMENDATIONS

In conclusion, the intersection of technology adoption and rural women entrepreneurship within the cassava value chain presents a multifaceted landscape with significant implications for agricultural development and gender empowerment. This study highlighted the critical role that women play in the value addition process of cassava, where their involvement not only enhances productivity but also contributes to economic resilience especially in rural communities. Women serve as key actors in processing, marketing, and distributing cassava products, thus driving local economies and improving food security.

However, the findings underscore that despite their pivotal roles, rural women face numerous challenges that hinder their full participation in the cassava value chain. Barriers such as limited access to improved processing technologies, financial constraints, inadequate technical knowledge, and socio-cultural norms restrict their entrepreneurial potential. Based on these findings, the following recommendations were made;

1. The need for targeted interventions that supports women's active involvement in cassava value addition and technology adoption should be prioritized by government at all levels and other private service providers;
2. Establishment of financial support mechanisms tailored to the needs of rural women entrepreneurs in the cassava sector. This can involve creating microfinance options, grants, or subsidized loans that specifically target women-led businesses. Additionally, training programs on financial literacy and business management should be implemented to empower women in making informed financial decisions and managing their enterprises effectively.
3. Social-cultural laws preventing women from land ownership and access to technological machines should be abolished through appropriate legislation and policies implementation.

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**Productivity Differentials Between Male and Female Smallholder
Arable Crop Farmers in Abia State, Nigeria**

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ABSTRACT

The study investigated productivity differentials between male and female smallholder arable crop farmers in Abia State, Nigeria. The specific objectives were to derive and compare the productivity levels of both groups and to estimate the determinants of productivity using data from 120 respondents per gender. Data were analyzed using total factor productivity and ordinary least squares regression. Results showed that a significant proportion of male (52%) and female (52.7%) farmers fall within the lowest productivity category (₦0.1–₦1.0), reflecting widespread inefficiency arising from poor access to quality inputs, weak extension, and limited market information. Despite facing similar constraints, gender-based distinctions were evident. About 25% of male farmers attained moderate productivity (₦1.1–₦2.0), while females outperformed males at higher thresholds, with 12.5% of women achieving ₦4.1–₦5.0 compared to 6.7% of men. This was reinforced by mean productivity values of ₦1.70 for females and ₦1.46 for males, suggesting that women who overcome structural barriers demonstrate higher efficiency. Regression results revealed that for males, age and farm size had negative effects at the 1% and 5% levels, while planting materials, farm income, and capital were positive at 5% and 10%. For females, age and farm income were negative at 1% and 10%, whereas education, cooperative membership, farming experience, and capital significantly enhanced productivity at 1%, 1%, 10%, and 5% levels, respectively. The study concludes that female-led cooperatives, better access to credit, and strengthened extension services are critical for improving productivity and narrowing gender gaps in smallholder farming systems.

Keywords: Productivity differentials, male, female, smallholder farmers, Abia State

INTRODUCTION

Gender inequality in agricultural productivity is widely acknowledged across sub-Saharan Africa. Women supply over half of the agricultural labour force, and contribute up to 60-70 percent of the food production, yet consistently face limited access to land, credit, extension services, and modern inputs due to patriarchal norms and institutional barrier resulting in yield gap and reducing the overall efficiency, (FAO, 2011, Wikipidia, 2023a). Empirical estimates indicate that if women had the same access to productive resource as men do, their yields could rise by 20-30%, boosting national agricultural output by 2.5-4%, (Wikipidia, 2023b).

In context of Abia State, agriculture employs around 70% of the workforce and contributes to 27% of GDP predominantly through smallholder arable crop farming including staples like cassava, yam, maize and rice, (Wikipidia, 2023c). Male farmers, by contrast, typically operate larger farms and benefit from stronger institutional linkages, enabling higher technical and allocative efficiency (Okoye et al., 2022). These

findings underscore that despite women's central role in production; systemic barriers continue to constrain their productivity outcomes.

Male cassava farmers in Abia State has a mean technical efficiency score of 0.82 compare to 0.78 for female farmers- with women efficiency strongly influenced by factors such as cooperative membership and land ownership, (Udoka and Ibekwe, 2021). Despite the substantial involvement of both genders in arable crop farming in Abia State, persistent productivity gap exists. Empirical evidence indicates that female smallholder farmers exhibit comparatively lower yields and reduced farm income relative to their male counterparts.

Recent evidence shows that productivity gaps between male- and female-managed plots persist in Nigeria and across SSA, largely due to unequal access to land, credit, quality inputs, extension services and institutional support; moreover, structural constraints mean that equalizing inputs alone may be insufficient. (World Bank, 2023; and FAO, 2023).

METHODOLOGY

This research was carried out in Abia State, Nigeria. The State is located in the South-East region of Nigeria. It lies between Latitudes of 4°40' and 6°14' North of the Equator and Longitudes 7°10' and 8° 10' East of the Greenwich Meridian. It has a population density of 580 persons per square kilometer and a population of 2,845,380 persons and projected population of 4,143,093 million people in year 2022 (National population Commission-NPC, 2006; 2020) and occupies an area of about 6420 km² with about 2.6 percent of the country's population. It has an average population density of 364 persons per square kilometer with 63 percent of the people involved in agricultural production as a result of the rich soil which stretches from the northern to the southern part of the State and has an average household size of 6 persons per family (NPC, 2006). It has three Senatorial Zones namely; Abia North, Abia South and Abia Central, with 17 Local Government Areas, grouped into 3 Agricultural Zones which are Umuahia, Ohafia and Aba Zones. The State has two major seasons: the rainy season which starts from April – to October, and the dry season commences from November to March. The mean annual rainfall ranges from 20,000mm- 25,000mm, with a relative humidity of 98% during the rainy season and between 60% and 80% during the dry season, while the temperature ranges from 22°C to 35°C (Nwaru,2004; Balogun, 2008).

The majority of the population lives in the rural areas. Agriculture is the major occupation and the economic activities of the people in the state. The predominant soil of the area is loam while the natural vegetation is tropical rainforest which makes the area suitable for farming, and the farmers primarily involved in food crop production and animal husbandry such as poultry, sheep and goat rearing. The major food/arable crops grown in the area are rice, yam, cocoyam, maize, cassava, potato, vegetables, fruits and cash crops such as cocoa, rubber cotton, palm oil groundnut, which are produced for consumption and export purposes (Okoye, 2010).

Multistage random sampling and purposive sampling were used in selecting the samples. In the first stage, all the three agricultural zones in the State were purposively selected for this study namely Umuahia, Ohafia and Aba Agricultural Zones because of the level of arable crop activities in the State. In the second stage, **two** Local Government Areas were purposively selected from all the Agricultural Zones in stage one. That is, from Umuahia Agricultural Zone: Ikwuano, and Umuahia South Local Government Areas. From: Ohafia Agricultural Zone, Isiukwuato, and Bende Local Government Areas and from Aba Agricultural Zone Isiala Ngwa South and North: bringing to a total of 6 Local Government Areas. In the third stage, two communities were randomly selected from each of the Local Government Areas selected, bringing to a total of 12 communities. The fourth stage involved a simple random selection of two villages each from the 12 chosen autonomous communities, and this gave a total of 24 villages for this study. The arable crop farmers in each of these villages selected form the sampling frame. The final stage involves a random selection of 10 arable crop farmers from the 24 villages selected. One hundred and twenty (120) male and female arable crop farmers respectively each were randomly selected comprising a total of 240 respondents which form the sample size for this study.

Primary data was used for this study; these were collected using well-structured questionnaire and interview method, which was help in eliciting information from the respondents. A cross-sectional data was collected

forth- nightly within the agricultural zones. Data were collected on resource inputs and quantity of output levels such as land, capital, labour, fertilizers, and seedlings, as well as cost and returns from the sales of the output were collected. Data were analyzed using total factor productivity (TFP) analysis and ordinary least square multiple regression as used by Nwaru (2018): This is given as.

Total Factor Productivity = $\left(\frac{\text{total output}}{\text{total input}} \right)$ measured in naira -(1

The ordinary least square (OLS) multiple regression analysis was used to estimate the determinants of productivity of male and female arable crop farmers. This is specified implicitly in line with Nwaru (2018); and Fawole and Rahji (2016) as:

$$TFP_{1,2,3} = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10}) \dots\dots\dots (2)$$

Where,

TFP_{1,2,3} = is the total factor productivity of ith arable farmer, 1= male arable crop farmers, 2= female arable crop farmers, 3 = pooled arable farmers

X₁= Age of farmer (years)

X₂ = Level of education (years)

X₃ = value of planting materials (Naira)

X₄ = Farm Size (in hectares),

X₅ = Labour used: household and hired labour (mandays),

X₆ = Membership of farmers' association (Member =1, otherwise = 0))

X₇ =Farm income (Naira),

X₈ = Capital input used (rent on land, depreciation of farm assets and tools, accrued interest on borrowed capital) ((naira)

X₉= Extension visits (number of visits)

X₁₀ = farm income ((naira)

This was also estimated for male and female smallholder arable crop farmers)

Four functional forms -Linear, Double-log, Exponential and Semi-log were fitted to the data. The equation that gave the 'best fit' was then selected as the lead equation based on its conformity with the *a priori* expectations (expected signs of the estimators, the magnitude of the coefficient of multiple determination (R²), and the statistical significance of the parameter estimates.

RESULTS AND DISCUSSION

Productivity level for male and female smallholder arable crop farmers in Abia State

The result for productivity level for male and female smallholder arable crop farmers is presented in Table 1:

Table 1: Productivity level of male and female arable crop farmers in the study area

Productivity ((₦)	Male		Female		Pooled Frq	Pooled %
	Frequency	Percentage	Frequency	Percentage		
0.1 -1.0	63	52	62	51.7	125	52.1%
1.1 -2.0	30	25	21	17.5	51	21.3%
2.1 -3.0	10	8.3	9	7.5	19	7.9
3.0 4.0	9	7.5	13	10.8	22	9.2
4.1 -5.0	8	6.7	15	12.5	23	9.6
Total	120	100	120	100	240	100
Mean	1.46		1.70			

Source: field survey 2025

The result of productivity level of male and female arable crop farmers analysis presented in Table 1 reveals that a substantial share of both male (52.0%) and female (51.7%) arable crop farmers is concentrated within the lowest productivity category (₦0.1–₦1.0), indicating that more than half of the farming population, irrespective of gender, operates at minimal output levels. This widespread low productivity points to

systemic inefficiencies in the region's agricultural sector, often rooted in limited access to quality inputs, suboptimal agronomic practices, inadequate extension services, and weak market connectivity (Ajao, Adepoju, & Yusuf, 2021). The nearly identical proportions between male and female farmers in this category suggest that these constraints are broadly structural rather than gender-specific, affecting all farmers under similar production conditions. However, a more nuanced assessment of the middle and upper productivity categories reveals discernible gender-based differences. Notably, 25.0% of male farmers fall within the ₦1.1–₦2.0 band, surpassing the 17.5% recorded for females. Yet, at higher productivity thresholds, female farmers exhibit greater representation. For instance, 10.8% of women attained productivity levels between ₦3.1–₦4.0, compared to 7.5% of men, and 12.5% of women achieved ₦4.1–₦5.0, nearly double the 6.7% of males in the same category. These findings suggest that while a majority of women remain in the lower tier, those who surpass it tend to outperform their male counterparts. This supports the conclusions of Doss and Meinzen-Dick (2020), who argue that when female farmers are granted equitable access to agricultural inputs and support systems, their productivity can match or even exceed that of male farmers.

Moreover, the mean productivity values further emphasize that female farmers obtained a higher average productivity of ₦1.70 compared to ₦1.46 for males, indicating a comparatively stronger performance among women. This challenges longstanding assumptions in agricultural development literature, which often link higher productivity with male farmers due to their more favorable access to land, credit, and technology (Palacios-López, Christiaensen, & Kilic, 2017). Instead, it aligns with emerging evidence that highlights the resilience, efficiency, and strategic resource utilization of female farmers particularly when supported by farmer cooperatives, training programs, or interventions from NGOs (Adetunji, Akinbode, & Okeowo, 2023; FAO, 2022). These outcomes may reflect the ability of women to maximize output despite operating under more restrictive conditions.

The pooled results further underscore that low productivity remains a pervasive issue across the study area. Overall, 52.1% of all respondents fall within the lowest productivity category, while only 18.8% achieve outputs above ₦3.1. This persistent underperformance signals a broader challenge in smallholder agriculture, demanding targeted policy interventions focused on enhancing input accessibility, improving extension delivery, and strengthening market linkages for all farmers, regardless of gender

Determinants of productivity levels of male and female arable crop farmers in Abia State

The Ordinary Least Square (OLS) result for the determinants of the productivity levels of male and female arable crop farmers summarized and presented in Table 2:

Determinants of Productivity of Male arable crop farmers

The Ordinary Least Square of multiple regression results on factors influencing the productivity level of male arable crop farmers is presented in Table 4.9. The four functional forms of the model (linear, exponential, semi log and double log) were tried. The lead equation was chosen based on the number of criteria such as coefficient of multiple determination (R^2), signs and coefficient of parameters estimate, as well as their statistical significance. The double log function was chosen as the lead equation and the F-ratio was statistically significant at 1% meaning that the explanatory variables were well fitted into the model. The coefficient of multiple determination (R^2) of 0.7200 was obtained, implying that at 72% variations in the productivity level of male arable crop farmers were accounted by the changes in the explanatory variables included in the model while the remaining 28.00% of the variations were due to the errors.

Table 2: Determinants of Productivity level of male arable crop farmers

Variable	Linear	Exponential	Semi log	Double log +
Constant	15553.286 (32.1559)***	9.655 (282.594)***	35030.440 (4.544)***	11.047 (10.00)***
Age	-19.180 (-3.062)***	-0.001 (-3.053)***	-660.776 (-3.107)***	-0.047 (-3.091)***
Education	115.422 (1.578)*	0.008 (1.609)*	136.849 (0.851)	0.010 (0.881)
Planting material	278.311	0.020	2478.224	0.177

	(1.821)*	(1.842)*	(2.457)**	(2.459)**
Labour	-0.032	-2.392	87.137	0.006
	(-0.287)	(-0.302)	(0.666)	(0.645)
Farm size	-0.276	-1.968	-2295.493	-0.164
	(-1.668)*	(-1.667)*	(2.220)**	(-2.219)**
Cooperative	-0.081	-5.883	-72.070	-0.005
society	(-1.097)	(-1.115)	(-0.419)	(-0.443)
Farm income	-0.257	-1.820	259.034	0.018
	(-0.648)	(-0.642)	(2.057)**	(2.045)**
Farming	0.368	2.598	83.633	0.006
experience	(0.939)	(0.927)	(0.645)	(0.634)
Capital	-0.253	-1.801	-236.268	0.017
	(-2.407)**	(-2.399)**	(-1.831)*	(1.824)*
Extension visit	-27.588	-0.002	-84.160	-0.006
	(-0.695)	(-0.685)	(-0.371)	(-0.361)
R ²	(0.6500)	(0.6800)	(0.700)	(0.7200)
R: adjusted	0.60	0.63	0.65	0.67
F- ratio	15.20 ***	16.50***	17.80***	18.50***

Source: field survey, 2025, + lead equation, ***, significant at 1%, **, significant at 5%, and *, significant at 10% respectively, and the values in parentheses are t - values.

The result in Table 2: show that age of farmers, value of planting material used farm size, farm income and capital used were the significant variables influencing the productivity of male arable crop farmers in the study area.

The age of farmers has a negative correlation with the productivity of female farmers of arable crops and is statistically significant at the 1% level. This suggests that older male farmers of arable crops are generally less productive than their younger counterparts. This conclusion about the age of farmers is consistent with a priori expectations and recent studies on aging and labor productivity in agriculture (Smith et al., 2023). Farmers' ability to perform labor-intensive chores may be impacted as their physical capabilities, technological adaptation, and general health deteriorate with age. More precisely, older farmers might be less likely to invest in new equipment or embrace creative agricultural methods, which would further lower production (Johnson & Lee, 2022). This negative relationship highlights the importance of generational turnover in agriculture, where younger farmers, often better equipped with digital knowledge and innovative skills, could potentially enhance productivity. The economic policies should focus on facilitating knowledge transfer from older to younger farmers, promoting retirement schemes for elderly farmers, and incentivizing youth participation in agriculture. Subsidies for young farmers, vocational training programs, and access to land for new entrants could address the generational gap (Smith et al., 2023).

The coefficient of value of planting material was positively signed at 5% level of significant and related to productivity of female arable crop farmers. This result on value of planting material underscores the critical role of quality inputs in agricultural output. High-value planting materials, such as improved seeds or seedlings, are often associated with higher yields due to their genetic superiority, resistance to pests, and adaptability to local conditions (Nguyen et al., 2024). This finding suggests that investments in superior planting materials can serve as a catalyst for increasing productivity among male arable crop farmers. However, access to such materials may be constrained by financial resources, market availability, or knowledge gaps, which could explain variability in productivity across the study area. Governments and agricultural extension services should subsidize high-value planting materials and ensure their availability through public-private partnerships. Education campaigns on the benefits of improved seeds and seedlings can also bridge knowledge gaps (Nguyen et al., 2024).

The coefficient of farm income is significant at 5% level, and positively correlated to the productivity of male arable crop farmers in the study area. The positive relationship between farm income and productivity implies that higher income levels enable farmers to reinvest in their operations, such as purchasing better

inputs, hiring labour, or improving infrastructure. This finding is consistent with economic theories of capital accumulation capacity, and the study by (Li & Zhang, 2022), where income acts as a proxy for financial stability and investment). However, it also raises questions about the initial conditions of farmers: those with lower productivity may struggle to generate sufficient income, creating a vicious cycle. This variable highlights the need for income-support mechanisms to break such cycles and boost overall productivity.

Farm size was negatively signed at 5% level to the productivity of male arable crop farmers. This result implies that, as farm size increases, the productivity of male arable crop farmers declines. The significance of farm size indicates that larger farms tend to be more productive, likely due to economies of scale, better resource allocation, and the ability to diversify production (Garcia & Martinez, 2023). Larger farm sizes allow farmers to spread fixed costs over a greater output, invest in mechanization, and reduce labour bottlenecks. However, this finding must be contextualized within the study area, as smallholder farmers (common in many regions) may face challenges in expanding farm size due to land tenure issues or capital constraints. The economic policies suggest that a consolidating land or supporting cooperative farming could be enhanced to improve the male productivity level.

The coefficient of capital was positively related to the productivity of male arable crop farmers at 10% level. This finding suggests that as capital accumulation of farmers increase, their productivity levels increase. The significance of capital used suggests that access to and efficient use of capital (e.g., machinery, irrigation systems, and financial credit) are pivotal for enhancing productivity. This finding is in agreement with a priori expectation and the study by (Kumar & Singh, 2023) who posited that capital-intensive farming can reduce reliance on manual labour, improve timeliness of operations, and increase output per unit of land. However, the effectiveness of capital depends on its allocation and the farmer's ability to manage it. This finding also points to the importance of financial inclusion and access to credit as drivers of agricultural productivity. The economic policy is that access to credit and financial services should be expanded and tailored to farmers' needs, such as low-interest loans for purchasing machinery or irrigation systems. Public investment in rural infrastructure, such as roads and storage facilities, can also reduce transaction costs and improve capital efficiency (Kumar & Singh, 2023).

Determinants of Productivity of female arable crop farmers

The Ordinary Least Square of multiple regression results on factors influencing the productivity level of female arable crop farmers is presented in Table 3:. The four functional forms of the model (linear, exponential, semi log and double log) were tried. The lead equations were chosen based on the number of criteria such as coefficient of multiple determinations (R^2), signs and coefficient of parameters estimate, as well as their statistical significance. The semi log function was chosen as the lead equation and the F- ratio was statistically significant at 1% meaning that the explanatory variables were well fitted into the model. The coefficient of multiple determinations (R^2) of 0.647, implies that at 64.7% variations in the productivity level of female arable crop farmers were accounted by the changes in the explanatory variables included in the model while the remaining 35.3% of the variations were due to the errors.

Table 3: Determinants of Productivity level of female arable crop farmers

Variable	Linear	Exponential	Semi log +	Double log
Constant	16853.475 (15.694)***	9.747 (127.072)***	30120.026 (3.279)***	10.700 (16.307)***
Age	-18.175 (-2.912)**	-0.001 (-3.053)***	-648.088 (-3.052)***	-0.046 (-3.037)***
Education	83.467 (1.157)	0.006 (1.192)	104.773 (6.617)***	0,008 (0.696)
Planting material	101.621 (0.531)	0.007 (0.539)	1813.650 (1.475)	0.130 (0.481)
Labour	-0.091	-6.533	-1639.974	-0.117

	(-0.443)	(-0.447)	(-1.314)	(-1.317)
Farm size	-0.022	-1.724	86.535	0.006
	(-0.205)	(-0.222)	(0.668)	(0.646)
Cooperative society	-0.056	-0.4080	37.807	0.003
	(-0.749)	(-0.769)	(9.102)***	(2.315)**
Farm income	-0.180	-1.273	-238.317	-0.017
	(-0.454)	(-0.443)	(-1.871)*	(-1.860)*
Farming experience	-0.259	-1.844	244.420	0.017
	(2.492)**	(2.484)**	(1.901)*	(1.895)*
Capital	0.288	2.030	63.576	0.004
	(0.744)	(0.734)	(2.209)**	(4.848)***
Extension visit	-1558.221	-0.111	-766.164	-0.054
	(-1.474)	(1.466)	(-0.144)	(-0.936)
R²	(0.455)	(0.598)	(0.647)	(0.563)
R⁻²	0.354	0.353	0.586	0.184
F- ratio	3.166***	3.143***	3.721**	3.692***

Source: field survey, 2025, + lead equation, ***, significant at 1%, **, significant at 5%, and *, significant at 10% respectively, and the values in parentheses are t - values.

The result in Table 3: show that age of farmers, level of education, and cooperative membership of society, farming experience, farm income and amount of capital used were the significant variables influencing the productivity of female arable crop farmers in the study area.

The coefficient of age of the farmers was significant at 1% level and negatively related to the productivity of female arable crop farmers, suggesting that as farmers advance in age, their productivity levels decline. The observed negative relationship between farmers' age and productivity is consistent with expectations and is supported by recent empirical findings. For example, Omotilewa et al. (2023) conducted a nationwide study on Nigerian farmers and found that as age increases, agricultural output significantly declines. This decline was attributed to reduced physical strength, slower decision-making, and a lower likelihood of adopting new technologies among older farmers. Even after controlling for factors such as education and farm size, age remained a statistically significant determinant of lower productivity.

Similarly, Eze et al. (2024), in their study on the adoption of agroforestry practices in Southwestern Nigeria, reported that age negatively influenced farmers' willingness to adopt improved agricultural technologies. Their logistic regression analysis showed that younger and middle-aged farmers were significantly more likely to embrace innovative practices compared to older farmers. The study concluded that older farmers tend to be more risk-averse and less adaptable to change, which affects their overall productivity. *The policy implication is that young female farmers should go into arable crop production to increase their productivity levels.*

The coefficient of education was positively associated with productivity and significant at the 1% level, suggesting that educated female farmers are more likely to adopt improved practices and access relevant information that enhances productivity. This research study on educational attainment of farmers is in line with a priori expectation that education enhances a farmer's capacity to acquire, interpret, and apply agricultural information—such as the proper use of inputs, adoption of improved technologies, and market decisions. For female farmers in particular, education can improve confidence, bargaining power, and access to resources. Recent empirical studies reaffirm that education plays a crucial role in enhancing female farmers' access to extension services and adoption of agricultural innovations. Achukwu et al. (2023) demonstrated that among smallholder rice farmers in Gwagwalada Area Council, Nigeria, women with at least secondary education were significantly more likely to engage with extension programs and adopt modern technologies such as improved seeds, herbicides, and fertilizers—leading to notable improvements in productivity.

Cooperative society membership was positively related to productivity and significant at 1% level, indicating that the productivity of female farmers who are members of cooperative society are higher than those who are not a member of any association. More specifically, female farmers who belonged to cooperatives had higher productivity levels, likely due to better access to inputs, training, credit, and market

information. This result on cooperative membership corroborates with the findings of Agbo et al. (2012), who reported that cooperative membership significantly enhanced the economic empowerment and farm performance of rural women in Nigeria. The policy intervention should gear toward the formation and operation of female-led cooperatives as vehicles for increasing productivity, resource access, and market integration for farmers.

The coefficient of farming experience was positive and significant at 10% level related to productivity of female arable crop farmers, indicating that more experienced female farmers tend to achieve higher yields. This aligns with the findings of Adepoju & Salman (2013), who observed that farming experience enhances decision-making, efficiency in resource allocation, and adoption of best agronomic practices. Experienced farmers are better equipped to handle risks, optimize input use, and implement effective farm management strategies. The policy measure for female arable crop farmers on experience is to encourage the experienced farmers into arable crop production for productivity gain.

Farm income was negatively associated with the productivity of female arable crop farmers at a 10% level of significance. This negative relationship suggests that as female farmers' productivity increases—such as through higher yields or improved technical efficiency—their farm income does not increase proportionally and may even decline. This counterintuitive outcome could result from market saturation, where increased output leads to a local surplus and falling prices. Additionally, female farmers may lack the bargaining power, marketing networks, or access to value-added opportunities needed to capitalize on their higher output, thereby limiting income gains from productivity improvements.

This finding is consistent with recent evidence. For example, Quisumbing et al. (2020) reported that although women contribute significantly to agricultural productivity, they often receive lower economic returns due to gender-based constraints in access to land, capital, and market services. Similarly, FAO (2021) and World Bank (2023) emphasize that systemic gender disparities—particularly in market participation, ownership rights, and institutional support—can suppress the income benefits of productivity gains for female farmers.

The coefficient of capital used was positive and significant at the 5% level, indicating that higher financial investment enhances productivity. Female farmers with greater capital access are more likely to obtain improved seeds, fertilizers, mechanized tools, and irrigation facilities, thereby raising output. This result aligns with expectations and recent evidence from Nigeria, where inadequate access to finance was shown to constrain smallholder productivity (Ojo et al., 2023). The finding highlights the need for gender-sensitive financial inclusion policies to close capital access disparities among female arable crop farmers.

CONCLUSION

The study concludes that productivity among smallholder arable crop farmers by gender in Abia State remains generally low due to inadequate inputs, weak extension services, and poor market access. However, women had higher mean productivity and beat men at upper thresholds, indicating greater efficiency when structural barriers are reduced. The analysis further revealed gender-specific determinants, while age and farm size constrained male farmers, education, cooperative membership, experience, and capital significantly enhanced female productivity.

RECOMMENDATIONS

1. Government and development agencies should ensure equitable access to high quality agricultural inputs for both male and female farmers to enhance agricultural productivity.
2. Encourage the formation and support of female led cooperative to enhance access to credit, training. Market information and collective bargaining. Such cooperatives can serve as platforms for resource pooling, knowledge sharing and improving the productivity of female farmers.
3. Implement youth and gender focused programs that provide land access, vocational training and startup capital. These initiatives should target farmers particularly women to address the declining productivity.

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Utilization of Soil Erosion Management Strategies by Arable Crop Farmers in Abia State, Nigeria

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ABSTRACT

*This study assessed the utilization of soil erosion management strategies by arable crop farmers in Abia State, Nigeria. Multistage random sampling procedure was adopted in the selection of hundred and twenty (120) arable crop farmers involved in the study respondents. Descriptive and Inferential statistics were used to analyze the data collected. The soil erosion management strategies with high utilization included use of organic manure ($\bar{x}=2.6$), cover cropping ($\bar{x}=2.6$), mixed cropping ($\bar{x}=2.5$), mulching ($\bar{x}=2.5$) and use of sand bag ($\bar{x}=2.5$). However, the grand mean score was 2.43 indicating that level of utilization is not high. Also, difficulty in carrying out the practice ($\bar{x}=2.63$), lack of training on the strategies ($\bar{x}=2.50$) and unavailability of resources ($\bar{x}=2.50$) are the factors the study found to constrain the high-level utilization of soil management strategies. The socio-economic factors that influenced significantly the level of utilization of soil erosion management strategies were age (-4.51***), sex (7.83***), educational qualification (3.28***), and membership to co-operative (11.07***) and hence the null hypothesis was rejected. The study concluded that the level of utilization of the erosion management strategies by the arable crop farmers in the study area was not high and therefore recommended that the extension agents should increase awareness and diligently carry out trainings for the farmers to encourage the adoption of sustainable soil erosion practices.*

Key words: Utilization, Soil erosion, Management strategies, Arable crop farmers

INTRODUCTION

Soil provides a physical medium for plant growth. Since the soil supplies nutrients, water, air, and anchoring and is compatible with life on earth. Soil undoubtedly plays pivotal roles in the agricultural production systems. As a medium that physically supports crop and animal growth, the sustainability of crop productivity also depends on the quality of soil. Though a fixed asset, soil is primarily essential to guarantee food security, industrial crop production and improved household financial status (Anjichi *et al.*, 2020). Jing *et al.* (2019) noted that soil erosion is a serious environmental, economic, and social problem and that not only does it cause soil degradation and soil productivity loss but also threatens the stability and health of society in the global and sustainable development of rural areas. A vast area of farmlands has been lost due to the menace of gully erosion while others are at their various stages of destruction leading to a drastic decrease in agricultural productivity and ultimately food shortage that can lead to extreme food insecurity (Wang *et al.*, 2018).

Such erosion measures include tillage, mulch farming, cover crops, alley farming, ridge-furrow system, contour farming, contour bunds, terraces and vegetative barriers. Majority of the erosion control measures mentioned above was associated with one or more problems that made it difficult for farmers to adopt them (Edeghon *et al.* 2018). Some of these challenges have made the control of soil erosion to be difficult among

arable crop farmers thereby increasing and worsening the destructive effects of erosion in arable crop production. Transportation of farm produce has also been affected and this also often leads to loss of agricultural products especially the perishable ones. Traders who also go to these areas for their trade are also cut off from their normal day-to-day business (Wang *et al*, 2018).

Soil erosion has given rise to the infertile and barren land that may need to be reclaimed. This usually brings untold hardship to the inhabitants of the land is still inhabitable but has been severely affected. According to Abdulfatai *et al.*, (2019), Abia State has lost over 30 percent of its land area, and over 40 percent of the total area of land and homes are being threatened by the menace of soil erosion, according to the Abia State Ministry of Environment (Gupta 2018, Coulombo, 2018; Wang *et al*, 2018). Hence, there's need to study the utilization of various strategies by the arable crop farmers in the study area to manage the problem of erosion in their farms for increased food production.

Specifically, the objectives of the study were to: describe the socio-economic characteristics of arable crop farmers in the study area; ascertain the level of utilization of erosion management strategies among arable crop farmers and assess the challenges facing the utilization of erosion management strategies among arable crop farmers in the study area.

METHODOLOGY

Study Area

The study was conducted in Abia State Nigeria. Abia State is located in southeast Nigeria with Umuahia as her capital town, this area constitutes one of the nine (9) states in the Niger Delta region of Nigeria. The area occupies about 5,834 km² with a population of 2,833,999 (NPC, 2018) and is bounded on the north and Northeast by Anambra, Enugu and Ebonyi States. The state is bounded to the west by Imo State and to her east and southeast by Cross River State and Akwa Ibom State respectively.

The rainy season begins in March and ends in October with a break in August. The dry season which lasts for four months begins in November. Heavy thunderstorms are characteristic of the onset of the rainy season. The total rainfall decreases from 2200mm in the south to 1900mm in the north. The relative humidity is usually high throughout the year, reaching a maximum during the rainy season when values above ninety per cent are recorded.

The state is badly hit by the menace called erosion. It is the biggest ecological problem of the state. It makes other degradation like flooding; poor sanitation and pollution look like child's play. It is most prominent in the Northern and central parts of the state – Umunneochi, Isiukwuato Bende, Arochukwu, Ohafia, Umuahia North & South and Ikwuano (Abia NEW MAP, 2021).

Sample and Sampling Procedure

Multistage random sampling procedure was adopted in the selection of respondents. In the first stage, purposive sampling technique were adopted to select two (2) senatorial zones from the three (3) senatorial zones in Abia State, because of the high intensity of erosion in the area as reported by Abia NEW MAP (2021). At the second stage, two (2) LGAs each were selected from the two Senatorial Zones comprising Umunneochi and Isiukwuato from Abia North Senatorial District then Umuahia North and Umuahia South from Abia Central Senatorial District. In the third stage, simple random sampling procedure was used to select three (3) rural communities each from the three Local Government Areas making a total of twelve (12) communities. They were: in Umunneochi L.G.A. – Ngodo, Amuda and Achara; in Isiukwuato L.G.A. – Ovim, Umuasua and Uturu, in Umuahia North L.G.A. – Amafor Isingwu, Amuzukwu Ibeku and Mbom. Then in Umuahia South L.G.A, they included Umunwanwa Umuopara, Umuobia Olokoro and Mgbarakuma Ubakala giving a total of 12 communities. Then in the fourth stage, simple random sampling procedure was also adopted to select ten (10) arable crop farmers from each of the selected twelve (12) rural communities, to give a total of hundred and twenty (120) arable crop farmers that were involved in the study.

Method of data collection

Data for the study were generated from primary source using a structured questionnaire to elicit information from the farmers. Both descriptive and inferential statistics were used to analyze the data. Specifically, all the objectives were realized using descriptive statistics such as frequency counts and percentages, standard deviation and mean while the hypothesis was analyzed using OLS regression model.

Measurement of Variables

Objective i: describe socio-economic Characteristics of farmers were analyzed using descriptive statistics such as frequencies, percentages and mean

Objective ii: ascertain the level of utilization of erosion management strategies among arable crop farmers in the study area. This was measured and rated on a 4-point Likert type rating scale of; Always =4, Sometimes = 3, Rarely = 2 and Never = 1. Respondents mean scores were computed for each farm input by adding the weights of $4+3+2+1 = 10/2=2.5$. The following decision rules were adopted. Mean scores between 1.50 – 1.99 = low utilization, 2.00 – 2.49 = moderate utilization and 2.50 and above = high utilization

Objective iii: assess the challenges facing the utilization of erosion management strategies among arable crop farmers in the study area. This was measured and rated on a 3-point Likert type rating scale of; Severe = 3, mild = 2 and not severe =1. A midpoint was obtained thus; $3+2+1 = 6/3 =2.0$. The following decision rules were adopted. Mean scores between 1.00 – 1.49 = not severe constraint, 1.50 – 1.99 = mild constraint and 2.00 and above = severe constraint.

Model Specifications

Multiple regression analysis was used in testing the hypothesis which states that Selected socio economic characteristics of arable crop farmers do not have significant effect on the level of utilization of erosion management strategies among arable crop farmers in the study area

The model is specified explicitly as follows:

Linear function

$$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8 + \beta_9X_9 + \beta_{10}X_{10} + e_i \dots \text{eq 1}$$

Exponential function

$$\text{Ln}Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8 + \beta_9X_9 + \beta_{10}X_{10} + e_i \dots \text{eq 2}$$

Semi log function

$$Y = \text{Ln}\beta_0 + \beta_1\log X_1 + \beta_2\log X_2 + \beta_3\log X_3 + \beta_4\log X_4 + \beta_5\log X_5 + \beta_6\log X_6 + \beta_7\log X_7 + \beta_8\log X_8 + \beta_9\log X_9 + \beta_{10}\log X_{10} + e_i \dots \text{eq 3}$$

Double Log function

$$\text{Ln}Y = \text{Ln}\beta_0 + \beta_1\text{Ln}X_1 + \beta_2\text{Ln}X_2 + \beta_3\text{Ln}X_3 + \beta_4\text{Ln}X_4 + \beta_5\text{Ln}X_5 + \beta_6\text{Ln}X_6 + \beta_7\text{Ln}X_7 + \beta_8\text{Ln}X_8 + \beta_9\text{Ln}X_9 + \beta_{10}\text{Ln}X_{10} + e_i \dots \text{eq 4}$$

Where

Y = Level of utilization of erosion management strategies (Mean)

X₁ = Sex (Male=1, Female=0)

X₂ = Age (Years)

X₃ = household size (No of persons living together and eat from same pot)

X₄ = Farming experience (years)

X₅ = Education (years of schooling)

X₆ = Cooperative membership (years)

X₇ = Access to credit (Access = 1, No Access = 0)

X₈ = Marital status (married = 1, Otherwise = 0)

β₀ = Intercept

e_i = Error term

RESULTS AND DISCUSSION

Socio-Economic Characteristics of Arable Crop Farmers in the Study Area

Entries in Table 1 showed the distribution of farmers based on their socio-economic characteristics. The results showed that mean age of the farmers was 39 years. This indicated that the farmers are still in their middle age and likely to be receptive to new techniques of erosion management. Age has been described as an important factor that influences the level of participation in farming activities in agriculture (Ukoha and Okonkwo, 2017).

Also, a greater proportion of women (61.7%) are involved in arable crop production than the males. This showed that more involvement of women in arable crop production and men getting involved in other economic activities is a livelihood diversification strategy in many rural areas. The results equally revealed that majority of the farmers (71.5%) were married. The finding is in line with that of Ukoha and Okonkwo (2017). Marriage goes with more responsibilities to cultivate crops in order to provide food for their family members. Furthermore, a greater percentage (90.1%) of the farmers had one form of formal education or the other and their mean farming experience was 12 years indicating a vast experience in agricultural production and practical knowledge of the negative effects of erosion crop production. It's also in tandem with that of Ifenkwe and Izuogu (2015) that education and training enhance farmers' productivity and innovativeness.

For the household size, the result showed that the mean household size of the arable crop farmers in the study area was 6, indicating that the farmers have large household size suitable for farming activities. However, having a large household size may provide most of the labour needed for cocoa production in order to reduce the cost expended in hiring labourers, thereby leading to increased productivity (Kanu, 2020), large household size means more mouth to feed thereby putting pressure on the family income.

The entries in Table 1 also showed that more than half (55.0%) of the farmers did not belong to co-operative societies, indicating low membership. This is in addition to a greater percentage (63.3%) not having access to credit. The low membership to cooperative societies and low access to credit by the arable farmers might cause a decline in adoption of soil erosion management strategies among the arable farmers as co-operative societies organize seminars, workshop and meetings which could enlighten the farmers on various erosion managements strategies and how to make each method effective. Nmeregini, Onuekwusi and Ekweanya (2020) opined that membership to cooperative will positively influence the participation of farmers in agricultural activities.

Table 1: Distribution of the farmers based on Socio-Economic Characteristics n = 120

Variables	Frequency	Percentage
Age		
Less than 20	8	6.7
21 – 40	39	32.5
41 – 50	55	45.8
Greater than 50	18	15.0
$\bar{x} =$	39.4	
Sex		
Male	46	38.3
Female	74	61.7
Marital status		
Single	34	28.3
Divorced	14	11.6
Widowed	16	13.3
Married	56	46.6
Education Status		
No formal education	12	10.0
Primary education	10	8.3
Secondary education	35	29.3
Tertiary education	63	52.5
Household Size		
0 – 2	4	3.3
2-4	12	10.0

4-6	45	37.5
Greater than 6	59	49.2
$\bar{x}$ =	6	
Years of Farming experience		
1 – 3	4	3.3
4- 6	33	27.5
6 – 8	17	14.2
Greater than 8	66	55.0
$\bar{x}$ =	12	
Cooperative membership		
Yes	54	45.0
No	66	55.0
Access to Credit		
Yes	44	36.6
No	76	63.3

Source: Field Survey, 2022

Level of utilization of erosion management strategies among arable crop farmers

The result in Table 2 shows level of utilization of erosion management strategies among arable crop farmers. The soil erosion management strategies with high utilization include: Use of organic manure ($\bar{x}$ = 3.4), mixed cropping ($\bar{x}$ =2.5), cover cropping ($\bar{x}$ =2.6), mulching($\bar{x}$ =2.5) and use of sand bag ($\bar{x}$ =2.6). Furthermore, management strategies like tie ridging ($\bar{x}$ =2.3), strip cropping ($\bar{x}$ =2.1), Cross strip ($\bar{x}$ =2.1) and construction of diversion ditch ($\bar{x}$ =2.0) attracted moderate utilization. The grand mean score was 2.44, indicating that the level of utilization of erosion management strategies among arable crop farmers in the study area not high. This is because the grand mean score of 2.44 is below the bench mark mean of 2.50. Farmers get engaged in erosion management strategies that do not demand excessive cost and financial input. However, Odoemelum *et al*, (2016), stated that farmers can only utilize technologies when they are aware of the technologies.

Table 2: Level of utilization of erosion management strategies among arable crop farmers

Erosion management strategies	Always 4	Sometimes 3	Rarely 2	Never 1	Total	$\bar{X}$
Construction of diversion ditch	11(44)	6(18)	75(150)	28(28)	240	2.0
Cross strip	16(64)	5(15)	72(144)	27(27)	250	2.1
Mixed cropping	40(160)	25(75)	10(20)	45(45)	300	2.5
Use of sand bag	40(160)	25(75)	10(20)	45(45)	300	2.5
Mulching	41(164)	5(15)	45(90)	29(29)	298	2.5
Strip cropping	16(64)	10(30)	66(132)	28(28)	254	2.1
Tie ridging	45(180)	5(15)	5(10)	65(65)	270	2.3
Cover Cropping	45(180)	20(60)	20(40)	35(35)	315	2.6
Use of organic manure	65(260)	45(135)	5(10)	5(5)	410	3.4
Total mean scores					2637	22.0
Grand Mean score						2.4

Note: Mean scores between 1.50 – 1.99 = low utilization, 2.00 – 2.49 = moderate utilization and 2.50 and above = high utilization

Source: Field Survey, 2022

Challenges facing the utilization of erosion management strategies among arable crop farmers in the study area

The results in Table 3 showed the challenges facing the utilization of erosion management strategies among arable crop farmers in the study area. These include difficulty in using the strategies ($\bar{x}$ =2.63), lack of training on the strategies ($\bar{x}$ =2.50), high cost of using the practice ($mean$ =2.38), unavailability of resources required ($\bar{x}$ =2.45), size of farm land involved ($\bar{x}$ =2.38) and that had $\bar{x}$ ratings above the benchmark $\bar{x}$ score

of 2.0. Also, the grand mean score which was 2.47, above the bench mark score indicated that the constraints are severe that need adequate attention to avoid loss of crops and other resources.

Table 3: Challenges facing the utilization of erosion management strategies among arable crop farmers in the study area
n=120

Constraints	Severe constraint	Mild constraint	Not Severe	Total	$\bar{X}$
Lack of training on the strategies	75(225)	30(60)	15(15)	300	2.50
Difficulty in carrying out the strategies	85(255)	25(50)	10(10)	315	2.63
High cost of using the practice	63(189)	40(80)	17(17)	286	2.38
Size of farm land in involved	60(180)	46(92)	14(14)	286	2.38
Unavailability of resources required	60(180)	54(108)	6(6)	294	2.45
Total mean scores				1481	12.34
Grant mean score					2.47

Mean scores between 1.00 – 1.49 = not severe constraint, 1.50 – 1.99 = mild constraint and 2.00 and above = severe constraint.

Source: Field Survey, 2022

TEST OF HYPOTHESIS

H0: Selected socio-economic characteristics of arable crop farmers do not have significant effect on the level of utilization of erosion management strategies among arable crop farmers in the study area was tested with Ordinary Least Square (OLS) Regression.

The result of the Regression estimates is presented in Table 4. The linear regression model was chosen as lead equation based on its conformity with econometric and significant criteria such as the magnitude of R^2 , F ratio, number of significant variables and agreement with a priori expectation. The R^2 value of 0.871, indicate 87.1% variability in the level of utilization of erosion management strategies among arable crop farmers in the study area is explained by the independent variables. The F-value (103.16) was highly significant at 1.0% level of probability indicating a goodness of fit of the regression.

The regression coefficient for age (-0.21***) of farmers was negative and significant at 1% as it relates to level of utilization of erosion management strategies among arable crop farmers in the study area. This indicated an inverse relationship between level of utilization of erosion management strategies and their age in years. This implies that the level of utilization of erosion management strategies decreases with increases in the age of the farmers. This could be because younger arable crop farmers have the energy and zeal to undertake the stressful activities associated with the management of erosion in the study area. This finding is similar to that of Ukoha and Nzeakor (2020) that noted that the reason could be that physical energy of older farmers to perform certain soil erosion management operations has declined and this probably accounts for why they may not be fully involved in soil erosion management.

Also, the coefficient of sex (4.99***) was positively signed and significant at 1% level of probability. This implies that the male arable famers adopted erosion management strategies than female arable farmers.

The regression coefficient for educational level (3.28***) of the farmers was positive and significant at 1% as it relates to level of utilization of erosion management strategies among arable crop farmers in the study area. This implies that level of utilization of erosion management strategies increases with increase in the educational level of the farmers. This suggests that well educated arable farmers will adopt erosion management strategies than their less educated counterparts. Therefore, level of utilization of erosion management strategies is dependent on the educational level of the farmers.

The coefficient of membership to co-operative society (11.07***) was positive and significant at 1% level of probability. This implies that the more the farmers belong to cooperatives, the more they adopt the erosion strategies. Nmeregini et al. (2020) noted that co-operative societies organize seminars, workshop and meetings which could enlighten the farmers on various erosion managements strategies and how to make each method effective. This in turn increases the level of utilization of erosion management strategies by its members as they have been educated of its relevance and possibly how to adopt each method without involving much cos

The results showed that Age, sex, educational qualification and membership to co-operative society were significant at 1% level of probability. The implication is that Age, sex, educational qualification and membership to co-operative society affected the level of utilization of erosion management strategies among arable crop farmers in the study area in the study area. Therefore, the null hypothesis which stated that selected socio-economic characteristics of arable crop farmers do not have significant effect on the level of utilization of erosion management strategies among arable crop farmers in the study area. was rejected, while the alternative hypothesis was accepted.

Table 4: Regression Estimates of Determinants of Level of Utilization of Erosion Management Strategies among Arable Crop Farmers in the Study Area

Variable	Linear+	Exponential	Cob Douglass	Semi Log
(Constant)	36.77(19.62)	3.60(52.98)	4.38(24.12)	56.69(11.37)
Age	-0.21(-4.506)***	-0.01(-4.82)***	-0.29(-4.14)***	-7.51(-3.97)***
Sex	4.99(7.83)***	0.17(7.19)***	0.17(7.39)***	5.29(8.16)***
Marital status	-1.34(-1.93)*	-0.03(-1.13)	-0.03(-0.78)	-1.33(-1.33)
Educational qualification	1.07(3.28)***	0.04(3.48)***	-0.04(2.93)***	0.91(2.79)***
Household size	0.28(1.21)	0.01(1.49)	0.01(0.36)	0.19(0.25)
Years in agriculture	0.13(0.88)	0.00(0.33)	0.00(0.03)	0.63(0.36)
Co-operative membership	9.45(11.07)***	0.26(8.36)***	0.28(8.79)***	9.93(11.41)***
R ²	0.871	0.82	0.82	0.80
R ² Adjusted	0.86	0.80	0.80	0.81
F- Value	103.16	72.80	70.69	100.47

Source: Computed by the author from field survey data, 2022

NB: *** Significant at 1%; ** Significant at 5%; * Significant at 10%. Figures in parentheses are t-values; + = lead equation

CONCLUSION AND RECOMMENDATIONS

The study concluded that the level of utilization of erosion management strategies by arable crop farmers in the study area was not high and that the farmers had a lot of constraints that affected them severely in utilizing those strategies which hinged more on lack of training in utilizing the strategies and difficulty in carrying out the practices.

Therefore, the study recommended that extension agents should step up awareness on the effect of erosion on farm lands and diligently train the farmers on how to carry out good management strategies to curb the erosion menace in order to increase food production in the study area.

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Theme: Agricultural Extension for Food Security and Community Empowerment

Effect Of Microcredit Availability on the Performance of Micro Enterprises in Abia State, Nigeria

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ABSTRACT

The study assessed the effect of microcredit availability on the performance of micro enterprises in Abia State, Nigeria. The study specifically looked at the following objectives; determine the socioeconomic characteristics of respondents, determine the level of credit availability to microenterprises, determine the factors influencing the level of credit availability, and determine the effect of credit availability on microenterprise performance. The study adopted a proportionate sampling technique in selecting 90 micro entrepreneurs. Primary data were collected from the respondents using a structured questionnaire. Data collected were analyzed using simple descriptive statistics such as means, percentages, frequency distributions, OLS Regression, Analysis of Variance (ANOVA). The study showed that majority (99.6%) of the respondents under study with and without access to microcredit were majorly food based micro entrepreneurs that are educated, married, with a substantial year of enterprise practical knowledge and belonged to cooperatives Societies. However, only 42% of these individuals had access to credit. This could be due to the level of their compliance to credit terms and conditions as well as the viability of their microenterprises. Furthermore, there was a positive and significant effect of credit availability on the performance of micro enterprises. The study concluded majority (70%) of the respondents had the required socioeconomic characteristics that are suitable to access microcredit. Also, that being a member of the cooperative societies could aid respondents in accessing microcredit. The study therefore recommended that respondents involved in food-based microenterprises with the required age, years of experience with verifiable assets accumulation value and membership of cooperatives should be selected in credit schemes/programs. These measures would ensure effective microcredit utilization and microenterprises development and sustainability.

Key Words: Microcredit, Availability, Performance, Micro Agroenterprises

INTRODUCTION

Micro enterprises constitute the major component of the Nigerian economy (Ukoha *et al.*, 2021). They provide a means of livelihood for an estimated 65% - 70% of the country's population (Akpabio, 2019). It is the major driver of the non-oil sector of the economy, contributing about one-third of annual economic growth (Akpabio, 2019). Generally, micro-enterprise irrespective of the sector, has no single definition, but the common feature of these definitions is the micro level. Micro-enterprise is conceptualized as an enterprise that is relatively small in size, capital, and operations. These are the commonest enterprises in our present-day society, which contribute positively to the growth and development of society.

Micro-enterprise financing has proven to be a powerful instrument against poverty reduction and development in rural areas. Ololade and Olagunju (2013) in their opinion stated that micro enterprise credit is very important for sustainable micro enterprise development to be achieved in Nigeria. More especially,

micro enterprise operators that are agro-based are particularly in need of such instrument (i.e. finance), because of the seasonal pattern of their activities and the uncertainty they are facing. Access to financing facilities by these micro-enterprises that mostly reside in rural areas, has the potential of making the change between crushing poverty and economically secured life as well as improving their enterprise productivity (Ajah *et al.*, 2017). Furthermore, micro-enterprise financing has been recognized as an essential tool for promoting microenterprises (Ogah-Alo *et al.*, 2019). Therefore, Microcredit access refers to the ability of enterprise owners to secure necessary financial resources on acceptable terms, which include the rate of interest, collateral requirements, and repayment schedule (Olayiwola & Magaji, 2024). For agro micro enterprises these financial resources are crucial for the procurement of inputs like seeds, fertilizers, and machinery, which can significantly enhance productivity.

The socioeconomic characteristics of micro entrepreneurs, such as education level, enterprise experience, and assets value status, are closely linked to their access to microcredit facilities. Studies have shown that lenders consider these factors as indicators of a enterprise operator's ability to repay loans, thus affecting their willingness to extend credit. For instance, enterprise operator with higher education levels or larger assets status are often perceived as lower-risk borrowers.

However, lack of credit facilities has been regarded as the major constraint micro enterprise owners' face when they try to improve their economic activity and/or living conditions (Ogbe and Igwemadu, 2021). Despite the fact that capital is an important input for enterprise growth, enterprise operators still have difficulties in accessing this input. In addition, the provision of financial services to entrepreneurs involved in micro agro sector has generally been static and has been decline in some of the developing countries because of risks involved in dealing with agro-entrepreneurs. Furthermore, lack of repayment discipline, loan delinquency and default has plagued micro credit program in developing countries. Based on this background, this study sought to examine the effect of credit availability on the performance of microenterprises in Abia State. The specific objectives include to: determine the socioeconomic characteristics of respondents, determine the level of microcredit availability to microenterprises, determine the factors influencing the level of microcredit availability, and determine the effect of credit availability on microenterprise performance. It was hypothesized that there is no significant difference between socioeconomic characteristics of the respondents and microcredit availability,

METHODOLOGY

Abia is a State in the southeastern part of Nigeria with Umuahia as the capital. Abia State occupies about 6,320 square kilometers and is bounded on the northeast by the states of Anambra Enugu, and Ebonyi. To the west of Abia is Imo State, to the southeast are Cross Rivers State and Akwa Ibom State respectively and to the south is Rivers State. There are 904,721 micro-enterprises in Abia State (NBS, 2013). First, random sampling technique was used in selecting 6 LGAs from the seventeen LGAs for study. Furthermore, a proportionate sampling procedure was used in selecting 90 microenterprises within 20km of the selected Local Government Areas. The use of the 20km radius of the LGAs is because of the high economic activities of micro, small, and medium-scale operations and the ease of accessing the selected respondents for the study. The lists of microenterprises were obtained from the LGA's unit on SMES operations at the different headquarters in the selected LGAs. These lists formed the sampling frame for the selection of respondents for the study. Primary data was collected from the respondents using a structured questionnaire and interview schedule. Data collected were analyzed using simple descriptive statistics such as means, percentages, frequency distributions, OLS Regression, Analysis of Variance (ANOVA). The implicit linear functional form of the regression model is highlighted as follows;

$$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7)$$

Where;

Y = credit availability (availability=1, non-availability=0)

X₁ = Age of the respondents measured in years

X₂ = Level of education measured by the number of years spent in acquiring formal education

X₃ = Marital Status (Single=0, Married=1)

X₄ = Years of experience

X_5 = Business size (naira)

X_6 = Assets measured in naira

X_7 = Membership of Cooperative (Membership=1, non-membership=0)

While the effect of credit availability on the performance of microenterprises is stated as follows;

$Y = f(X_1)$

Where Y = Performance (Naira)

X_1 = Credit Availability (availability=1, non-availability=0)

Testing Of Hypotheses

Hypothesis one and two was tested using Multiple Regression F statistics. The formula is shown below;

$$F^* = \frac{\sum \hat{Y}^2 / N - K}{\sum e^2 / (K - 1)}$$

Where,

$\sum \hat{Y}^2$ = the total sum of square deviation explained by all the regression together.

$\sum Y^2$ = the total sum of square deviation of Y^2

$\sum e^2$ = the sum of residual deviation

$N - K$ = Sample size, $N - K + K - 1$ = Degree of freedom per $\sum Y^2$

RESULTS AND DISCUSSION

Socio-economic Characteristics of the Respondents

Age

Distribution of respondents based on age along access to credit or without credit, is presented Table 1

Table 1: Distribution of respondents based on age, with or without credit

Access to credit/Age range	21-30		31-40		41-50		51-60		61-70		Total		
	Freq	(%)	Freq	(%)	Freq	(%)	Freq	(%)	Freq	(%)	Freq	(%)	Mean
Access to credit	10	11.1	10	11.1	9	10.0	9	10.0	2	2.2	40	44.4	40.87
No access to credit	11	12.2	11	12.2	2	2.2	20	22.2	6	6.7	50	55.6	45.12
Total	21	23.3	21	23.3	11	12.2	29	32.2	8	8.9	90	100	

Source: Field survey, 2019

Table 1 shows that about 59% of the respondents had age ranging between 21-50years. However, only 32% of the respondents who had access to credit fell within the stated age range. The mean age of the respondents with access to credit was 41years, this means that majority of the respondents were young, vibrant and enterprising. This study is in line with the findings of Mejeha and Ogbe (2010) that young entrepreneurs are not constrained by physical energy needed in carrying out their business operations.

Marital Status

Distribution of respondents based on marital status, is presented in Table 2

Table 2: Distribution of respondents based on marital status.

Access to credit/Marital status	Married		Single		Total	
	Freq	(%)	Freq	(%)	Freq	(%)
Access to credit	25	27.8	15	16.7	40	44.4
Non access to credit	33	36.7	17	18.9	50	55.6
Total	58	64.4	32	35.6	90	100

Source: Field survey, 2019

Table 2 shows that 64.4% and 35.6% of the respondents were married and single respectively. In addition, 27.8% of the respondents who were married, as compared to 16.7% of the respondents who were single, had access to credit. This means that being married put one in a favorable position for financial aid. This may be due to the fact that lenders expect a high level of accountability and responsibility, of which married micro entrepreneurs have such competences.

Education

Distribution of respondents based on level of education along with or without credit is presented in Table 3

Table 3: Distribution of respondents based on level of education

Access to credit/Education	No formal education		Primary		Secondary		Tertiary		Total	
	Freq	(%)	Freq	(%)	Freq	(%)	Freq	(%)	Freq	(%)
Access to credit	1	1.1	7	7.8	15	16.7	17	18.9	40	44.4
Non access to credit	5	5.6	29	32.2	8	8.9	8	8.9	50	55.6
Total	6	6.7	36	40.0	23	25.6	25	27.8	90	100

Source: Field survey, 2019

Table 3 shows that 93.3% of the respondents had acquired one form of education or another. In addition, only 43.3% of the respondents with at least primary education were able to access credit. This indicates that majority of the respondents who had access to microcredit were educated. This study is in line with Echeta (2024) that small and medium scale enterprises with owners who have educational qualification are more likely to be favored by financial institutions to access microcredit.

Experience

Distribution of respondents based on experience along with or without credit, is presented in Table 4

Table 4: Distribution of respondents based on experience, with or without credit

Access to credit/Experience	1-5		6-10		11-15		16-20		21-25		Total	
	Freq	(%)	Freq	(%)	Freq	(%)	Freq	(%)	Freq	(%)	Freq	(%)
Access to credit	16	18.0	15	16.9	6	6.7	2	2.2	1	1.1	40	44.4
Non access to credit	13	14.6	27	30.3	0	0.0	0	0.0	10	11.2	50	55.6
Total	29	32.6	42	47.2	6	6.7	2	2.2	11	12.3	90	100

Source: Field survey, 2019

Table 4 shows that 79.8% of the respondents had business experience ranging between 1-10years, while 20.2% of the respondents had business experience ranging between 11-25years. However, only 34.9% of the respondents with about 10years experience have access to credit. The mean years of practical experience of the respondents with access to credit in micro enterprises was about 8 years, signifies that majority of the respondents had a substantial year of experience on microenterprise management and operations.

Membership of Co-operative

Distribution of respondents based on membership to co-operative along access to credit is presented in Table 5

Table 5 Distribution of respondents based on membership to co-operative along access to credit.

Access to credit/Cooperatives	Membership		Non-Membership		Total	
	Freq	%	Freq	%	Freq	%
Access to credit	36	75	4	9.52	40	44.4
No access to credit	12	25	38	90.47	50	55.6

Total	48	100	42	100	90	100

Source: Field survey, 2019

Table 5 shows that 53.0% and 47.0% of the respondents are members and non-members of co-operative respectively. This indicates that majority of the respondents are members of co-operatives. The membership of a co-operative by the respondents could be due to the fact that co-operative societies help provide financial and non-financial assistance when needed at little or no cost.

Type of microenterprises involved in by the respondents

Distribution of respondents based on type of microenterprises involved in by the respondents along with or without access to credit is presented in Table 6

Table 6: Distribution of respondents based on type of enterprise, with or without access to credit.

Access to credit/Enterprise	Food based		Non food		Total	
	Freq	(%)	Freq	(%)	Freq	(%)
Access to credit	35	42.3	5	62.5	40	44.4
Non access to credit	47	57.3	3	37.5	50	55.6
Total	82	99.6	8	100.0	90	100

Source: Field survey, 2019

Table 6 shows that 99.6% of the respondents are involved in food-based microenterprise. This means that majority of the respondents under study with and without access credit were food based micro entrepreneurs. However, only 42% of these individuals were had access to credit. This could be due to their compliance to credit terms and conditions.

Factors influencing the level of credit availability among micro entrepreneurs

Factors influencing the level of credit availability among micro entrepreneurs is presented in Table 7

Table 7: Factors influencing the level of credit availability among micro entrepreneurs

Variable	Linear	T value
Constant	3282.306	(0.144)
Age	488.491	(1.702)*
Education	1086.058	(1.283)
Marital status	3671.586	(0.562)
Experience	1416.125	(2.530)**
Income	-38.315	(-1.215)
Assets	0.009	(2.729)***
Co-operative	12647.680	(2.146)**
R ²	0.454	
R ⁻²	0.330	
F-ratio	3.678***	

Source: Field survey, 2019 *** significant at 1%,** significant at 5% , * significant at 10%

Table 7 shows that linear functional form was used to determine the factors influencing credit availability among micro entrepreneurs. The value of R² of 0.454 means that 45.4% of the total variability observed in the dependent variable is accounted for by the independent variables included in the model. The value of F- ratio (3.678) signifies that the model is statistically significant at 1%

Age was significant at 10% and positively related to credit availability. This means that as age of the respondents increased, credit availability also increased. Increase in age among respondents could be likened to the ability to adapt financial innovations with maturity. This further corroborates the findings of Ogbe and Ejim (2019) that adoption of financial innovation would position the respondents to gain and enjoy more financial intervention.

Experience was significant at 5% and is positively related to credit availability. This means that as the level of experience in the management of enterprises increased, the level of credit availability also increased. Onubuogu *et al.* (2014) and Esiobu *et al.* (2014) reported that enterprise owners with more experience would have a better knowledge of efficient allocation of resources and market situation and are thus expected to run a more efficient and profitable enterprise. This is in addition to the fact that more experienced enterprise owners are resilient in that they recover more quickly from stress and provocation (Ogbe, 2023).

Value of Assets was significant at 1% and positively related to the level of credit availability. This means that as the value of assets of the business increased, the level of credit availability increased also. Increased value of assets could mean value addition to business operations and sustainability

Membership of co-operative was significant at 1% and positively related to credit availability. This means that as membership to co-operative society increased, credit availability also increased. Membership of cooperative could mean greater opportunity to learn basic business skills and its application which will lead to better handling of financial and non-financial matters (Ogbe and Igwemadu, 2021).

Effect of credit availability on the performance of micro enterprises

Effect of credit availability on the performance of microenterprises is presented in Table 9

Table 9 Effect of credit availability and on the performance of microenterprises

Variable	Linear
Constant	663.699 (310.823)
Credit availability	0.000 (2.200)**
R ²	0.113
R ⁻²	0.090
F-ratio	4.840***

Source: Field survey, 2019 *** significant at 1%, ** significant at 5% , * significant at 10%

Table 9 shows that credit availability was significant at 5% and is positively related to performance. This means that as credit availability increased, performance of microenterprises also increased. Credit availability could define the capacity of a microenterprise in terms of choice of technology, access to markets and access to essential resources, which in turn greatly influences the variability and success of a business enterprise.

TEST OF HYPOTHESIS

Table 10: There is no significant difference between socioeconomic characteristics and credit availability.

Model	Sum of Squares	Df	Mean square	F-cal	F-tab
Regression	272.006	7	38.858	14.465	2.33
Residual	83.277	31	2.686		
Total	355.283	38			

Source: Field survey, 2019 Decision rule; if F cal is > F tab, reject the Ho and accept the HA otherwise accept the Ho.

Table 10 shows that F Cal (14.465) was greater than F Tab (2.33). So, reject the Ho and accept the HA. Therefore, there is a significant difference between socioeconomic characteristics and credit availability.

CONCLUSION AND RECOMMENDATIONS

The study showed that majority (99.6%) of the respondents under study with and without access to microcredit were food based micro entrepreneurs that are educated, married, with substantial years of enterprise practical knowledge and belonged to cooperatives. However, only 42% of these individuals had access to credit. This could be due to the level of their compliance to credit terms and conditions as well as the viability of their microenterprises. Furthermore, there was a positive and significant effect of credit

availability on the performance of micro enterprises. More so, majority (70%) of the respondents had the required socioeconomic characteristics that are suitable to access microcredit. Also, that being a member of the cooperative societies could aid respondents in accessing microcredit.

The study therefore recommended that respondents involved in food-based microenterprises with the required age, years of experience with verifiable assets accumulation value and membership of cooperatives should be selected in credit schemes/programs. These measures would ensure effective microcredit utilization, microenterprises development and sustainability. In addition, microcredit scheme that will target food-based microenterprises should be encouraged. This move will encourage food security, employment creation and the growth of local economies

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