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Adoption effect of improved fish processing technologies on food security: Experience from artisanal fish processors in Lagos state, Nigeria

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Abstract: Fish is a highly perishable food product, necessitating effective preservation methods to mitigate food loss. Traditional preservation techniques often pose health risks, underscoring the need for improved, environmentally safe processing technologies suitable for human consumption. This study examined the effects of adoption of improved fish processing technologies on food security among artisanal fish processors in Lagos State, Nigeria. A two-stage sampling procedure was adopted in the random selection of 121 fish processors across the selected fishing communities. The dataset elicited was analyzed using descriptive statistics to depict the demographic and socio-economic characteristics of the processors. The study used composite score analysis to categorize processors based on their level of technology adoption, and Foster, Greer, and Thorbecke approach to measure food security status. Fractional logistic regression was applied to examine the effects of technology adoption on food security. Findings indicate that 62% of the sampled processors were female, with an average age of approximately 46 years. Commonly used processing techniques included charcoal ovens (57.9%), smoking kilns (64.5%), electric dryers (45.5%), solar dryers (37.2%), and gas ovens (55.4%). Information sources for respondents included extension agents, research, personal experience, religious organizations, friends, internet, and newspapers. Approximately 66.1% of respondents showed moderate adoption of improved technologies, while 16% and 18% exhibited high and low adoption levels, respectively. Notably, 63.6% were food-secure, while 36.3% were food-insecure. Significant factors affecting food security included marital status ($p=2.17$), access to storage facilities ($p=1.83$), and the adoption of improved fish processing technologies ($p=2.12$). The study concludes that adoption of improved fish processing technologies significantly boosts food security among processors. Recommendations include enhancing storage facilities and encouraging the adoption of advanced processing methods to reduce spoilage and extend shelf life, ensuring safe food and improved food security.
Keywords: Artisanal, fish processing technologies, fractional logistic regression, Lagos, Nigeria

INTRODUCTION

Fish is a good source of protein to large population of Nigeria as it provides 40% of the dietary intake of animal protein of the average Nigerian. According to Oladipo *et al.* (2015), fish and fish products constitute more than 60% of the total protein intake in adults, especially in rural areas. Fish has a nutrient profile superior to all terrestrial meats (beef, pork and chicken), an excellent source of high-quality animal protein and highly digestible energy. Fish is a good source of Sulphur and essential amino acids such as lysine, leucine, valine and arginine. It is therefore suitable for supplementing diets of high carbohydrates contents; fish is also a good source of thiamine as well as an extremely rich source of Omega-3 polysaturated fatty acids, fat-soluble vitamins (A, D and E) and water-soluble vitamins (B complex) and minerals (Calcium, Phosphorus, Iron, Iodine and Selenium) (Oladipo *et al.,* 2015).

Fish also have a high content of Polyunsaturated Omega III fatty acids, which are important in lowering blood cholesterol level and high blood pressure. It can mitigate and alleviate platelets of cholesterol aggregation and various arteriosclerosis conditions in adult populations. However, it reduces the risk of sudden death from heart attacks and reduces rheumatoid arthritis, Omega-3 fatty acids also lower the risk of age-related muscular degeneration and vision impairment; it decreases the risk of bowel cancer and reduces insulin resistance in skeletal muscles (Kudi *et al.,* 2011).

The significance of fish, particularly to people living in emerging countries, has been well acknowledged in the literature. Fish is one of the economical sources of dietary protein, especially in secluded fishing communities; source of employment as the fishery sector generates employment for over 70% of persons living in rural areas (Federal Department of Fisheries (FDF), 2013). It is also of medicinal value and further useful for industrial purposes such as in the production of fish meal. The use of fish as a source of protein to aid growth and development of both humans and livestock cannot be over-emphasized. Quite a sizeable proportion of the Nigerian population depends on fishing as a source of income. Apart from being an income earner to many Nigerians especially people in coastal, river-rine and lake areas of the country. Some people earn their living from fish processing and marketing while others engaged in fishery research. It is therefore necessary to ensure that improved fish processing technologies that have been developed and disseminated are adopted, in order to increase fish processing and improve food security. A number of fish processing technologies that have been developed and disseminated to processors in Nigeria include the electric dryer, gas oven, chorkor oven, solar dryer and smoking kiln. Effective dissemination of these technologies to processors, their adoption and diffusion are expected to bring about increase in fish

processing and enhance food security in Nigeria. The roles of fish processing technologies are to simplify and make fish processing more effective and efficient. It is therefore pertinent to investigate the extent to which fish processing technologies have been transferred to processors and the extent to which the technology end-users have taken advantage of these technologies in fish processing.

The global demand for fish as food is increasing not only due to increased population growth but because it is a safe source of animal protein that is widely available and affordable for all regardless of socio-economic status (Olaoye *et al.,* 2015). More so, Nigeria is a highly populated country; hence, the demand for fish and fish products continues to increase, and the supply has failed to meet the demand. This thereby creates a gap between the fish demand and supply thereby causing nutritional and food insecurity (Kumolu-Johnson and Ndimele, 2011). Bearing in mind that fish is a perishable product, processors employed various techniques for its preservation to avoid food loss; owing to this, traditional processing of fish remains a pivotal means of making cured fish available to Nigerians and many other Africans over a long time which not only preserves the fish but also protects against income loss by the fish processors (Sakyi *et al.,* 2019). Literatures have shown that majority of smoked fish processors in Nigeria employed traditional techniques and processing equipment that have been in existence for several decades such as cylindrical metal or oil-drum oven (full or half drum), mud oven, box oven, and brick kiln (Davies and Bekibele, 2008; George *et al.,* 2014; Olaoye *et al.,* 2015; Odediran and Ojebiyi, 2017). However, the major shortcoming of traditional smoking ovens hinged on the poor-quality smoked fish as evidenced by higher polycyclic aromatic hydrocarbons concentration which raise public safety and health concerns. Bolorunduro *et al.,* (2005) noted that post-harvest losses could be reduced by simply improving the handling and processing methods. Equally, Davies (2005) submitted that the development of appropriate fish machinery and technologies that employ effective handling, harvesting, processing and storage cannot be over-emphasized, especially in the age when aquaculture development is fast gathering momentum in Nigeria. In line with this view, the Federal Government of Nigeria, in collaboration with international agencies (such as FAO) and State Governments, has funded research across various research institutes to invent and develop improved processing and preservation technologies.

The general objective of this research is to examine the effects of adoption of improved fish processing technologies on food security status among artisanal fish processors in Lagos State, Nigeria.

The specific objectives of this study are to:

- identify the available varieties of improved fish processing technologies among artisanal fish processors in the study area.
- estimate the level of adoption of improved fish processing technologies in the study area.
- characterize the respondents' food security status based on their level of improved fish processing technologies in the study area.
- examine the effects of adoption of improved fish processing technologies on the food security status of the respondents in the study area.
- identify the constraints militating against the adoption of improved fish processing technologies in the study area.

METHODOLOGY

The study area is Lagos State, South-west, Nigeria. The State lies approximately on longitude 2°42" and 3° 22" taste of the Greenwich Meridian and between the latitude 6° 22" and 6° 42" North of the Equator. It has an estimated population of 17,552,940 persons (LASG, 2012). It is bounded in the North and East by Ogun State and in the West and South by Republic of Benin and Atlantic Ocean respectively (Oyediran *et al.,* 2016). Although the State is primarily Yoruba speaking, it attracts people of other ethnic groups within the country and foreign neighboring countries (Adefuye, 1987). Fishing is the main industry of the indigenous population of the selected communities. The fishing villages are scattered with various forms of water bodies; lagoons, rivers, creeks and swamps. By virtue of its location in Nigeria, Lagos and the environments are veritable fishing area. Most of inhabitants of the selected communities, therefore, derive their livelihood from fishing as an income generating activity.

Two stage sampling technique were used for this research. In the first stage, four artisanal fishing communities (Badagry, Eti-Osa, Epe and Ikorodu) in Lagos State were purposively selected because of the predominant activities of artisanal fishing activities in these areas. The second stage involved the use of proportionality factor (that is, the use of a random proportionate to size sampling technique) in the selection of 128 fish processors across the selected fishing communities.

Descriptive statistics such as frequency counts, percentages and mean value were used to describe the demographic and socio-economic characteristics of the respondents, while composite score technique and cross-tabulation analysis were applied to categorize the respondents' food security status based on the levels of adoption of improved fish processing techniques. Fractional logistic regression analysis was also applied to model the effect of adoption of improved fish processing

technologies and other dynamics on the food security status of the respondents in the study area.

Fractional Regression: Model Specification

According to Villadsen and Wulff (2021), fractional model regression is an appropriate technique for modeling fractional outcomes. Papke and Wooldridge (1996) suggested imposing a functional form for the conditional mean of the fractional outcome: $E(y/X)G = G(X\beta)$, where the nonlinear function $G(.)$ ensures that predictions lie inside the unit interval (Villadsen and Wulff, 2021). Explicitly, the relationship between food security status and adoption of improved fish processing technologies and other dynamics can be expressed as:

$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 \ldots\ldots\ldots\ldots\ldots b_nX_n+\mu$ …… (4) where:

Y= Index of food security status

b_0 = intercept

b_i = regression coefficient

$X_1 \ldots\ldots\ldots X_n$ = hypothesized independent variables influencing the respondents' food security status.

μ = random error term.

RESULTS AND DISCUSSION

Personal and socioeconomic characteristics

The findings in Table 1 revealed that 38.0% of the sampled artisanal fish processors were male, while 62.0% were female. Although the study is not gender based, the result underlies the fact that female in the study area had greater access to fish processing. This research finding was further supported by the assertion of Oyediran et al. (2016) that the female dominance in fish processing contributes to their economic empowerment, poverty reduction and food security. By implication, women who participated in fish processing were motivated to adopt new technologies that offer nutritional benefits. The result also indicated that males are now getting involved in fish processing as against the earlier submissions that fish processing is the sole responsibility of women in fishing industries.

Also, the results revealed the age-group distribution of the artisanal fish processors in the study area. The findings indicated the predominance of people who fall within the active age groups of the economy. Most of the respondents fell between the ages of 36-45 years while the lowest percentage (4.1%) of the artisanal fish processors fell within less than 25 years of age. By implication, fish processing in the study area were dominated by young people, who are energetic enough to withstand the stress involved in fish processing with readiness to adopt and try out new technologies. This finding agrees with Kumar et al. (2018), but disagrees with Fapojuwo *et al.* (2018), who reported a much lesser average age of the farmers.

Similarly, the findings revealed that 61.2 percent of the respondents were married and, therefore would have greater family responsibility, 22.3 percent were single, 13.2 percent were divorced, while 3.3 percent were separated. Most married people have dependants, and thus require a steady source of income. This result implies that most of the respondents were married, though some were single, widowed and few were divorced. By implication, this result suggests that most actors were married and this is in line with the findings of Adebayo et al. (2017), who reported similar findings in their study conducted in South-West Nigeria.

In terms of household size, the findings revealed that the largest percentage of household size of the respondents were 30.6% with household size ranging from 5-10. 25.6% had 2 to 5 household size while 23.1 % had less or equal to 2 members in their household which showed that most of the respondents do not adopt family planning. The study affirms that large households tend to have free labor supply toward the adoption of an innovation rather than the smaller households. By implication, this result suggests by Danso-Abbeam et al. (2018) who reported similar findings in their study conducted in Ghana. The findings also revealed that 26.5 percent of the respondents completed their secondary school education, 21.5 percent completed primary school education, 22.3 percent attempted secondary school, 9.1 percent were exempted from primary school and 10.7 percent had no formal education while 9.9 percent had tertiary education. This result implies that most of the respondents have basic education recommended and made compulsory by Federal Government of Nigeria. With this educational attainment, the adoption of fish processing technologies could be facilitated as education plays a significant role in adoption of improved technologies.

The findings also indicated that 33.9 percent of the fish processors had between 6-10 years of fish processing experience, 4.1 percent of the respondents had between 1-5 years of fish processing experience, 15.7 percent of the respondents had between 16-20 years and more than 20 years of fish processing experience, respectively. Then, 30.6 percent of the respondents also had between 11-15 years of fish processing experience. The result implies that the respondents were well experienced in fish processing in the study area. This finding agrees with Okidim and Obe-Nwaka (2021) who reported similar findings in their study conducted in River State, Nigeria. In the same vein, the findings revealed that 33.9 percent of the income fell between N151000-N250000, 32.2 percent of the income fell between N50000-N150000, 14.9 percent of the income realized by the respondents fell between N351000-450000 and 451000 and above while 4.1 percent of the income fell N251000-N350000. This indicates that most of the respondents realized good income from fish processing. This also implies that fish farming is a

high-income generating investment. The result is in line with Aminu et al. (2017) who reported similar findings in their study conducted in Lagos State, Nigeria. Overall, the results showed that the respondents have differentiated socio-economic characteristics, and this can influence the level of adoption of improved fish processing technologies and their food security status.

Table 1: Selected personal and socio-economic features of artisanal fish processors (n=121)

Variables	Frequency	Percentage
Gender		
Male	46	38.0
Female	75	62.0
Age-group (years)		
<= 25	5	4.1
26-35	37	30.6
36-45	50	41.3
46-55	19	15.7
Above 55	10	8.3
(Mean = 46 years)		
Marital status		
Married	74	61.2
Single	27	22.3
Divorced	16	13.2
Separated	4	3.3
Household size		
≤ 2	25	20.7
2-5	31	25.6
5-10	37	30.6
Above 10	28	23.1
Educational status		
No formal education	13	10.7
Primary School exempted	11	9.1
Primary School completed	26	21.5
Secondary School Attempted	27	22.3
Secondary School completed	32	26.5
Tertiary	12	9.9
Years of experience		
<5	5	4.1
6-10	41	33.9
11-15	37	30.6
16-20	19	15.7
Above 20	19	15.7
Monthly Income		
50000-150000	41	33.9
151000-250000	39	32.2
251000-350000	5	4.1
351000-450000	18	14.9
451000 and above	18	14.9

Source: Field survey, 2023

Fish processing technologies adopted

The findings in Table 2 revealed that 57.9 percent of the respondents used Charcoal oven as a fish processing technique while 64.5 percent of the respondents used fish smoking kiln as a processing technique. 45.5 percent of the respondents use electric dryer oven as a fish processing technique, 37.2 percent of the respondents use solar dryer as a fish processing technique while 55.4 percent of the respondents use gas oven as a fish processing technique. From the results, the respondents' usage of fish processing techniques spread across the study area.

Table 2: Distribution of the respondents based on fish processing technologies

Fish processing technologies	Frequency	Percentage
Charcoal oven	70	57.9
Smoking kiln	78	64.5
Electric dryer	55	45.5
Solar dryer	45	37.2
Gas oven	67	55.4

***Multiple response**
Source: Field survey, 2023

Sources of information on improved fish processing technologies

Table 3 revealed that 58.7 percent of the respondents used extension agents as the source of information on improved fish processing practices, 56.2 percent of the respondent used market as the source of information, 60.7 percent of the respondent used Radio as the source of information on fish processing practices, 57.9 percent of the respondent used Television as the source of information on fish processing practices, 59.5 percent of the respondent used Friends as the source of information on fish processing practices, 58.7 percent of the respondent used Research as the source of information on fish processing practices,. 62.0 percent of the respondent used Self experience as the source of information on fish processing practices. 61.2 percent of the respondent used religious organization as the source of information on fish processing practices. 60.3 percent of the respondents used Organization as the source of information on approved fish processing practices, 61.2 percent of the respondent used Internet as the source of information on fish processing practices. 62.8 percent of the respondents used Newspaper as the source of information on fish processing practices.

Table 3: Distribution of the respondents based on source of information

Sources	Frequency	Percentage
Extension Agents	71	58.7
Market	68	56.2
Radio	73	60.7
Television	70	57.9
Friends	72	59.5
Research	71	58.5
Self	75	62.0
Religious	74	61.2
Cooperative	73	60.3
Internet	74	61.2
Newspaper	76	62.8

***Multiple response**
Source: Field survey, 2023

Distribution of respondents by level of adoption and food security status

Table 4 presented the level of adoption and food security status of respondents in the study area. The table revealed that majority of individuals in all levels of adoption are food secured, with 67.53% of individuals in the moderate adoption group being food secured, the highest among the three groups. While 19.48% of the respondents who are in the high level of adoption group were found to be food secured and the lowest percentage of food secured individuals was found in the low adoption group, with 12.99%. Furthermore, the result showed that majority (63.63%) of the respondents who are in the moderate level of adoption group were found to be food non-secured, also 27.27% of the respondents who are in the low level of adoption were found to be food non-secured and 9.09% of the respondent who are in the high level of adoption group were found to be food non-secured. The total result revealed that the moderate level of adoption has the highest percentage of food secured households (67.53%) and food non-secured households (63.64%). However, the result indicated that there is a correlation between the level of adoption and food security. The moderate adoption group has the highest percentage of food-secured individuals, which may indicate that certain adoption of fish processing technologies is more effective at promoting food security.

Table 4: Distribution of respondents by Level of Adoption and Food Security Status

Level of Adoption	Food Secure	Food Insecure	Total
Low	10 (12.99)	12 (27.27)	22 (18.18)
Moderate	52 (67.53)	28 (63.63)	80 (66.12)
High	15 (19.48)	4 (9.09)	19 (15.70)
Total	77 (100.00)	44 (100.00)	121 (100.00)

Source: Field Survey, 2023

Effect of adoption of improved fish processing technologies on food security status of fish processors

Table 5 presents the results of the fractional logistic regression analysis fitted to model the effects of adoption of improved fish processing technologies on food security status of the respondents in the study area. It was observed that the coefficient of adoption index was positive (a direct relationship with food security status) and it is statistically significant at 5% probability level, while the coefficient of marital status is negative (an inverse relationship with food security status), and it is also significant at 5% probability level. Meanwhile, the coefficient of access to storage facilities was positive (a direct relationship with food security status) and it is also significant at 10% probability level.

Given these results, the coefficient of adoption index was found to be significant and positive, which implies that an increase in the rate of adoption of improved fish processing technologies has the possibility of increasing food security status of the respondent by 0.5587 unit, and the association between adoption index and food security status is statistically significant. This is in line with what Obisesan and Omonona (2013) reported in their related study in Nigeria where they revealed the impact of the Root and Tuber Expansion Programme (RTEP) improved production technology on the food insecurity incidence, depth and severity of the beneficiaries. As noted in their study, the food insecurity incidence of RTEP beneficiaries reduced by 16.27%, 12.02% and 21.54% when compared with the all the population of Non-RTEP beneficiaries (ANRTEPB), Non-RTEP beneficiaries within RTEP Areas (NRTEPBW) and Non-RTEP beneficiaries outside RTEP Areas (NRTEPBO), respectively. Furthermore, the coefficient of access to storage facilities was also found to be positive and significant, indicating that having access to storage facilities is associated with a higher likelihood of respondents been food secure by 0.1085 unit. However, the coefficient of marital status was found to be negative and significant indicating that married fish processors are more likely to be food secure by 0.1014, while unmarried fish processors are less likely to be food secure. By implication, married individuals will likely have more family members to use as family labour, hence the chance of having higher productivity outcome in terms of fish processing, income generated and being food secure is high.

In conclusion, since adoption of improved fish processing techniques appears to have a significant and positive relationship with the farmers' food security status, it is safe to reject the null hypothesis and accept the alternative hypothesis that adoption of improved fish processing techniques has a significant relationship with the processors' food security status in the study area.

Table 5: Effect of Adoption of Improved Technologies on Food Security Status

Variable	Coefficient	Marginal effect	Std.Err	Z value	p>/z/
Adoption index	2.9612	0.5587	1.3946	2.12**	0.034
Age	-0.2286	-0.431	0.1649	-1.39	0.166
Gender	0.7115	0.1342	0.4433	1.60	0.109
Marital Status	-0.5376	-0.1014	0.2477	-2.17**	0.030
Education	0.2205	0.0416	0.1385	1.59	0.111
Extension access	0.3957	0.0746	0.4653	0.85	0.395
Market access	-0.4147	-0.0782	0.4358	-0.95	0.341
Information from friends	0.5209	0.0983	0.4953	1.05	0.293
Information from Cooperative	-0.0846	-0.0159	0.4717	-0.18	0.858
Access to storage	0.5751	0.1085	0.3139	1.83*	0.067
Constant	-2.760	-	1.568	-1.76*	0.079

Source: Data analysis, 2023

Constraints affecting adoption of fish processing technologies

The result in Table 6 revealed the constraints and/or challenges (minor and major) affecting the adoption of improved processing technologies in the study area. Parts of the challenges considered by the respondents are: lack of storage facilities, high cost of procurement of the

equipment used for the technology, pest infestation, apathy towards transitioning from the old methods of processing to the improved ones, poor marketing structure, compatibility issue as regards the existing practice, and poor extension service delivery. Likewise, complexity of the technology, lack of seamless access to the technologies, lack of technical skills, and perception about the appropriateness of the improved technologies were also cited as parts of the constraints militating against the adoption of improved fish processing technique in the study area. With this observation, appropriate policy actions targeted at addressing these highlighted challenges, needs to be implemented so as to boost the adoption and uptake of the improved fish processing technologies as these have been shown to be good, from health and environmental perspectives.

Table 6: Distribution of the respondents based on the constraints affecting adoption of improved processing technologies

Constraint	Major	Minor	Not a constraint
High cost of procurement of the technologies	49 (40.5)	47 (38.8)	25 (20.7)
Complexity of the technology	42 (34.7)	51 (42.1)	28 (23.1)
Compatibility with existing practice	45 (37.2)	47 (38.8)	29 (24.0)
Apathy towards improved technologies	48(39.1)	45 (37.2)	28 (23.1)
Lack of easy access to the technologies	31(25.0)	52 (43.0)	38 (31.4)
Non-availability of the technologies	40 (33.1)	45 (37.2)	36 (29.8)
Technologies are not ideal for fish processing	40 (30.6)	43 (35.5)	39 (32.2)
Lack of storage facilities	60 (49.6)	39 (32.2)	21 (17.4)
Pest infestation	49 (40.5)	43 (35.5)	28 (23.1)
Inadequate capital	21 (17.4)	36 (29.8)	64 (52.9)
Poor marketing structure	46 (38.0)	46 (38.0)	29 (24.0)
Lack of technical skills	40 (33.1)	48 (39.7)	33 (27.3)
Poor extension service delivery	44 (36.4)	44 (36.4)	32 (26.4)
Poor transportation facility	32 (26.4)	38 (31.4)	50 (41.3)

The values indicated in the table are frequencies, while those in parentheses are percentages
* - Multiple response
Source: Field survey, 2023

CONCLUSION

Based on the findings of the study, it was concluded that artisanal fish processors is an industry that is mostly dominated by young, energetic male individuals who have a considerable level of fish processing experience and access to education. This suggests that there is potential for the industry to continue to thrive in the future, especially if interventions are made to increase adoption rates of improved fish processing technologies. Additionally, the good income realized by most of the respondents implies that artisanal fish processing can be a viable means of livelihood for individuals in the study area. Also, the study concluded that the artisanal fish processors in the study area have access to a variety of sources of information on fish processing technologies. However, the majority of them have only a moderate level of adoption of fish processing technologies, indicating a need for targeted interventions to increase adoption rates. The study also concluded that over a third of the respondents were classified as food non-secured suggesting that there is a significant food security issue in the area, which may be due to a variety of factors such as poverty, lack of employment, poor infrastructure, or inadequate social protection programs. Addressing these issues may be necessary to improve food security and enhance the livelihoods of artisanal fish processors in the study area. Based on the findings, it was also concluded that the adoption of improved fish processing technologies and access to storage facilities were positively associated with food security among artisanal fish processors in Lagos state. Therefore, interventions that encourage the adoption of improved fish processing technologies and provide access to storage facilities are likely to improve the food security status of fish processors. It was concluded from the findings that marital status is negatively associated with food security, with unmarried fish processors being less likely to be food-secure. Therefore, policies and programs that specifically target unmarried fish processors may be necessary to improve their food security status. Furthermore, it was concluded from the study that there were several constraints that affected the adoption of Fish Processing Technologies. The most significant constraint is the perception that these technologies have no relative advantage over traditional techniques. Lack of storage facilities and pest infestation were also identified as major constraints. Poor marketing structure and extension services were also significant barriers to adoption. However, complexity and difficulty in adopting improved technologies were found to be minor constraints and inadequate capital and lack of technical skills were not significant constraints.

RECOMMENDATIONS

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

- Given that the perception that the technologies are not ideal for fish processing and have no relative advantage over traditional techniques is a significant constraint affecting adoption, it is important to increase awareness among artisanal fish processors about the benefits of improved fish processing technologies. This could be done through targeted outreach programs that provide clear and concise information on the benefits of improved fish processing technologies.
- The study found that having access to storage facilities increases the likelihood of food security status of the respondents. Therefore, it is recommended that government and non-governmental organizations should provide storage facilities for artisanal fish processors to store their processed fish, which can help reduce spoilage and increase their income.
- Poor extension services were identified as a significant constraint to the adoption of improved fish processing technologies. Therefore, it is recommended that extension services be improved through training and capacity building programs for extension agents and the provision of necessary resources to enable them to effectively disseminate information to fish processors.
- The study found that poor marketing structures were a significant constraint to the adoption of improved fish processing technologies. Therefore, it is recommended that marketing structures be strengthened to provide better access to markets for artisanal fish processors. This can be achieved through the establishment of cooperative societies or the provision of credit facilities to help processors expand their businesses and access more markets.

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Household poverty effects and youth's life aspiration in Kwara state, Nigeria

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Abstract: The poverty experienced by youth is commonly linked to childhood deprivation and parental poverty which have implications across an individual's life-course including life aspiration. This study therefore investigated the effects of household poverty on life aspiration of youth in Kwara state. Systematic sampling technique was used to select 180 respondents for the study. Data was collected through structured questionnaire and analyzed using frequency counts, percentages mean Chi-square, Pearson Product Moment Correlation (PPMC), and T-test. Results revealed that 50.0% of respondents were male and female, with mean age of 22.2±3.5. and mean household size of 7± 2.6 people, while the primary occupation of most of the respondents' parents was trading (27.2%). Prayer ($\bar{x}$=1.08), ranked first as the coping strategies against poverty. Household poverty was high (51.1.4%) likewise life aspiration (54.4%). Aspiration categories such as personal growth ($\bar{x}$=14.07), wealth ($\bar{x}$=13.0) community contribution ($\bar{x}$= 10.8) were the most important life aspirations of the respondents. Parents' Primary occupation (χ^2= 25.415, p=0.000), Age (r=-0.153, p=0.041) and household poverty (r=0.338, p=0.000) had significant relationship with level of aspiration. There was also a significant difference in life aspiration of urban and rural youth (t= 3.218, p=0.003). The study concluded that household poverty had significant effect on life aspiration of youth. Governmental interventions should encourage a mentorship programme that will target young people from poor households.
Keywords: Youth poverty, Household poverty, Life aspiration, Youth.

INTRODUCTION

Poverty in Nigeria remains pervasive, chronic and multifaceted (Omonona, 2010)**.** It is viewed metaphorically as an elephant and complex to define as it is more easily recognized than defined. The United Nations Economic and Human Development Index suggested that any person in a community that is living below two US dollars a day is assumed to be poor, it is estimated that about 90% of young people in Nigeria are under this situation (United Nations World Population Prospects, 2011). Moore (2005) affirms that, poverty experienced by youth is linked to childhood deprivation and parental poverty and can have implications across an individual's life-course, and across the life-course of her or his household. In many cases, children who are born to young persons experiencing poverty may be especially susceptible to persistent poverty resulting into inability to afford adequate housing, unhygienic living conditions, low quality public services, isolation, social insecurity, lack of employment, inability to have regular job, economic stagnation, inability of household to meet up their required and necessary food need (Sijuade, 2008).

Today's youth generation face a much longer and more complex transition to adulthood (Honwana, 2012). Widespread poverty limits the material and emotional support young people receive at the household-level. It places pressure on them to be financially independent and, in alignment with cultural norms and values, to be contributors to the household, too. Also, the problems young people face in securing sustainable livelihood do not just adversely impact them in terms of limited incomes and delaying their ability to get married and start a family. It also impacts on them socially, they are not awarded the respect given to adults since they are unable to reach the social markers of adulthood, they are considered dependent and cannot contribute to household needs thus bringing shame and unhappiness to young men and women across the continent.

Furthermore, poverty creates internal psychological barriers that prevent individuals from breaking out of poverty. The experience prevents young people from developing self-confidence and the capacity to have a very clear vision of how they could achieve a reasonable living standard (Boateng and Lowe, 2018). Poverty reproduces itself by limiting aspirations, thereby creating a psychological poverty trap. It has negative influence on aspirations through material limitations such as limited incomes, less influential contacts, and limited access to relevant information (Dalton *et al*, 2015).

Aspiration is essential in ensuring sustainable livelihood. It is the platform through which young people strive to enhance their skills and knowledge in order to have more financial resources, assets and better social relationships thereby leading to successful future lives which is the anchor of sustainable livelihood. Where young people have grown up in environments that did not encourage hope or meaningful aspirations, they may not believe that they should aspire to much and may lack the courage or skills to invest in their dreams (Boateng and Lowe, 2018). Aspirations motivate people to work harder and achieve more according to Tafere (2014). Appadurai (2004) opined that poor people may lack the capability to aspire and to contest and alter the conditions of their own poverty.

Youth's aspirations in relation to poverty however remains a relatively unexplored area for researchers and is struggling to find its place in

sociological or socioeconomic research. Understanding the specific context of youth is critical to developing appropriate and effective strategies and programmes. With these viewpoints it becomes pertinent to empirically ascertain the influence of household poverty on life aspirations of youth in Kwara state of Nigeria. The general objective of the study ascertained household poverty effect on life aspiration of youth in Kwara State.

The study's specific objectives were to:

i. determine the personal/family characteristics of youth in the study area;
ii. describe the characteristics of youth poverty in the study area;
iii. identifie the coping strategies for poverty by youth in the study area;
iv. determine the household poverty status of youth in the study area;
v. ascertaine the life aspirations of youth in the study area.

The following hypotheses were tested for the study;

$H_0$1: There is no significant relationship between the family characteristics of respondents and their life aspirations.

$H_0$2: There is no significant relationship between household poverty level of youth and their life aspiration.

$H_0$3: There is no significant difference in life aspiration of rural and urban youth.

METHODOLOGY

The area of study for this research was Kwara state. Kwara is a state in Northern Nigeria. Its capital is Ilorin. The population of the study constituted both urban and rural youth residing with their parents within the ages of 18-30years in Kwara state. Multistage sampling procedure was used to select respondents for the study. The state was stratified into rural and urban dichotomy. In stage one: 10% of the urban and rural Local Government Araes (LGAs) was randomly selected. Ilorin west was selected out of 10 urban Local Government areas, while Moro was selected out of 6 rural Local government areas in the state. In stage two, 15% of wards in Ilorin west (Adewole and Baboko) and Moro ((Bode-saadu and Shao) were randomly selected to give a total of 4 wards. One community was randomly selected from each ward to give a total of 4 communities.i.e Bode-saadu and Shao; Adewole and Baboko). Stage 3: A systematic sampling was used to select 180 households. A youth within the age of 18-30 in the household was sampled for the study.

Strategies for coping with poverty was measured by asking the respondents to indicate their coping strategies for poverty using a ten-item scale with response options of Yes and No, which was assigned score of 1 and 0 respectively.

Household poverty was measured using fuzzy supplementary multidimensional poverty index. Indicators of poverty comprising housing, economic condition, goods of comfort, equipment and assets, education, energy, health were generated. These indicators were ordered categories. Items under each indicator were assigned the highest score of 4 and least score of 1. Poverty index was obtained and was used to categorize into high and low household poverty status...

The dependent variable of the study is youth life aspiration. Aspiration index scale developed by Kasser & Ryan (1996) was adapted for the study. Six categories of aspiration which include the extrinsic aspiration of wealth, fame and image and the intrinsic aspiration of meaningful relationships, personal growth, and community contribution were used for the study. These categories have a list of specific goals. Respondents were asked to rate the importance of each goals and the likelihood of attaining the goals. Three-point scale of 'very important', important and not important with a scoring of 2,1 and 0 respectively was used to determine the importance of the goals while a three point scale of very likely, likely and not likely with a score of 2,1 and 0 respectively was used to determine the likelihood of attaining such goals. The scores were pooled together and mean was generated which was used to categorize respondents' aspiration into high and low. Data were analysed with descriptive and inferential statistics.

RESULTS AND DISCUSSIONS

Personal characteristics of respondents

Result in Table 1 indicates a proportionate distribution of male (50.0%) and female (50.0%). This implies that both genders were equally represented in the sample. Age distribution of the respondents shows that 100% of respondents were within the age range of 18-35 years, which is the recommended age category for youths by the United Nations. The mean age of 22.2±3.5 implies that most of the youths were still very active, agile and strong in their productive years which will positively influence their capability to have high life aspiration.

Table 1 further shows that majority (95.0%) of the respondents were single, while 5.0% were married. This implies that majority of the respondents were being guided by their parents or guardian and were not attached emotionally to anyone which might make them concentrate more on aspiring and achieving their life goals.

Majority (71.1%) of the respondents were secondary senior school certificate holders. This implies that majority of youth in the study area were educated. This might increase their life aspiration goals. This is in line with Tafere (2014) study, who stated that as the grade levels increase, the aspirations of students also become higher, and vice versa.

As reflected in Table1, 55.1% of the respondents were between first to third born of the family. The position an individual occupies within the family may likely influence their level of aspiration. For instance, the first born of the family might have high level of aspiration more so as to take care of their younger ones and also to be a good role model for their siblings.

Furthermore, Table 2 shows that majority (54.4%) of the youth sampled had between 5 to 7 persons in their household, The mean household size was 7±2.6which indicates that the household size of respondents in the study area was large. This implies that with large household size, the respondents are likely to aspire more so as to have enough to take care of their family.

Also, 27.2% of the respondent's fathers were into trading, 26.1% were civil servant, 25.6% were famers, 10% were logistic manager, 8.9% were teachers and lecturers, and 2.2% were accountant. This implies respondents had parents who are engaged in one occupation or the other in order to fend for the family. Banks (2016) in his study opined that youth aspirations are being influenced by the background and occupation of their parents.

Table 2: Distribution of the personal characteristics of respondents (n= 180)

Variables	Frequency (f)	Percentage (%)	Mean score
Sex			
Male	90	50.0	
Female	90	50.0	
Age			
18-21	90	50.0	22.2
22-25	63	35.0	
26-29	14	7.8	
30-33	13	7.2	
Marital status			
Single	171	95.0	
Married	9	5.0	
Educational attainment			
Primary education	3	1.7	
Secondary education	128	71.1	
Tertiary Education	49	27.2	
Position in family			
1st – 3rd	99	55.1	
4th – 6th	65	36.2	
7th and above	16	8.9	
Household size			
2-4	18	10.0	7±2.6
5-7	98	54.4	
8-10	50	27.8	
11-13	9	5.0	
14-16	1	0.6	
17-19	4	2.2	
Primary Occupation			
Trading	49	27.2	
Logistic Manager	18	10.0	
Civil service	47	26.1	
Farming	46	25.6	
Lecturing/teaching	16	8.9	
Accountant	4	2.2	
Total	180	100.0	

Source: Field survey (2018)

Coping strategies for poverty by youth

Coping strategies refer to those things that youth do in order to adjust to poverty or leave the poverty cycle. From the result in Table 3 coping strategies employed by youth against poverty in the study area included prayer ($\bar{x}$=1.08), courage to move on ($\bar{x}$=0.96), hope/imagining a better future ($\bar{x}$=0.92), talent display ($\bar{x}$=0.90), skills learning ($\bar{x}$=0.85), street vendouring/hawking ($\bar{x}$=0.77), livelihood diversification ($\bar{x}$=0.76), stamina ($\bar{x}$=0.72). Hansen (2010) posited that street knowledge, stamina, ingenuity and innovation are critical attributes youth are forced to acquire as a

form of tactical agency to cope with the concrete, immediate conditions of their lives, where such tactics do not exist, hardship can lead to criminality.

Table 3: Coping strategies for poverty by youth

Coping strategies	Yes	No	Mean	Rank
Livelihood diversification	76.1	23.9	0.76	7th
Street vendouring/hawking	69.4	30.6	0.77	6th
Learning of new skills	85	15	0.85	5th
Marrying early	52.8	47.3	0.52	
Using street knowledge	66.7	33.3	0.66	9th
Having stamina to withstand stress	71.7	28.3	0.72	8th
Engage in corporate begging	60	40	0.60	
Ingenuity	53.9	46.1	0.54	
Hope/ Imagining a better future	92.2	7.8	0.92	3rd
Building courage	96.7	3.3	0.97	2nd
Use of talent	90	10	0.90	4th
Praying	97.2	2.8	1.08	1st

Source: Field survey (2018)

Household poverty

The result on Table 4 shows a slightly high household poverty level (51.1%). This suggests that a moderately high proportion of respondents were unable to care about their basic needs and meet social and economic obligations. This can limit the capacity of young people within this household and dampen their aspirations.

Table 4: Household poverty status

Level	Frequency	Percent
High	92	51.1
Low	88	45.6

Source: Field survey (2018)

Life aspiration of youth

The result on Table 5 reveals that aspiration for personal growth ($\bar{x}$=14.07) was considered the most important goal to achieve, this implies that respondents' goal of learning new things, having a well -paying job, working hard to get ahead and having a happy life is more important to them. The result further reveals that the likelihood of achieving this goal was high. Aspiration for wealth (13.03) was considered next important to personal growth, this suggests that young people aspire to be very wealthy, have many expensive possessions and have enough money to buy everything they want, particularly if they are coming from a deprived household. Aspiration to be wealthy is expected to motivate young people to engage in sustainable livelihood that is capable of enriching their lives and not express desperation by engaging in crime and criminal activities. Respondents also aspired to contribute to community development ($\bar{x}$=10.80), it was also very important to them and the likelihood to achieve it was equally high ($\bar{x}$=10.62). Aspiration goals such as image ($\bar{x}$=8.5) and fame ($\bar{x}$=4.8) were the least important to the respondents and the likelihood of achieving them was similarly low.

Furthermore, categorization of life aspiration of youth as shown in Table 6 indicates that respondents had high aspiration (54.4%). This implies that respondents had goals and target that are ambitious, therefore, they are likely to move out of household poverty as result of their high aspiration. Narayan et al (2009) reported that aspirations for the future had a statistically significant impact on a household's ability to move out of poverty. Appadurai (2004) also opined that it is only through capacity to aspire that individuals can find the internal and material resources they need to contest and alter the conditions of their own poverty.

Table 5: Life aspiration of youth

	Aspirations	Importance				Likelihood			
		VI	I	NIAA	Mean	VL	L	NLA	Mean
A	**Wealth**								
1.	To be a very wealthy person	78.3	20.5	1.1		88.9	11.1	0.0	
2.	To have many expensive possessions	38.9	59.5	1.7	13.0	65.6	33.4	1.2	13.7
3.	To be rich	71.1	28.9	0.0		80.6	9.5	0.0	
4.	To have enough money to buy everything I want	71.1	28.9	0.0		67.2	32.8	0.0	
5.	To save money for the future	86.7	13.3	0.0		66.1	33.4	0.0	
B	**Fame**								
1.	To have my name known by many people	50.6	48.9	0.6	4.8	46.7	53.3	0.0	5.0
2.	To be admired by many people	62.2	36.7	1.1		70.0	30	0.0	
C	**Image**								
1.	To choose what I do, instead of being pushed along by life.	82.6	17.3	0.0	8.5	75.6	23.9	0.6	8.1
2.	To have an image that others find appealing	76.7	23.3	0.0		68.9	31.1.	0.0	
3.	To have a good reputation in the community	87.2	3.8	0.0		75.6	24.4	0.0	
D	**Personal growth**								
1.	To grow and learn new things	70.6	29.4	0.0	14.1	60.0	39.5	0.6	13.6
2.	To have a well paying job	84.4	15.5	0.0		73.3	26.7	0.0	
3.	To work hard to get ahead	86.1	13.9	0.0		75.6	24.5	0.0	
4.	To have a happy life	90.6	9.5	0.0		82.2	17.8	0.0	
5.	At the end of my life, to be able took back on my life as meaningful and complete	85.6	13.9	0.6		81.7	16.1	2.2	
E	**Community contribution**								
1.	To work to make the world a better place	77.2	22.8	0.0	10.8	81.1	18.9	0.0	10.6
2.	To help others improve their lives	81.1	18.9	0.0		53.9	40.1	0.0	
3.	To work for betterment of society	68.9	31.1	0.0		58.3	41.7	0.0	
4.	To assist people, asking nothing in return	75.6	24.5	0.0		79.4	20.6	0.0	
F	**Meaningful relationships**								
1.	To have committed, intimate relationships	72.2	27.2	0.6	7.7	72.8	27.2	0.0	7.9
2.	To share my life with someone I love	77.8	21.6	0.6		82.2	17.8	0.0	
3.	To have good friends that I can count on	7.2	52.2	0.6		58.3	41.6	0.0	

Field survey, 2018 VI- Very Important ; I – Important ; NVI –Not Very Important ; NIAA- Not Important At All
VL – Very Likely; L – Likely; NVL- Not Very Likely; NLAA -Not Likely At All

Table 6: Level of youth aspiration

Level	Frequency	Percent
High (36.0-70.0)	98	54.4
Low (0.0-35.0)	82	45.6

Field survey, 2018

Test of hypotheses

There is no significant relationship between the family characteristics of respondents and their life aspirations.

The result of analysis in Table 7 shows that sex, religion, educational attainment, marital status and position in family had no significant relationship with life aspiration of youth $p<0.05$($p=0.765$, $p=0.177$, $p=0.625$, $p=0.418$ and $p=0.308$

respectively). However, primary occupation of respondents' parents or caregiver is significantly related to life aspiration of youth (p=0.000). This implies that the life aspiration of youth can be positively or negatively influenced by parent's occupation. For instance, an individual can aspire to become like his or her parents in future or aspire to become a better person than the parents. This corroborates the findings of Stewart et al. (2007) who revealed that, as compared to their counterparts, children with better economic status due to their parent's occupation, hold higher aspirations and achieve better.

Table 7: Chi-square test relationship between selected family characteristics of respondents and their life aspiration

Variables	χ^2	df	p-value	Decision
Sex	0.090	1	0.765	Not significant
Religion	3.460	2	0.177	Not significant
Educational attainment	0.939	2	0.625	Not significant
Marital status	1.745	2	0.418	Not significant
Position in family	10.553	9	0.308	Not significant
Primary occupation	25.415	5	0.000	Significant

Source: Field Survey, 2018. x^2 Value = chi square value, df = degree of freedom, p=probability value

Table 7b shows that age (r= -0.153, p = 0.041) was significantly related to life aspiration of respondents. This implies that as youth grow older their level of aspirations also increases. This assertion is in line with the view of St Clair and Benjamin (2011) who stated that aspirations are not static and will change considerably through an individual's life as they grow.

Table 7b: Pearson Product Moment Correlation (PPMC) Analysis of the relationship between selected personal characteristics of respondents and their life aspiration.

Variable	R	N	p-value	Decision
Age	-0.153	180	0.041	Significant
Household size	-0.122	180	0.102	Not significant

Source: Field Survey, 2018

Findings in Table 8 reveal that that there was a significant relationship between household poverty level of respondents and their life aspiration (r= 0.338, p< 0.000). This suggests that household poverty could influence the level of aspiration of youth. This supports the findings of Narayan et al (2009) who reported that aspirations for the future had a statistically significant impact on a household's ability to move out of poverty. The result however contradicts the assertion of Darton *et al* (2015) that poverty reproduces itself by limiting aspirations, thereby creating a psychological poverty trap.

Table 8: Pearson Product Moment Correlation (PPMC) Analysis of the relationship between the household poverty level of respondents and the youth life aspiration goals

Variable	r-value	N	p-value	Remark
Household poverty level	0.338	180	0.000	Significant

Source: Field survey, 2018

The result of test of difference between life aspiration of rural and urban youth in Table 9 shows that there was a significant difference in life aspiration of urban youth and rural youth (t=3.218 and p<0.05). This suggests that the life goals and ambition of urban and rural youth are different, this could be as result of the environmental

Table 9: T-test for test of difference in life aspiration of rural and urban youth in kwara state

Participants	N	Mean Score	T	Df	P-value	Decision
Urban	100	1.560	3.218	178	0.003	Significant
Rural	80	1.325				

Source: Field survey 2018

CONCLUSION AND RECOMMENDATION

The study concluded that the poverty level among youth households was moderately high and significantly influenced their life aspirations. Personal growth and wealth were the most important life aspiration of the youth. It was recommended that

government interventions should promote mentorship programs targeting youth from poor households. Also, poverty alleviation programmes should focus on building the capacity of youth and their entire household. Furthermore, both government and non-government organizations should provide mentorship opportunities aligned with the career aspirations of the youth.

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Fish consumption preferences and behavioural pattern in Oyo state, Nigeria

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Abstract: The study investigated fish preference and consumption pattern of households in Oyo State, Nigeria. It specifically analysed fish consumption preference of the households; estimated the determinants of the fish consumption preference and analysed the consumption pattern of fish in the study area. Multistage random sampling techniques were used to collect primary data from 151 respondents. The data were analysed using Tobit regression model and Quadratic Almost Ideal Demand System (QUAIDS). The results show that residents in Oyo state have preference for tilapia and mackerel fish be it fresh, frozen, smoked or dried. Further results also revealed that income, price of egg, price of beef and price per kg of frozen fish influence the consumption preference of fish in the study area. Also, the study established that fish is a necessity in the study area. It is therefore recommended that the benefits of fish should be advocated by the government and the non-governmental organisations among the respondents in the study area for improved behaviour towards fish consumption.
Keywords: Fish preference, Consumption pattern, QUAIDS

INTRODUCTION

In Nigeria, the prevalence of chronic or transitory food and nutrition insecurity in households has been a major problem. According to International Rescue Committee (2024), it is about 58%. Findings from Erdogan et al.; (2011) and Blisard et al., (2020) showed that pregnant women and men that lack ability to consume enough fish are prone to malnutrition, cardiac and other related diseases. 14.3 million people in Nigeria were regarded as undernourished in 2016 (Food and Agricultural Organisation Statistics 2017). However, malnutrition is a major problem that is rampant among the larger population of children (Quamme and Iversen, 2022). Also, low fish consumption in men and women increases their disease exposure. Aside what malnutrition does to adults, about 67% of children between the age of 0.5 – 2 years lack food rich in iron and 52% lack the intake of Vitamin A-rich foods in 24-hour diet (National Population Council (NPC) and International Classification Functioning Disability and Health (ICF), 2014). In addition, about 10.8% of children under the age of 5 years had a prevalence of wasting, while 43.8% are stunted (Nigeria Bureau of Statistics and United Nations International Children's Emergency Fund (UNICEF), 2017). Findings from Ayanoye (2023) revealed that the issue of nutrition insecurity is prevalent in the study area (52%) with little or no information about their consumption pattern now and efforts to improve their welfare.

In the same vein, NBS (2015) revealed that socio-economic factors, power outages, seasonal and climatic fluctuations affect the frequency of fish consumption, the type of fish households prefer for storage and consequently for consumption. This necessitates the need to probe into the frequency of fish consumption and their preference in the study area. During harvest around February, according to NBS (2015), about 38% of households prefer frozen fish neglecting other types of fish as a result of some reasons or factors which are yet to be unravelled or determined that explains household consumption preference and behavioural pattern in the study area. Consumer preferences of products usually depend on two major factors, which are the consumer's socioeconomic status and the nature of the product (Maria Font-i-Furnols & Luis Guerrero 2014, Isabel Schaufele & Ulrich Hamm 2017). The social and economic status of consumers plays a significant role in fish consumption patterns and consumption preferences. Consumer preference is influenced by income, religious composition, among many other factors affecting fish consumption across different regions and communities in Nigeria (Felix, et al, 2023 & Umaru et al, 2024). In 2019, Oyo state is one of the states in southwestern Nigeria with high profile of food insecurity and malnutrition. Therefore, studying their preference for fish as a valuable source of protein might improve food and nutrition security thereby improving their livelihood.

Fish, has high healthy value in terms of high concentration of Omega-3 fatty acid (FAO, 2017), supplies essential nutrients to the body in the form of protein, lipids, vitamins and minerals (Tsado et al., 2012) which makes it a reliable way to combat food insecurity. Fish is rich in ω-3 polyunsaturated fatty acid with an optimum concentration of docosahexaenoic acid and eicosapentaenoic acid (Kong et al., 2011). Also, malnutrition and non-communicable diseases such as hypertension, diabetes, and heart diseases can be prevented through the consumption of healthy diets (WHO, 2016).

According to Ayantoye Kayode (2023), Oyo state is one of the states in the Southwest Nigeria with high profile of food insecurity and ultimately malnutrition. Findings from the literature shows that the consumption of two servings of fish per week reduces the risk of coronary heart diseases (The American Heart Association, 2015). It also has a positive health impact on chronic health problems such as hypertension, inflammation, and type 2 diabetes which could have been averted with daily

consumption of fish in its right quantity. Since several fish varieties predominate the market in Oyo state, it becomes very important to unravel the type of fish they prefer and the factors promoting it for a nutritionally secured environment in the state.

The broad objective of this study is to investigate the fish consumption preferences and its behavioural patterns in Oyo state.

The specific objectives are to

(i). analyse fish consumption preference of households; and

(ii). estimate the determinants of fish consumption preference and pattern of households among households in Oyo state.

METHODOLOGY

The study was carried out in Oyo state in the South-Western geo-political zone of Nigeria. Multi-stage stratified sampling technique was used to collect primary data on household characteristics, preference and frequency of fish species purchased with the quantity and amount of money spent of these weekly in the study area. In the first step, all local government areas in Oyo state were identified, and five local government areas were randomly selected. In the second stage, the number of towns were randomly selected. The third stage of the data collection involves stratification of respondents into groups; producers, marketers, and consumers. At the fourth stage, at least 10 respondents were randomly selected each from the producers, each from the marketers and consumers respectively to make a total of 30 respondents from each town to make a total of 151. Selected respondents were either household heads or individuals with substantial knowledge about the family and actively participate in the purchase of goods (fish and fish products) in the study area.

Tobit regression model, and Quadratic Almost Ideal Demand System (QUAIDS) were used. The QUAIDS model is presented as equation 1 below:

$$w_i = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} \ln p_j + \beta_i \ln\left[\frac{m}{a(p)}\right] + \frac{\lambda_i}{b(p)}\left\{\ln\left[\frac{m}{P}\right]\right\}^2 + \mu_i \qquad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Wi = the expenditure shares for commodity. α, b , γ, λ, and η = estimated parameters; and e = error term. Where Yi is the Consumption preference of respondents, Xi's = the preference and behavioural attributes of respondents: X_1 = income level of respondents (Naira), X_2 = age of respondents (year), X_3 = sex or gender of respondents (male or female), X_4= marital status of respondents (married, = 1, otherwise 0), X_5 = household size (number), X_6 = education level of respondents (number of years spent in school), X_7 = price of substitutes (Naira/kg), X_8= increased health concern, X_9= fish preparation method (smoked, dried, fresh, frozen, etc.), X10 = advertisement, X_{11} = distance from home to fish seller or market (kilometres), X_{12}= taste of fish, X_{13} = price of fish (Naira/kg), X_{14} = type of fish (frozen, cultural, processed and captured).

The Tobit regression model was fitted as this:

$Yi^* = \beta Xi + ei$ …..…….……..…… (2)

Where Y is fish preference,

Whereas, Xi's are independent variables which represents:

X_1 = Age of household head (years), X_2 = Educational level of household head (years), X_3 = Household size, X_4= Taste of fish, X_5 = Ease of preparation of fish, X_6 = Safeness to eat fish, X_7 = Freshness of fish, X_8 = Cleanliness of fish, X_9 = Appearance of fish, X_{10} = Odour (smell) of fish, X_{11} = Availability of fish in the open market, X_{12} =Expenditure on substitutes (naira). ei = Error term.

RESULTS AND DISCUSSIONS

Fish consumption preference

The result as shown in Table 1 reveals that frozen tilapia (60.3%), smoked tilapia (66.9%), fresh (cultured) tilapia (79.5%), fresh (captured) tilapia (79.5%) and dried tilapia (51.7%) were strongly preferred by most households. Frozen horse mackerel (52.3%), smoked catfish (37.7%), fresh (cultured) tilapia (19.2%), fresh (captured) catfish (45.7%) and smoked panla (43%) were slightly preferred by most households. Frozen herrings (46.4%), smoked herrings (32.5%), fresh (cultured) catfish (23.8%), fresh (captured) catfish (41.7%) and dried tilapia (19.9%) had the highest indifference level. Smoked herrings and tilapia (9.9%), fresh (captured) croaker (1.3%), and dried catfish (27.2%) were not preferred by households. Frozen hake (82.1%), smoked herrings (25.8%), fresh (cultured) catfish (29.1%), fresh (captured) shark (99.3%) and dried oporoko (68.9%) were most disliked among households. In summary, respondents in Oyo state much prefer Tilapia fish whether it is frozen, smoked, cultured, captured or dried. They also showed some dislike for hake fish, croaker, shark and oporoko fish. This disagrees with the findings of Abiona (2016) in her studies on fish species and forms consumed in both water and non-water bodies of Oyo State, Nigeria.

Table 1: Consumers preference for fish in the study area

		Consumer Preference				
Form of the Fish	**Type of Fish**	**Strongly preferred (%)**	**Slightly preferred (%)**	**Indifferent (%)**	**Not preferred (%)**	**Dislike (%)**
Frozen	Croaker	9.9	6.6	29.1	0	54.3
	Herrings	0	13.2	46.4	0	40.4
	Horse mackerel	26.5	52.3	9.3	0	11.9
	Mackerel	49.7	40.4	9.9	0	0
	Hake	0	0	17.9	0	82.1
	Tilapia	60.3	33.1	5.3	0	1.3
	Catfish	13.9	41.7	20.5	0	23.8
Smoked	Tilapia	66.9	27.8	5.3	0	0
	Herrings	6.5	25.2	32.5	0	25.8
	Horse mackerel	27.8	34.4	25.8	0	11.8
	Mackerel	49.7	29.8	10.6	0	0
	Catfish	49.0	37.7	5.3	0	7.9
Fresh Cultured	Tilapia	79.5	19.2.	1.3	0	0
	Catfish	34.4	12.6	23.8	0	29.1
Fresh Captured	Tilapia	94.7	4.0	1.3	0	0
	Catfish	6.6	45.7	41.7	0	6.0
	Croaker	0	31.1	33.1	1.3	34.4
	Shark	0	0	0	0.7	99.3
Dried	Tilapia	51.7	28.5	19.9	0	0
	Catfish	29.1	39.7	0	27.2	4.0
	Oporoko	0	5.3	15.9	9.9	68.9
	Panla	38.4	43.0	10.6	0	7.9

Source: Data analysis, 2021

Estimating the determinants of fish consumption preference

Table 2 presents the estimation of the various factors affecting fish consumption preference using Tobit regression model. The result shows that the probability of respondent's preference for fish increases with an increase in number years spent in school. This connotes that the more educated the respondents are, the stronger would be their preference for fish. However, there is a probability that the preference would reduce with an increase in age, gender, marital status, income and the prices of different fish forms and that of its substitutes which conforms to the result of Mozammel Mridha (2020). The result shows that if the price of income, price of frozen fish, fresh fish both captured and cultured and price of meet and egg increase by 100%, there would be about 0% increase in the preference for fish. This suggests that residents in Oyo state would not want to but fish if they have more money or if the price of the fish goes up. This somehow indicates that the respondents prefer other forms of protein than fish.

Table 2: Determinants of fish consumption preference

Consumption preference	**Coefficient**	**Std error**	**T**	**P>t**
Age	-0.020	0.031	0.625	0.333
Family size	-0.0034	0..224	-0.15	0.881
Years spent in school	0.0176	0.0315	0.55	0.428
Gender	-0.0308	0.0156	-1.97	0.052
Marital status	-.0233	0.0851	-0.27	0.785
Income	$-2.49e^{-06}$***	$4.61e^{-07}$	5.41	0.000
Price/kg of frozen fish	$1.26e^{-04}$*	$7.56e^{-05}$	1.68	0.097
Price/kg of captured fish	2.98^{-04}	$3.75e^{-04}$	0.80	0.428
Price/kg of cultured fish	$2.49e^{-06}$***	$4.61e^{-07}$	5.41	0.000
Price of beef	$1.33e^{-04}$***	$4.79e^{-05}$	2.79	0.006
Price of egg	$-6.11e^{-04}$***	$2.34e^{-04}$	-2.61	0.007
_Cons	2.3736	0.4485	5.29	0.000
Sigma	0.3732	0.0293		
LR Chi^2	70.46			

Pseudo R^2	0.3515

Please note that *** =1%, ** = 5%, *= 10%
Source: data analysis 2021

Consumption pattern of households towards frozen fish

Table 3 expressed the compensated own price elasticity coefficients, which shows percentage change in demand in response to its own price; Mackerel fish has the highest own price elasticity of (0.44) followed by croaker fish (0.43). This indicates that a one percent increase in the price index led to a rise in demand for mackerel and croaker fish by about 0.45 percent and 0.43 percent, respectively. Therefore, these groups can be interpreted as necessity goods.

Similarly, the compensated cross-price elasticity coefficients for all the fish can be observed from Table 3. It was measured as the percentage change in demand for the first good that occurs in response to a percentage change in the price of a second good. This measure enables us to determine whether two groups are complementary or substitute goods. For croaker fish, mackerel fish and herrings were found as its complement, while others were its substitutes. In the case of herring fish, all other fish complement herrings except mackerel fish. For horse mackerel, only catfish was its substitutes. Others were the complements of horse mackerel fish. On the contrary, hake, tilapia and catfish were complements to mackerel while tilapia fish was a substitute to hake and catfish complements it.

From Table 4, Compensated computes demand elasticity to changes in prices, ignoring income effects. These elasticities are also known as Hicksian price elasticities. Uncompensated computes demand elasticity due to changes in prices. These elasticities are also known as Marshallian price elasticities. The elasticities are computed at the estimation sample means of the prices, expenditures, and any demographic variables. Compensated or Hicksian elasticities in this study as presented in Table 4 were reduced to contain only price effects and compensated for the effect of a change in the relative income on demand. The values of the uncompensated elasticities of the food groups obtained were not lower than the compensated elasticities like Obayelu, et. al., (2009) found out. All own-price elasticities were not negative as stipulated by the apriori expectation. This agrees with the findings of Elzaki et. al., (2021) which shows that a unit increase in the price of the frozen fishes with positive elasticities would bring about an increase in their demand and vice versa if the elastic is negative. The own price elasticity of horse mackerel (compensated and uncompensated) was the smallest in absolute terms, indicating that horse mackerel was the least sensitive to changes in its price.

Table 3: Frozen Fish consumption pattern of households using Quadratic Almost ideal Demand System

Variable Expenditure	Symbols	Croaker	Herrings	Horse Mackerel	Mackerel	Hake	Tilapia	Catfish
Constants	α_i	0.734***	-0.114	0.058	-0.523	0.099	0.522*	0.228
		(0.000)	(0.161)	(0.829)	(0.161)	(0.564)	(0.065)	(0.442)
Prices	β_i	0.436***	-0.187	0.019	-0.443***	0.028	0.1527	-0.006
		(0.000)	(0.114)	(0.883)	(0.009)	(0.727)	(0.254)	(0.966)
Croaker	λ_{i1}	**0.421*** **	0.352	0.013	-0.352**	0.017	0.192	0.610
		(0.000)	(0.003)	(0.919)	(0.048)	(0.833)	(0.137)	(0.660)
Herrings	λ_{i2}		**0.270**	-0.051	0.281**	-0.028	-0.110	-0.100
			(0.016)	(0.472)	(0.028)	(0.580)	(0.185)	(0.905)
Horse mackerel	λ_{i3}			**0.091**	-0.006	-0.018	-0.314	0.003
				(0.275)	(0.970)	(0.669)	(0.654)	(0.969)
Mackerel	λ_{i4}				**0.450**	-0.077	-0.320*	-0.026
					(0.157)	(0.420)	(0.070)	(0.862
Hake	λ_{i5}					**0.090***	0.581	-0.042
						(0.068)	(0.223)	(0.362)
Tilapia	λ_{i6}						**0.230****	-0.018
							(0.048)	(0.827)
Catfish	λ_{i7}							**0.031**
								(0.757)

Source: Data analysis, 2021

Table 4: Price elasticities of frozen fish

Change in quantity	Change in Price Croaker		Herrings		Horse mackerel		Mackerel		Hake		Tilapia		Catfish	
	C	U	C	U	C	U	C	U	C	U	C	U	C	U
Croaker	-0.53	-0.53	-2.14	-2.12	-0.04	-0.02	0.67	0.73	-0.55	-0.05	1.01	1.03	1.09	1.11
Herrings	-1.31	-1.42	0.63	0.43	-0.15	-0.35	1.24	0.75	-0.71	-0.15	-0.35	0.52	0.01	-0.2
Horse mackerel	-0.03	-0.08	-1.14	-2.21	-0.25	-0.33	0.42	0.22	-0.09	-0.13	-0.11	-0.18	0.21	0.12
Mackerel	0.15	0.08	0.49	0.36	0.17	0.03	-0.32	-0.65	-0.10	-0.16	-0.45	-0.57	0.06	-0.09
Hake	-0.08	-0.15	-0.17	-0.29	-0.24	-0.36	-0.64	-0.92	0.69	0.65	1.05	0.95	-0.62	-0.74
Tilapia	0.69	0.57	-0.38	-0.57	-0.12	-0.32	-1.24	1.72	0.47	0.40	0.62	0.44	-0.02	-0.23
Catfish	0.59	0.48	0.01	-0.16	0.19	0.01	0.12	-0.31	0.22	-0.29	-0.12	-0.17	-0.67	-0.86

Note:
C=Compensated price elasticities,
U=Uncompensated elasticities
Source: Data analysis, 2021

Consumption pattern of households towards dried fish

The own price of different types of dried fish is shown in Table 5. Tilapia has 0.71 while catfish, oporoko and panla has 1.60, -0.35 and -0.25 respectively. This means that a one percent increase in the price index of this types of fish causes a drop in demand of oporoko and panla by of 0.35% and 0.25% in the study area and an increase of 0.71% and 1.6% in the demand of tilapia fish and catsfish responsively. This pinpoints than demand was elastic for dried catfish and inelastic for others. For dried tilapia fish, dried catfish was a complement to it while oporoko was a complement to dried catfish and dried panla was a complement to oporoko.

Unlike the findings from Table 4, Table 6 presents the compensated and the uncompensated elasticities of dried fish is Oyo state. The table shows that all own price of the dried fished are negative which conforms to the apriori expectations and further shows that the elasticities are relatively elastic for all the dried fish except for oporoko which is elastic. A similar experience was also observed in the quantity of oporoko that would be purchased when the price of tilapia changes by 1%. This disagrees with the conclusion of Onyeneke et. al., (2020) in their study on the consumption of different forms of fish in abakaliki, Nigeria.

Table 5: Dried Fish consumption pattern of households using Quadratic Almost ideal Demand System

Variable	Symbols	Tilapia	Catfish	Oporoko	Panla
Constant	α_i	-0.702	2.134***	-0.273	-0.196
		(0.326)	(0.003)	(0.442)	(0.643)
Prices	β_i	-0.401	0.720	0.123	-0.196
		(0.262)	(0.074)	(0.413)	(0.643)
Tilapia	λ_{i1}	**0.710**	-1.057	0.228	0.069
		(0.480)	(0.480)	(0.230)	(0.902)
Catfish	λ_{i2}		**1.606**	0.236	-0.313
			(0.436)	(0.540)	(0.799)
Oporoko	λ_{i3}			**-0.035**	-0.006
				(0.802)	(0.973)
Panla	λ_{i4}				**-0.250**
					(0.671)

Source: Data analysis, 2021
Please note that ***=1%, **=5%, *=10%

Table 6: Price elasticities of dried fish

Change in Quantity	Change in Price Tilapia		Catfish		Oporoko		Panla	
	C	U	C	U	C	U	C	U
Tilapia	-0.09	-0.30	-0.05	-0.31	0.44	0.43	-0.30	0.61
Catfish	-0.04	-0.38	-0.96	-1.37	0.18	0.16	0.84	0.37
Oporoko	7.39	7.22	3.59	3.39	-6.18	-6.19	-4.80	-5.05
Panla	-0.22	-0.49	0.71	0.39	-0.20	-0.22	-0.29	-0.67

CONCLUSION AND RECOMMENDATION

This paper presents an analysis of household fish preference and pattern using a cross-sectional data using retested questionnaire. The data was analysed using QUAIDS which generates more stable and realistic elasticities. The results of the QUAIDS model show that own price of all food consumed in the study area is inelastic except

oporoko implying that a percentage change in the quantity of fish consumed in any form is less than the percentage changes in their price. This has serious implication on a household' nutrition security in the study area because majority of these fish are usually imported and the naira to dollar exchange rate is getting eroded by the day. The negative and positive own-prices elasticity of the fish of any form imply that a unit reduction or increase in the price of the fish will increase or decrease its demand. In such a case, there is the need for government at all levels to embark on agricultural policies that will boost local production of these fishes and thus reduce the daily burden of exchange rate and thus reduce their prices in order to enhance access by households. This also expresses that if there is shortage of fish available for consumption in the study area, the price might go up. It was also discovered that respondents in Oyo state preferred tilapia fish in any form and they would prefer other forms of animal protein than fish if they have more money to buy it. The fish available if Oyo state were substitutes and complements to one another. It was also revealed that the respondents in Oyo state would still buy more of dried catfish even if there is an increase in price.

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Analysis of input demand, substitutability and complementarity among yam farmers in Ekiti state, Nigeria: A cost function approach

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Abstract: Yam (Dioscorea spp.) is a significant staple crop in Nigeria, particularly in Ekiti State, where it plays a crucial role in food security and the economy. However, in recent times, as prices of inputs increase, the price of yam has increased making it a luxury food rather than a staple food for many people and the management of available resources in such a way as to improve productivity is therefore inevitable. The study employs a translog cost function approach to analyse input demand, substitutability, and complementarity among key inputs—labour, land, capital, and seedyam—used by yam farmers in Ekiti State, Nigeria. Data was collected from 180 respondents and using a multistage sampling technique. The data collected was analysed using descriptive statistics and translog cost function. Results showed that while labour and seedyam are critical inputs, their cost impact varies, with labour showing lower elasticity compared to seed yam. Capital and land, though less significant in terms of cost share, also play vital roles in yam production. The scale effect indicated that yam production using seed yam is capital saving. The study also reveals significant substitutability and complementarity among inputs, with important policy implications for improving input efficiency, reducing production costs, and enhancing yam productivity. The findings suggest that targeted interventions, such as providing quality and affordable seedyam and improving access to capital, could enhance resource allocation and support sustainable yam production in Ekiti State.
Keywords: Yam production, input demand, substitutability, complementarity, resource allocation, elasticity.

INTRODUCTION

Yam (Dioscorea spp.) is a crucial staple food in Nigeria, playing a vital role in both food security and the national economy. Nigeria is the world's largest producer of yam, contributing over 60% of the global output (Verter and Bečvářová, 2015). Within Nigeria, Ekiti State, located in the southwestern region, is one of the leading producers of yam. Yam is one of the major staple food in Nigeria and has potential for livestock feed and industrial starch production (Ayanwuyi et al, 2011). It is one of the principal tuber crops in the economy, regarding land under cultivation and in the volume and value of production (Toluwase and Sekunmade, (2017). Amusa *et al.* (2018) observed that white yam alone contributes about 200 dietary calories daily for more than 95 million people in Nigeria while also serving as an important source of income and livelihood security to many people who are involved in various stages of its production, transportation, marketing and processing. The crop is a significant source of calories for the local population and a vital commodity in cultural practices and ceremonies. Interestingly, yam is categorised as chief among the major staple foods of Nigerians on account of its indispensability. Worthy of note is the fact that many important cultural values are also attached to yam, especially during weddings and other social ceremonies. Despite its importance, yam production in Ekiti State, like in many other parts of Nigeria, faces several challenges, including low productivity, high labour costs, land fragmentation, and suboptimal input use (Umeh *et al.,* 2017).

Enhancing agricultural productivity often involves a dual approach: boosting farm resource levels and optimizing the use of existing resources. However, the uncertainty in productivity, especially noted in yam production compared to other crops, is not due to a lack of resources only but also their inefficient utilization. The relationship between the inputs used in yam production is of great interest to agricultural economists and policymakers, particularly in understanding how these inputs can be effectively managed for optimum resource allocation and improving farmers' livelihood (Adeyeye *et al.*, 2024). The concepts of input substitutability and complementarity are central to this understanding. Input substitutability refers to the ability to replace one input with another in the production process without affecting the output level, while complementarity indicates that the use of one input enhances the productivity of another (Otunaiya *et al.*, 2013). If an increase in the price of one input leads to an increase in the demand for another input, the two inputs are considered complements but if it leads to a decrease in the demand for the other input, then the two inputs are substitutes.

While previous studies have explored input use in Nigerian agriculture, they have predominantly focused on production functions (Adeyeye *et al.,* 2024; Anugwo and Egwue, 2024). These studies, though valuable, often fail to capture the complex interactions between inputs that a cost-function approach can reveal. This study aims to fill this gap by employing a translog cost function to analyze the price elasticities of input demand, and input substitutability and complementarity among key inputs—labour, land, capital, and fertilizer—used by yam farmers in Ekiti State. Understanding these relationships is crucial for designing policies that enhance the efficiency of input use, reduce production costs, and ultimately increase yam productivity.

This study is particularly relevant in the context of Nigeria's broader agricultural policy objectives, which emphasize increasing food production to ensure food security and reduce poverty. By identifying the nature of input relationships, this study provides evidence-based insights that can guide policymakers in developing targeted interventions to support yam farmers.

The concept of production function is used to represent the technical relationships between maximum output and a set of inputs given the state of technology. A specific functional form for the production function must be assumed. The parameters of this function provide information on important characteristics of the technology i.e. elasticity of scale and elasticity of substitution (Russell, 2020). Elasticity of scale measures the proportional change in output due to a proportional change in all inputs. The concept of elasticity of substitution measures the ease of substitutability between two different inputs with constant output. Empirical estimation in production analysis is based on two main approaches i.e primal and dual approaches. The primal approach consists of specifying a functional form for the production function and then solving the cost minimisation problem. Essentially the firm is faced with the constrained minimisation problem, i.e. produce output with the minimal costs. In order to minimize costs, the firm should produce at that point on the isoquant at which the rate of technical substitution of inputs is equal to the ratio of the inputs' prices (Varian, 2010). From a mathematical point of view, the constrained optimisation problem can be solved through the Lagrange multiplier method. At the same time, profit maximisation requires that the firms hire each input up to the point where its marginal contribution to revenue is equal to its market price. The first-order conditions of the cost minimisation problem, given the prices, lead to an implicit demand for inputs, which is contingent on the level of output being produced. Moreover, the production function approach is based on the physical quantities of inputs, which can be considered endogenous variables to the firm. Instead, in a more realistic setting, decisions on factor use are made according to factor prices, which are exogenous. Over time, there has been a movement from the 'primal approach', based on the production function, to the 'dual approach'. The dual approach offers a simple way of deriving input demand and output supply systems directly from the dual objective function. One of the advantages of the duality approach is the ability to accommodate a multiple output as well as a multiple input. As it was first shown rigorously by Shephard (1953), there exists a duality between production and cost functions, which implies that if producers minimise input costs, then the cost function contains sufficient information to completely describe the technology (Kreps, 2012). Essentially a cost function can be simply defined as:

$C = f(Y, w)$ ………………………………(1)

Where cost (C) is a function of output (Y), which is predetermined, and of input prices (w).

The advantages of specifying the cost function are that the factor levels are now endogenous and the input demand functions for the factors of production can be easily derived as the partial derivatives of the total-cost function with respect to the factor prices (Shephard's lemma). Because the output produced enters the total-cost function, input demand is contingent on that variable and this is why we refer as 'contingent' demand functions.

METHODOLOGY

Ekiti State situates in the Southwestern geopolitical zone of Nigeria. It is located within latitude $7^0 30^1$N and $8^0 15^1$N and Longitude $4^0 47^1$E to $5^0 40^1$E of the Greenwich Meridian. It shares boundaries with Kwara State in the North, Kogi State in the East, Ondo State in the South and Osun State in the West. It covers a total land area of about 6,353 square kilometres with a population of 2, 398, 957 people as at 2006 and projected to 3,785,003 as at 2021 (Ekiti State Bureau of Statistics, 2022). The State is mainly an upland zone located in the rainforest agro-ecological zones with two distinct seasons namely: wet and dry seasons. The Wet season characterised by rainfall, is between April and October while the dry season is between November and March. The mean annual rainfall ranges between 1,000mm and 1,500mm while the mean temperature is 30^0C. Farming is the major occupation of the people. They cultivate tree crops such as cocoa and food crops such as yam, cocoyam, cassava and maize. A multistage sampling technique was used to select respondents 180 respondents for the study. The state is divided into three zones based on the Agricultural Development Program (ADP) zoning and 2 local government areas (LGAs) were purposively selected from each of the three zones (these include: Oye Ekiti and Ikole Ekiti from northern zone; Aramoko Ekiti and Irepodun Ekiti from central zone and Emure Ekiti and Ose Ekiti from the southern zone) based on their predominance in yam production. The second stage involved the simple random selection of 3 villages from each of the LGAs and in the third stage, 10 yam farmers were randomly selected.

Data were collected, using structured questionnaire, on farmers' socio economic characteristics (such as gender, age, years of experience, educational status), input and output especially, labour for yam production activities (land preparation, mulching, planting, weeding, staking), costs and prices.

Empirical Model

The translog form of the production cost model was stated as:

$$lnC(Y,w) = ln \propto_0 + \sum_{i=1}^{n} \propto_1 lnw_i + \frac{1}{2} \cdot \sum_{i=1}^{n}\sum_{j=1}^{n} \gamma_{ij} lnw_i lnw_j + \propto_Y lnY + \frac{1}{2}\gamma_{YY}(lnY)^2 + \sum_{i=1}^{n} \gamma_{iY} lnw_i lnY \quad \text{.....(2)}$$

Where, C = Total Cost of yam production (Naira), Y= Total value of yam output (Kg)

w_1= price of land (Naira), w_2= price of seed yam (Naira), w_3= price of capital (Naira), w_4= price of labour (Naira).

The cost share equation was derived from the above as:

$$S_i = \left(\frac{\partial lnC}{\partial lnw_i}\right) = \propto_i + \sum_{j=1}^{n} \gamma_{ij} lnw_j + \gamma_{iY} lnY \quad \text{.....(3)}$$

Where;

$$S_i = \frac{w_i X_i}{C} \quad \text{.....(4)}$$

$$\frac{w_i X_i}{C} = \propto_i + \sum_{j=i}^{n} \gamma_{ij} lnw_j + \gamma_{iY} lnY \quad \text{..... (5)}$$

$$X_i = \frac{C\left[\propto_i + \sum_{j=i}^{n} \gamma_{ij} lnw_j + \gamma_{iY} lnY\right]}{w_i} \quad \text{.....(6)}$$

Where, S_i is the cost share of the ith input; X_i is the quantity of the ith input demanded. The parameters estimates were used to estimate the Allen Elasticity of Substitution related to input demand and the price elasticity of demand for each of the input. The elasticity estimates represent the structure of the production system for the yam farms in the study area. The complementarity and substitutability of inputs was checked using the Allen Elasticity of Substitution (AES), this is given as:

$$\sigma_{ij} = \frac{Y_{ij} + S_i S_j}{S_i S_j} \qquad i \neq j \quad \text{.....(7)}$$

$$\sigma_{ii} = \frac{Y_{ii} + S_i^2 - S_i}{S_i^2} \quad \text{..... (8)}$$

The own price elasticity of demand and the cross-price elasticity of demand for the inputs were examined and given as follow:

$$\in_{ij} = S_j \sigma_{ij} \quad \text{..... (9)}$$

$$\in_{ii} = S_i \sigma_{ii} \quad \text{..... (10)}$$

The symmetry and homogeneity properties of the cost function was also examined to ensure the equality of the cross partial derivatives as follows:

$$Y_{ij} = Y_{ji}, \qquad i \neq j \quad \text{..... (11)}$$

$$\sum_{i=1}^{n} \propto_i = 1, \ \sum_{i=1}^{n} Y_{ij} = \sum_{j=1}^{n} Y_{ji} = \sum_{i=1}^{n} \gamma_{iY} = 0 \quad \text{..... (12)}$$

RESULTS AND DISCUSSION

Description of input use, output and cost share by respondents.

Table 1 shows the mean input use of the sampled yam farmers in the study area. The table revealed that the mean Labour usage is 398 man-days per hectare, with a cost of ₦189,421.00 per hectare, contributing 45.32% to the total production cost. The high-cost share indicates that labour is the most significant factor in yam production costs and labour is scarce and expensive in the study area, probably because of rural-urban migration of the able-bodied men or their engagement in other non-farm activities, especially commercial motor cycle business, which gives better daily income rather than the more labour intensive farming activities. This finding is consistent with existing literature, which often emphasizes the labour-intensive nature of yam cultivation, particularly in traditional farming systems as in the study area. Studies like those by Anyiro et al. (2013) and Adeyeye *et al.* (2024) have also highlighted that labour is a dominant cost factor in yam production due to the manual operations involved, such as planting, staking, and harvesting. Seedyam, which is the planting material for yam, has a cost of ₦140,354.86 per hectare and constitutes 33.58% of the total production cost. This cost is relatively high compared to land capital costs probably due to the large quantity needed and the importance of using disease-free material to ensure good yields. The high cost of seedyam aligns with findings of Okeke (2016), who reported that the high cost of quality seedyam is a challenge for yam farmers. Table 1 also reveals relatively low capital cost and land cost shares. The mean capital cost per hectare amount to ₦86,489.00, representing 20.69% of total production costs. This relatively low capital cost share is in line with findings of Agyei-Holmes *et al*. (2014) which also observed that capital investments in inputs like fertilizers, pesticides, and equipment contribute significantly to yam production costs, but to a lesser extent than labour. In contrast to the cost share of labour and capital, the cost of land per hectare is relatively very low at ₦1,661.80, with a cost share of 0.40%. This very low-cost share is typical in the study area where land is either abundant or leased at low rates such as in the study area. However, in areas where land is scarce or more expensive, this share could be higher. The very low land cost suggests that land is not a major constraint in yam production in the study area. However, this might change with increasing land competition or if policies alter land tenure arrangements. The average output per hectare is 8,624.5 kg, with a standard deviation of 3,420.12, indicating significant variability in yield.

Table 1: Description of output and factor costs shares

Factor	Quantity per hectare	Cost per hectare	Cost Share
Labour (Man-day)	398 (77.16)	189,421.00 (90925.32)	0.45324
Capital (Naira)	86,489.00 (42071.85)	86,488.78 (42071.85)	0.206947
Land cost (Naira)	1661.80 (974.65)	1,661.80 (974.65)	0.003976
Seedyam (kg)	2,772.60 (1272.00)	140,354.86 (66381.52)	0.335836
Total		417926.44	1.00
Output (Kg)	8624.5 (3420.12)		

Figures in parenthesis are standard deviations

Determinants of input demand in yam production

Table 2 shows the determinants of factor share estimates of the translog cost equations. The coefficient of Yam output is positive and significant in the seedyam (0.0171) and negative in capital (-0.0123) equations. This means that the scale effect is seedyam and capital using. This implies that the quantity of seedyam concerning the share of the seedyam cost increases with the output of yam, while the amount of capital with regard to the share of the capital costs decreases with the output. Hence, the scale effect is capital saving but seedyam using but labour and land inputs in Yam production are not significantly affecting output. This agrees with the findings of Otunaiya *et al.*, (2013) who also reported that the scale effect in yam production is planting material using. The coefficients of capital variable is significant in land, labour and capital equations, whereas the coefficient has a negative sign in land and labour inputs, it has a positive sign in the capital equation. The implication is that capital use is land-saving and labour-saving. This means that the greater the quantity of capital used, the lower the shares of land and labour input costs. This may be due to a low capital use rate observed in the study area probably because majority of the farmers are poor and do not have collateral for credits. The coefficients of seedyan variable is also significant in seedyam, labour and capital equations. The coefficient has negative sign in capital and labour input equations, it has positive sign in seedyam equation. This implies that seedyam use is capital-saving and labour-saving. This means that the greater the quantity of seedyam used the lower the shares of capital and labour input costs. This may be due to the fact that many farmers in the study area did not buy their seedyam. They often get them from the savings from their past harvests. The coefficients of labour variable is significant in seedyam, labour and capital equations. The coefficient has negative sign in seedyam and capital input equations, but positive sign in labour equation. This implies that labour use is seedyam-saving and capital-saving. This means that the greater the quantity of labour used the lower the shares of seedyam and capital input costs. This may be because many farmers in the study area depend more on family labour, which is not appropriately priced. Despite this, the cost share of labour input is still the highest in the study area (Table1).

Table 2: Factors share estimates of the translog cost function

Inputs	Constant	Land	Seedyam	Labour	Capital	Output	R^2
Land Cost	-0.0423***	0.0046***	0.0005	0.0026	-0.0009**	0.0001	0.3274
Share	(0.0143)	(0.0005)	(0.0012)	(0.0016)	(0.0004)	(0.0002)	
Seedyam	0.2533	0.0100	0.2054***	-0.1338**	0.0015	0.0171**	0.1876
Cost Share	(0.5199)	(0.0195)	(0.0446)	(0.0577)	(0.0131)	(0.0072)	
Labour	0.1663	-0.0012	-0.1166**	0.2476***	-0.0891***	-0.0049	0.2705
Cost Share	(0.5762)	(0.0216)	(0.0495)	(0.0639)	(0.0146)	(0.0079)	
Capital	0.6227**	-0.0133	-0.0893***	-0.1164***	0.0886***	-0.0123***	0.5635
Cost Share	(0.2826)	(0.0106)	(0.0243)	(0.0314)	(0.0071)	(0.0039)	

Figures in parenthesis are standard errors, ** and *** represents 5% and 1% significance levels

The price elasticity of input demand

Table 3 shows the price elasticities of input demand. All own price elasticities of factor demand have expected negative sign implying that the demand for these inputs decrease with increase in their respective prices. This result is consistent with the law of demand, which states that ceteris paribus, the quantity demanded of a commodity is inversely proportional to the price of the commodity. The negative own price elasticity of land demand aligns with findings of Du *et al.* (2019), which indicated that higher land prices reduce land demand. The own price elasticities of all the inputs (except for seedyam which is elastic) are also less than one indicating that they are inelastic. The high elastic nature of demand for seedyam (3.77) in the study area could probably be as a result of abundance of seedyam from savings of past harvests from where farmers can source for seedyam when there is an increase in price of seedyam. The relatively high inelastic nature of demand for labour (-0.539) suggests scarcity of labour in the study area; since

the own price elasticity of labour shows that labour is a normal good. The cross price elasticity of demand refers to the degree of responsiveness of quantity demanded of an input to the change in price of another factor. Positive cross price elasticity of demand means that the factors are substitutes while negative cross price elasticity of demand implies that the inputs are complements. The results of cross-price elasticity of demand for the factors are also presented in Table 3. The results reveal that labour-capital pair and labour-land pair are substitutes. These results are theoretically correct and practically plausible. The result implies that as the price of labour increases, less labour is employed in production and more of capital and land inputs are demanded. The labour-seedyam pair and capital-seedyam pair, on the other hand, are complements. The complementarities of labour-seedyam pair and capital-seedyam pair implies that an increase in the price of labour (or capital) will reduce demand for labour (or capital) and result in a consequential decrease in demand for seedyam. The positive cross price elasticities of demand for labour-capital pair and labour-land pair are consistent with Prajapati (2021) who found some degree of substitutability between land and labour in conventional farms.

Table 3: Estimates of Price Elasticities of Input Demand

Price Elasticity	Land	Seedyam	Capital	Labour
Land	-0.8409	0.061	0.314	0.399
Seedyam	0.787	-2.498	-0.384	-0.274
Capital	0.180	-0.017	-0.651	0.438
Labour	0.173	-0.009	0.331	-0.539
Yam output	0.195	0.015	0.339	0.45

Elasticities of substitution and complementarity of the input demand

Table 4 shows the estimated values of the allen elasticities of substitution and complementarity of input demanded by the sampled yam farmers. This concept is used to indicate the relative demand change in one factor when its price changes relative to another factor price. The major diagonal found in Table 4 is composed of each of the four factor's own elasticity of substitution. The values outside the main diagonal are symmetric; positive signs indicate substitution and negative signs indicate complementarity. As expected by the theory, all the values in the main diagonal are negative. This result has little economic meaning but does indicate that each production factor is self-complementary and confirms the concavity of the cost function. For example, the elasticity of substitution for land with itself is negative and quite large. This indicates that the substitution between different uses of land is extremely limited or negative (-4.312), suggesting that increasing the intensity of land use does not compensate for a reduction in the quality or availability of land. This finding is consistent with literature that shows land is a critical and relatively inelastic factor in agriculture.

According to the Allen elasticity of substitution concept, seedyam and capital factor pair and seedyam and labour factor pair are complementary in yam production. For a 1 % relative increase (decrease) in seedyam price, the relative demand for capital decreases (increases) by 1.129%. Considering capital and seedyam factors, the same rationale applies because Table 4 is symmetric. This result shows a strong complementary relationship, since the relative demand change of one factor is more than proportional to its relative price change. This result is consistent with findings of Otunaiya *et al.* (2013), which reported that the combination of inputs like seedyam and capital is not easily interchangeable. Most of the other elasticities presented in Table 4 show a positive sign, indicating substitution between these yam production factors. There is a substitution relationship between land and labour, land and capital, and labour and capital. Among these pairs of factors, capital and labour pair has the largest elasticity of substitution (0.974), indicating that the relative demand for that pair of factors is inelastic. The value of the Allen elasticity of substitution between land and seedyam is larger than one. In this case, as the relative price of one factor increases (decreases) 1 %, the relative demand for the substitute factor increases (decreases) 4.036%, i.e., there is an increase (reduction) in the relative demand for the substitute factor that is more than proportional.

Table 4: Estimates of Elasticities of Substitution of Input Demand

Input	Land	Labour	Capital	Seedyam
Land	-4.312	0.886	0.925	4.036
Labour		-1.198	0.974	-0.608
Capital			-1.916	-1.129
Seedyam				-164.339

CONCLUSION

Yam production in Ekiti State, Nigeria, is a labour-intensive activity, with labor costs accounting for a significant portion of total production expenses. This reflects the broader challenges faced by yam farmers in Nigeria, where traditional farming techniques and rural-urban migration exacerbate labor scarcity. While the cost of labor is high, other inputs such as seedyam and capital also contribute to production expenses, though to a lesser extent. The findings of this study reveal that the scale effect is capital saving and seedyam using but labour and land inputs are not significantly affecting output. It also revealed that while capital use is land-saving and labour-saving, seedyam use is capital-saving and labour-saving and labour use is seedyam-saving and capital-saving. Furthermore, there are significant input relationships, with labour and capital acting as substitutes, while seedyam is complementary to both labor and capital. Understanding these relationships is crucial for improving resource allocation and reducing production costs. The study further highlights that the price elasticity of demand for inputs such as labor and seedyam significantly affects input use and cost shares, offering insights into potential efficiency improvements in yam farming. The analysis reveals the elasticity of substitution and complementarity between key inputs. Labour and capital exhibit a substitution relationship, meaning an increase in the use of capital inputs (such as tools or machinery) can reduce the reliance on labour. On the other hand, seedyam demonstrates complementarity with labor and capital, implying that an efficient increase in seedyam use requires proportional increases in labor and capital to optimize productivity.

RECOMMENDATIONS

The study recommended that given the substitution relationship between labor and capital, promoting affordable and improved access to capital will reduce labor dependency and overall production costs. Supporting farmers with capital investment, such as subsidies for fertilizers and equipment, will enhance the substitution of labor with capital, improving productivity and reducing production inefficiencies. Since seedyam is complementary to both labor and capital, policies that provide farmers with affordable, high-quality seedyam will ensure that labor and capital investments are maximized for better yields. Lastly, Farmers should be encouraged to expand their scale of farming operation through provision of improved and affordable seedyam since the scale effect is seedyam using. This will help to optimize the use of inputs.

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Determinants of food security among poultry egg farmers in Ogun state, Nigeria

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Abstract: Food security is a critical issue for households across Nigeria, particularly for poultry egg farmers in Ogun State. This study assessed their food security status, selecting 90 farmers through multi-stage random sampling. Using USDA methodology, it was found that 83.3% of the farmers were food insecure, with only 16.7% being food secure. Ordered probit regression analysis indicated that credit amount received at $P<0.01$, marital status and farming experience at $P<0.05$ significantly affect food security at the 5% level. Poultry farmers face numerous challenges that hinder productivity and profitability, including limited access to agricultural credit (78.9%), labour shortages (51.11%), and market price fluctuations (81.11%). Other issues include high input costs, input shortages, and insufficient veterinary services. To address these challenges, the study recommends targeted interventions by policymakers, such as improving access to credit, stabilizing input prices, enhancing extension services, and investing in infrastructure to ease transportation barriers. Collaborative efforts and knowledge-sharing among farmers are also crucial for building resilience against food insecurity.
Keywords: Food security, USDA, Poultry farmers, Ordered probit, PANOG

INTRODUCTION

Human progress and well-being depend on food security, a major problem in many emerging nations. Over 800 million people globally, and especially in developing nations, lack access to adequate food to meet their basic nutritional needs (Omotesho et al., 2006). Food insecurity is a complex issue that arises from a combination of factors, including poverty, inadequate access to nutritious food, limited agricultural productivity, and various socio-economic challenges, Food insecurity remains a critical challenge affecting many developing countries, with Nigeria being no exception. As Africa's most populous nation, Nigeria experiences high levels of food insecurity, impacting the well-being and livelihoods of millions of individuals and households. In rural areas, households are often most vulnerable to food insecurity due to limited access to resources, poor infrastructure, and low levels of income.

Food security is a condition in which all people constantly have physical and financial access to enough safe and nutritious food to satisfy their dietary needs and food preferences for a healthy and active life (FAO 1996 and Nandula et al. 2019). According to Mango et al. (2014), households are considered food insecure if they have inconsistent or limited access to food through socially acceptable routes. This issue affects many households globally, including those in Nigeria.

A significant portion of the average Nigerian household budget is allocated to food. Different types of food play a crucial role in delivering essential nutrients to the body, contributing to overall health. Therefore, it is essential to consume food in the appropriate quality and quantity (Omonona & Agoi, 2007). Observing the food security status of a specific population can aid in juxtaposing the local food security conditions with state and national trends. It allows for the evaluation of local requirements for food assistance, as well as the tracking of the impact of evolving policies or economic conditions (Omotesho et al., 2006).

Considering the significance of agriculture in the Nigerian economy, the poor performance of the agricultural sector could be linked to food insecurity and poverty. This, in turn, leads to challenges in both the availability and accessibility of food at both household and national levels (Bickel et al., 2015). Poultry production has a significant contribution to human food security and nutrition, protein, essential micro-nutrients, and the provision of energy through the ability to convert a wide variety of agri-food wastes and byproducts into edible meat and eggs (Onyeaka *et al.,* 2021*)*, (Daghir *et al.*, 2021). It is one of the most dominant meat and food industries in the world with about 23 billion birds worldwide in 2016, i.e., approximately 3 birds per person in the universe. Poultry production is important in the West African Economy, contributing about 30-50% of the GDP (Choi *et al.*, 2020). A significant area of the agricultural sector in Nigeria with enormous social and economic potential is the livestock sector.

The livestock sector particularly the poultry industry in Ogun State stands out for its small- to large-scale operations, intensive and semi-intensive rearing, improved domestic bird breeds, labor- and capital-intensive operations with high input and output rates, and intensive and semi-intensive rearing practices (Omodele and Okere 2014), (Akerele and Aderinto 2019). Ogun State has the highest poultry production rate in Nigeria's southwest geo-political zone. This largest poultry output is related not just to population, but also to market availability in neighboring States and other zones. However, the grains and other components utilized in the manufacturing of poultry feeds are also consumed by humans, thereby amplifying the demand for these

resources (John et al., 2022) . A fluctuation in the production output of maize and soybean meal, which are the primary inputs in poultry feed production, along with their prices, results in an immediate impact on the pricing of poultry feed. This, in turn, influences the prices of poultry products and subsequently affects overall profitability. Poultry production faces various challenges and limitations, leading to significant losses. Numerous factors contribute to this situation, including diseases, the scarcity, and the expensive nature of high-quality feed, which have forced many poultry operators out of business. Additionally, farmers' attributes, inadequate management practices, and reliance on traditional methods further contribute to the low productivity observed in Nigeria's poultry industry(Adewumi et.al ., 2022).

Based on Heinke's research in 2015, the poultry industry in Nigeria has the capability to fulfill the anticipated surge in demand for poultry product, thereby lowering poverty rates and enhancing food security among farmers. (Afodu et al., 2022). Given this context, this study aims to identify the challenges of poultry farmers' and the resulting impact on their food security status. The specific objectives of this study are to:

1. identify the challenges of poultry egg farmers in the study area
2. determine the food security status of the respondents.
3. Examine the determinants of food security in the study area

This study was conducted in the Remo zone of Poultry Association of Nigeria Ogun State (PANOG) zonal distribution, comprising Remo North, Ikenna, and Shagamu local government areas of Ogun State. On February 3rd, 1976, Ogun State was carved out of the previous Western State of Nigeria, and Abeokuta serves as the State capital. Due to its advantageous location in relation to the rest of the nation, it is frequently referred to as the "Gateway State." Ogun State is located between the longitudes of 2º38'57.1" and 4º36'22.9"E and the latitudes of 6 º17'57.9" and 7º58'39.8"N. The Egbas, Aworis, Ijebus, and the Remos are four different varieties of the Yoruba language spoken in the state of Ogun. Ogun specializes on traditional handicrafts like carving, sculpture, smithery, and poultry farming.

The State has a total population of 3,751,140 and a landmass of 16,981 sq km, or roughly 1.9% of the area of Nigeria. There are twenty (20) local governments area, according to (Omodele; and Okere, 2014). Small- to large-scale production, extensive or semi-intensive, and occasionally free-range rearing of improved domestic chicken breeds (in cages or on deep litter) are the main characteristics of the Ogun State poultry system. With a high input and high output, it is both labor- and capital-intensive. According to (Omodele; and Okere, 2014), Ogun State in the South-West geopolitical zone produces the most poultry in Nigeria. This largest poultry output is a result of both the high population and the market opportunities in the neighboring States and other regions.

METHODOLOGY

Primary data gotten from poultry egg farmers in the study area using the open-source Android app kobo collect was used for this investigation. Multi-stage sampling method was used, a zone was purposively chosen from the Poultry Association of Nigeria's Zonal distribution for the first stage (Remo Zone), this is because according to PANOG data, Remo zone had the highest number of farms registered with PANOG. The next stage involved the choice of three Local Government areas in the zone, the last step in the sampling process comprised selecting at random 30 poultry egg farmers from each Local Government Areas (LGA) that had been chosen, for a total of 90 poultry farmers.

Analytical tools that were used in the study are:

i. Descriptive statistics: including mean, percentage and frequency. The descriptive statistics were used to identify the farmer's challenges in the study area, and to describe respondents' socioeconomic characteristics which involved the use of frequency table, percentages and mean.
ii. the United States department of agriculture (USDA) food security approach

To accomplish study aim (iii), the USDA's food security strategy, which was adapted from Mustapha *et al.*, (2016), was implemented. the USDA system classifies household using a created scale for measuring food security, (Bickel et al., 2000). The scale is a linear number continuum with a range between 0 and 18. The scale assigns a single numerical value to each household's level of hunger and food insecurity. In essence, how a household rates on the scale is determined by how it responds to questions in a structured survey. The food security scale is first condensed into a smaller form in order to determine the level of food security for each household. which include:

i. food secure households: The food insecurity evidence in these household is either non-existent or very slight. The food security scale assigns them a number between 0 and 2
ii. food insecure without hunger households: Concerns exist regarding the sufficiency of the food supply for this set of households. They alter how they regulate their daily food intake. Their food security score ranges from 3 to 7.

iii. food insecure with hunger (moderate) households: The household have cut back on their food consumption to the point where the adults have felt physical pangs of hunger. The value of the group ranges from 8 to 12 on the scale.

iv. food insecure with hunger (severe) household: This household have reduced their children food intake to the point where the children have felt hungry. The group scores between 13 and 18 on the food security scale.

I. Using an ordered probit model, the determinants of food security status of the poultry egg farmers were investigated. Ordered probit is a generalization of the probit analysis used when an ordinal dependent variable has outcomes in more than two categories. From the following list, the dependent variable, "Food security," was ranked: "Food Secure," "Food Insecure Without Hunger," "Food Insecure with Hunger (Moderate")," and "Food Insecure with Hunger" (severe). The ordered probit model describing the link between the farmer's socio-economic characteristics and levels of food security has the highest likelihood since using Ordinary Least Squares (OLS) to estimate the model will produce biased and inconsistent findings. Let's say that the fundamental relationship to be described is,

$y_i = X_I\beta + \varepsilon_i$ ..... (1)

Where y_i is the precise but unobserved dependent variable; Xi is the group of unrelated variables., where β , is the vector of regression coefficients that we want to estimate. and ε_i is the error term such that ε_i is identically and independently distributed as N(0; 1). Further suppose that while we cannot observe y^*, we instead can only observe the categories of response:

$$y = \begin{cases} 0, \ if \ y* \leq 0, \\ 1, if \ 0 < y* \leq \mu_1 \\ 2, if \ \mu_1 < y* \leq \mu_2 \\ 3, if \ \mu_2 < y* \leq \mu_3 \end{cases} \quad \text{..... (2)}$$

The observations on y, which are a type of censored data on y^*, will then be used in the ordered probit approach to fit the parameter vector β.

$$Y = \beta_0 + \beta_1 Edu + \beta_2 Sex + \beta_3 Age + \beta_4 Marrital\ stat + \beta_5 HHSize + \beta_6 Mem\ assoc + \beta_7 Exten\ visit + \beta_8 Farm\ experience + \beta_9 Poutry\ income + \beta_{10} Nonfarm\ income + \beta_{11} Credit\ amount. \quad (3)$$

RESULTS AND DISCUSSION

Socioeconomic Characteristics

The socio-economic characteristics of poultry egg farmers in Ogun State Nigeria are of immense significance in the agricultural sector of the country. With Nigeria being one of the largest egg producers in Africa, these characteristics provide essential insights into the dynamics of this vital industry. Understanding the socio-economic factors of the poultry farmers such as Age, Gender, educational status and household size which may have influence on the operations is very important.

A summary of the socio- economic data is presented in Tables 1, The amount of food that households demand, which determines their level of food security, may or may not be influenced by these household characteristics (Omonona et.al.., 2007).

Table 1: Socioeconomic characteristics of poultry egg farmers

Characteristic	Frequency	Percentage
Age(years)		
20-30	4	4.4
31-40	25	27.8
41-50	32	35.6
50-60	20	22.2
61-70	7	7.8
≥ 70	2	2.2
Household Size		
1-3	13	14.4
4-6	71	78.9
≥7	6	6.7
Farming Experience(years)		
1-5	14	15.6
6-10	31	34.4
11-15	24	26.7
16-20	8	8.9
21-25	9	10.0
26-30	3	3.3
≥31	1	1.1

Characteristic	Frequency	Percentage
Flock Size		
≤ 1000 (Small)	16	17.8
1001-5000 (medium)	56	62.2
5001-10000 (controlled large)	18	20.0
Gender of Poultry Farmer		
Male	56	37.8
Female	34	62.2
Educational status		
Primary education	6	6.7
Secondary education	18	20.0
Tertiary education	66	73.3
Marital Status		
Married	78	86.7
Separated	2	2.2
Single	5	5.6
Widow/widower	5	5.6
Membership of Association		
Yes	72	80.0
No	18	20.0
Membership of Cooperative		
Yes	43	47.8
No	47	52.2
Visits by Extension Agents		
Yes	21	23.3
No	69	76.7

Source: Field Survey, 2023

Challenges of poultry egg farmers in the study area

Poultry egg farming plays a vital role in lowering poverty rates and enhancing food security among farmers. (Afodu et al., 2022).. However, egg farmers encounter various challenges that hinder their productivity and profitability. Table 2 shows a comprehensively analysed report of challenges faced by poultry egg farmers based on survey data, highlighting the percentages and frequencies of each challenge.

1. **Inadequate access to agricultural credit:** According to the survey results, a significant majority of poultry egg farmers (78.89%) reported experiencing inadequate access to agricultural credit. This challenge can hinder farmers' ability to invest in their operations, purchase equipment, and expand their businesses. Aromolaran et al.;(2013) and Rekwot et al., (2018) also listed credit issues as major challenges faced by poultry farmers.
2. **Inadequate hired/contract labour:** Approximately 51.11% of respondents indicated facing challenges related to inadequate hired or contract labor. This shortage of labor can impact various aspects of farm management, including feeding, cleaning, and maintenance tasks.
3. **Inadequate quality poultry feed:** About 35.56% of poultry egg farmers reported experiencing difficulties in accessing an adequate supply of poultry feed. Feed shortages or quality issues can negatively affect the health and productivity of laying hens, ultimately impacting egg production.
4. **Inadequate quality drugs:** 24.44% of respondents highlighted challenges related to the availability and quality of veterinary drugs. Access to high-quality medication is essential for preventing and treating diseases that can affect poultry health and egg production.
5. **Unavailability of extension services:** Over half of the farmers surveyed (53.33%) noted the unavailability of extension services as a challenge. Extension services provide valuable information and support on various aspects of poultry farming, including best practices, disease management, and market trends. Adeyemo, A. A., & Onikoyi, (2012) also reported that inadequate extension services are major challenges in the poultry industry.
6. **Reduction in output prices during egg glut:** A significant majority (81.11%) of respondents reported experiencing reductions in egg prices during periods of oversupply (egg glut). Fluctuations in market prices can significantly impact farmers' revenue and profitability.
7. **Increased/high cost of input prices:** Most respondents (86.67%) identified the high cost of inputs as a significant challenge.

Rising input prices, including feed, medication, and equipment, can squeeze profit margins for poultry egg farmers. Yenibehit et al., (2019) reported that high cost of input prices in poultry production was a major challenge for the industry.

8. **Shortage in input supply:** More than half of the farmers surveyed (54.44%) reported experiencing shortages in input supply. Delays or shortages in obtaining essential inputs can disrupt farm operations and impact productivity.
9. **Loss in farm revenue:** Nearly 70% of respondents (68.89%) reported experiencing losses in farm revenue. These losses can result from various factors, including market fluctuations, input costs, and disease outbreaks.
10. **Lack of output buyers (insufficient customers):** Over half of the surveyed farmers (53.33%) identified a lack of output buyers as a challenge. Limited market access or competition can make it difficult for farmers to sell their eggs at profitable prices.
11. **Reduced access/inability to access input market:** Approximately a quarter of respondents (24.44%) reported challenges in accessing input markets. Limited access to inputs can hinder farmers' ability to procure essential supplies for their operations.
12. **Disruption of day-to-day farm activity:** A significant minority (25.56%) of respondents noted experiencing disruptions in day-to-day farm activities. These disruptions can arise from various factors, including weather events, equipment breakdowns, or labor shortages.
13. **Unavailability of veterinary services:** A small percentage (13.33%) of respondents reported challenges in accessing veterinary services. Timely veterinary care is crucial for maintaining poultry health and preventing disease outbreaks. In similar research carried out by Adeyemo et al., 2012; and Rekwot et al., 2018, inadequate access to veterinary services were mentioned as challenges of the poultry farmers.
14. **Unavailability of public transportation to farm location:** Approximately 21.11% of respondents highlighted challenges related to the unavailability of public transportation to their farm locations. Limited transportation options can pose logistical challenges for farmers, especially in rural areas.

Table 2: Challenges of poultry egg farmers in the study area

Challenges of poultry egg farmers in the study area	Percentages	Frequencies
Experience inadequate access to agricultural credit	78.89	71
Experience inadequate hired/contract labour	51.11	46
Experience inadequate quality poultry feed	35.56	32
Experience inadequate quality drugs	24.44	22
Unavailability of extension services	53.33	48
Experience reduction in output prices during egg glut	81.11	73
Experience increased/high cost of input prices	86.67	78
Experience shortage in input supply	54.44	49
Experience loss in farm revenue	68.89	62
Experience lack of output buyers (insufficient customers)	53.33	48
Experience reduced access/inability to access input market	24.44	22
Disruption of day-to-day farm activity	25.56	23
Unavailability of veterinary services	13.33	12
Experience unavailability of public transportation to farm location	21.11	19

Source: Field Survey, 2023

Food security status of poultry egg farmers in Ogun state Nigeria

Based on the food security analysis results provided in Table 3, a small proportion of households (16.7%) can be classified as (food-secure), indicating their ability to meet their food requirement needs without requiring significant adjustments.

About 14.4% of the surveyed respondents fall into the category of food insecurity scale (without hunger), suggesting that these households need to make substantial changes to fulfil their food requirements.

Approximately 31.1% of the respondents are experiencing (moderate) food insecurity with hunger, which implies that this group has had to reduce their food intake to the extent that adult members of the household have repeatedly felt hunger.

Furthermore, the data shows that 37.8% of the respondents are experiencing (severe) food insecurity with hunger, meaning that these households have had to cut back on their children's

food intake to the point where the children have gone hungry.

These findings are consistent with the research conducted by Fakayode et al., (2009), which reported that only 12.2% of the country's households were food-secure, while 87.8% of Nigerian households experienced various levels of food insecurity. They also align with the findings of Oyakhilomen et al., (2015), who documented that only 10% of poultry egg farmers in Kaduna state were food-secure, with the remaining 90% on different levels of food insecurity.

The food security analysis indicated that only a small proportion (16.7%) of households were food-secure, with the majority (83.3%) experiencing varying levels of food insecurity. This underscores the severity of the situation and highlights the need for targeted interventions to address these challenges and improve food security among poultry egg farmers in Ogun State.

Table 3: Food Security Report for Poultry egg farmers in Ogun State.

Food security status	Frequency	Percentage
Food Secure (FS)	15	16.7
Food Insecure without Hunger (FIWOH)	13	14.4
Food Insecure with Moderate Hunger (FIWMH)	28	31.1
Food Insecure with Severe Hunger (FIWSH)	34	37.8
Total	**90**	**100**

Source: Field Survey 2023

Determinant of food security of poultry egg farmers in Ogun state Nigeria

Tables 4 and 5 report the factors influencing the food security status of poultry egg farmers in Ogun State, Nigeria. The study employs an ordered probit model to analyse the determinants of the respondent's food security status. The likelihood ratio chi-square (41.71) with a p-value (0.0002) revealed that all variables included in the model jointly and significantly influence the poultry farmers food insecurity status.

The estimated cut-off points (μ) adhere to the conditions whereby $\mu 1 < \mu 2 < \mu 3$, indicating that these categories are logically ordered and ranked as specified by Aboaba et al. (2020).

The estimated coefficients of independent variables indicate the likelihood of the dependent variable (household food security) falling into a particular category in response to a change in each independent variable. Consequently, the marginal effects of each independent variable were estimated to account for the actual magnitude of a change in the independent variables (Table 5).

The results of the ordered probit analysis indicate that poultry income, non-farm income and access to credit, along with other sociodemographic factors such as marital status, membership in poultry association and farming experience, play a significant role in determining the food security status of poultry egg farmers in the study area. In particular, Table 4 shows that farmers with low poultry farm income, non-farm income, and no credit or reduced credit access are likely to be in the food insecurity category; while not being married and being a member of the poultry association is associated with being food secure. However, the table also shows that increased years of farming experience may lead to food insecurity.

There is a significant ($P<0.001$) negative correlation between food insecurity and credit availability, meaning that having access to credit facilities lowers the risk of food insecurity for poultry egg farmers. Farm households may make a substantial contribution to purchasing high-quality, productivity-enhancing inputs that boost farm income and ensure food security by having access to credit facilities. The outcome supports the findings of Kehinde & Kehinde (2020), who found that having access to credit improves rural households' food security in southwest Nigeria.

Marital status had a significant ($p<0.05$) positive effect that affected the level of food security in households. This means that compared to their single counterparts, married households are less likely to have a secure food supply. The findings of this study contradict previous assumptions and the argument made by Ibrahim et al., (2022), which argues that married couples are more likely to pool their resources and may more easily allocate a decent percentage of their income to household consumption.

Membership in farmer associations has a significantly negative ($p<0.10$) influence on the household food insecurity status. This suggests that membership in farmer groups improves household food security in southwest Nigeria. Expectedly, a member of the farmer association should have a better chance of accessing useful information that can improve farm productivity and increase household income, which can then translate to better food security status.

Consistently, poultry farming and non-farm income have a significant negative ($P<0.1$) relation with food insecurity; this implies that an increase in household income for the farmers raises the probability of the farmers being food secure.

Table 4: Ordered probit estimates of the determinant of food security status of poultry egg farmers

HHFSSC	Coef.	Std. Err.	z	P>z
Years of schooling	-1.33E-01	8.56E-02	-1.55	0.121
Sex	1.11E-01	4.93E-01	0.23	0.821
Age	-3.47E-02	2.89E-02	-1.2	0.23
Marital status	1.51E+00**	7.09E-01	2.13	0.033
Household size	6.85E-02	1.79E-01	0.38	0.702
Memb Association	-1.14E+00*	6.59E-01	-1.73	0.084
extension visit	-1.53E-01	2.14E-01	-0.71	0.475
Farming experience	7.56E-02**	3.31E-02	2.28	0.022
Poultry income	-1.25E-06*	7.73E-07	-1.62	0.100
non-farm income	-1.23E-06*	7.42E-07	-1.65	0.099
credit amount	-6.38E-07***	1.91E-07	-3.35	0.001
/cut1	-5.23E+00	1.75E+00		
/cut2	-4.04E+00	1.72E+00		
/cut3	-2.37E+00	1.68E+00		

Source: field survey 2023, ***Significant at 1%, **Significant at 5%, *Significant at 10%

Table5: Marginal Effect of the Ordered Logistics Estimates of the Determinant of Food Security Status of Poultry Egg Farmers

	FOOD SECURE		FIWH		FIWMH		FIWSH	
variable	dy/dx	P>z	dy/dx	P>z	dy/dx	P>z	dy/dx	P>z
yearso~g	2.24E-02	0.177	1.07E-02	0.283	-1.41E-02	0.288	-1.90E-02	0.171
Sexofr~t*	-1.90E-02	0.822	-8.82E-03	0.822	1.20E-02	0.824	1.58E-02	0.821
Ageiny~s	5.86E-03	0.27	2.79E-03	0.351	-3.67E-03	0.347	-4.98E-03	0.272
Marit~s*	-3.20E-01*	0.064	-2.50E-02	0.81	1.95E-01**	0.046	1.51E-01*	0.073
Househ~s	-1.16E-02	0.708	-5.50E-03	0.705	7.25E-03	0.717	9.82E-03	0.701
Member~n*	1.57E-01*	0.102	1.08E-01	0.145	-6.48E-02	0.497	-2.00E-01	0.166
extens~t	2.59E-02	0.5	1.23E-02	0.501	-1.62E-02	0.532	-2.20E-02	0.478
farmin~s	-1.28E-02*	0.101	-6.07E-03	0.179	8.00E-03	0.237	1.08E-02*	0.056
Poultryi~e	2.12E-07	0.286	1.01E-07**	0.015	-1.33E-07	0.413	-1.80E-07***	0.001
nonfar~e	2.07E-07*	0.103	9.85E-08	0.327	-1.30E-07	0.206	-1.76E-07	0.204
credit~t	1.08E-07**	0.016	5.13E-08	0.208	-6.75E-08	0.141	-9.15E-08*	0.053

Source: field survey 2023, ***Significant at 1%, **Significant at 5%, *Significant at 10%

The socio-economic characteristics of poultry egg farmers in Ogun State, Nigeria, reveal a diverse demographic profile, including age distribution, household size, farming experience, flock size, gender, educational status, marital status, and association/cooperative membership. These characteristics provide insights into the composition and dynamics of the poultry farming sector in the region.

Poultry egg farmers face numerous challenges that hinder their productivity and profitability, affecting their food security status. These challenges underscore the complexity and multifaceted nature of the obstacles faced by poultry farmers in Ogun State.

The food security status report of poultry egg farmers reveals significant levels of food insecurity within the community. While a small proportion of households are food-secure (16.7%), a substantial portion (83.3%) experience varying degrees of food insecurity, ranging from moderate to severe hunger, while an assessment of the determinants of food security among the farmers shows that, credit amount received, income from poultry farming, and non-farm income, have a substantial impact on the household's food security status. These findings highlight the pressing need to address food security issues among poultry egg farmers and improve their access to nutritious food.

CONCLUSION AND RECOMMENDATION

The findings of this research underscore the critical importance of addressing the challenges faced by poultry egg farmers in Ogun State, Nigeria, to improve food security and livelihoods in the region. By implementing targeted interventions to enhance access to credit, labour, inputs, markets, and support services, policymakers, stakeholders, and development partners can promote the resilience and sustainability of the poultry farming sector while ensuring the well-being of farmers and their communities. Collaboration across government agencies, financial institutions, agricultural organizations, and local communities is essential to effectively address the multifaceted nature of the challenges and achieve a meaningful impact in improving food security among poultry egg farmers.

In addressing the identified challenges and improving food security among poultry egg farmers in Ogun State, the following recommendations are proposed:

1. **Enhanced Access to Agricultural Credit:** Government and financial institutions should collaborate to provide poultry farmers with easier access to affordable credit facilities, enabling them to invest in their operations and overcome financial constraints.
2. **Labour Support Programs:** Initiatives to address labour shortages through training programs, incentives for skilled labour, and partnerships with educational institutions can help alleviate staffing challenges on poultry farms.
3. Food Security Interventions: Programs to improve food security should target households with limited credit access and lower farming experience. The programs should also include support for increasing credit access and overall income generation in poultry egg farming.

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Economic analysis of postharvest losses in retail marketing of tomatoes in Oyo state, Nigeria

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Abstract: Postharvest losses of agricultural produce at the retail market level represent a critical challenge in developing countries, significantly impacting retailer income and investment returns. In Nigeria, despite policy efforts aimed at reducing these losses, effective implementation remains a challenge due to insufficient empirical data on current market-level losses. This study addresses this gap by investigating the effects of postharvest losses on the returns to investment with a particular focus on tomatoes. Using structured questionnaires, primary data was collected from tomato retailers in three key tomato retail markets in Ibadan, Oyo state. Postharvest loss was quantified through physical loss—tomatoes deemed unfit for consumption—and economic loss, which accounted for partially spoiled tomatoes that suffered price discounts. An investment loss analysis was conducted to assess the impact of these losses on retailer returns. Findings revealed an average market-level postharvest loss of NGN 4,697.64 per transaction, translating to an estimated investment loss of NGN 298,008.37, representing 10% of potential revenue. The study concludes that substantial investment losses threaten retailers' sustainability, potentially leading to business failures that adversely affect household welfare and food security. Recommendations include enhancing market infrastructure and expanding the provision of complementary services such as credit facilities for retailers.
Keywords: Postharvest Loss, Returns on Investment, Investment Loss, Tomatoes, Retail

INTRODUCTION

Reducing postharvest losses is a focal point for policymakers as part of broader efforts to develop sustainable food systems. These systems aim to enhance food production while minimizing waste throughout the supply chain, a crucial objective, given the significant link between postharvest losses and high levels of poverty, food insecurity, and diminished quality of life in many developing nations (Brander et al., 2020; Tesfaye and Tirivayi, 2018). Postharvest losses, which reduce both the quality and quantity of food, occur at various stages of the food value chain. Globally, these losses are estimated at 1.3 billion tonnes, and are linked to improper handling, storage, transportation, processing, packaging, and distribution (Food and Agriculture Organization, FAO, 2019). These losses are classified into two main groups: qualitative losses, which refer to losses in quality due to bruising or discolouration, and quantitative losses, which refer to damage that makes food unfit for consumption due to physiological, mechanical, or pathological factors. Reducing these losses is, therefore, essential for improving both food security and sustainability.

The Food and Agriculture Organization (FAO, 2019) estimates that approximately 14 percent of the world's food, valued at $400 billion, is lost annually between harvest and the retail market. Although this figure represents an improvement from a previous estimate of one-third lost globally, the problem remains significant, particularly in developing regions like Sub-Saharan Africa, where postharvest losses of key staples like maize can still reach 25%. The focus on where these losses occur has shifted, with developed nations experiencing more food waste at the consumer level, while low-income countries suffer greater losses during harvest, handling, and storage (United Nations Children Fund, UNICEF, 2023). The urgency of addressing postharvest losses is further highlighted by UNICEF's recent report on the potential for nearly 25 million Nigerians to face hunger between June and August 2023 if urgent measures are not implemented. Based on the October 2022 Cadre Harmonisé, this alarming projection underscores the unacceptable nature of food losses and waste in Nigeria, particularly in the context of widespread poverty, food insecurity, and undernourishment. Focusing on postharvest losses at the retail level is especially crucial, as this is where policies and programs aimed at reducing losses could yield the most significant results.

Market-level losses of fruits and vegetables not only reduce food availability but also significantly impact the returns on investment for retailers in Nigeria. Research indicates that postharvest losses—including damages incurred during storage, packaging, and transportation—result in substantial economic setbacks for these retailers. A study conducted in Ibadan; Oyo State revealed that postharvest losses could reduce the marketing margin for tomatoes by as much as percent (Omobowale, 2021). These losses stem from various factors, including physiological, pathological, and mechanical damages. Inadequate storage conditions, such as placing produce on wooden platforms or bare floors in poorly ventilated rooms, further exacerbate these issues. Additionally, the quality of fruits and vegetables deteriorates significantly during and after transportation, with approximately 89.2 percent of the produce experiencing some degree of quality loss (Omobowale, 2021).

However, the operationalization of postharvest loss reduction strategies in Nigeria remains a challenge. Ogundele (2022) points out significant gaps in the nation's understanding of food

crop losses, particularly regarding their nature, extent, and structural dimensions. Also, there is limited knowledge about the roles of various stakeholders along the value chain and the effectiveness of postharvest technologies. Addressing these information deficits is a primary goal of the National Agricultural Technology and Innovation Policy (NATIP:2022-2027) which aims to improve agricultural development by comprehensively addressing these gaps.

The research on market level postharvest losses of tomatoes generally follows two strains of thought. One focuses on the identification of causes and trends as in the case of a recent evaluation of the impact of the PYXERA Global Yieldwise project's improved post-harvest loss management practices on tomato farmers' output, income, and poverty status in Nigeria's North-West Zone by Tobe et al. (2023) which utilized a multi-stage random selection method, and applied descriptive statistics, double difference estimates, and the Foster-Greer-Thorbecke (FGT) poverty index. The findings revealed a significant output value difference of ₦82,888.94 between adopters and non-adopters of the improved practices. The poverty incidence among poor farm households was notably high, with 95% of non-adopters and 61% of adopters classified as poor. Furthermore, the depth of poverty was recorded at 85% for non-adopters compared to 36% for adopters, and the severity of poverty was 79% for non-adopters versus 26% for adopters. These results indicate a higher poverty incidence among non-adopting households, underscoring the positive effects of adopting improved post-harvest management practices on reducing losses, increasing income, and enhancing overall poverty status. The study concluded with recommendations to sustain the tomato post-harvest loss reduction campaign, particularly as the deadline for achieving the Sustainable Development Goals (SDGs) on food loss and waste approaches. It also emphasized the need for stakeholders in the tomato value chain to address challenges such as inadequate extension services, poor market linkages, and long distances to markets, which impede the adoption of improved practices. The second focuses on the empirical analysis of how postharvest losses significantly affect business margins, as in the case of empirical analysis by Adeoye et al. (2009) revealed that retail level postharvest losses significantly impacted retail marketing margins, reducing them by 34% to 94% depending on the variety.

This study fills a gap in knowledge through addition of another dimension of thought by focusing on the effect of retail level postharvest losses on returns on investments and how these could potentially affect retail trade of tomatoes. The broad objective of the study was to conduct an economic analysis of post-harvest losses in the retail trade of tomatoes in Oyo state. Specifically, the study aimed to estimate postharvest losses of tomatoes, determine the effect of market-level losses on the returns on investment of tomato retailers and identify constraints to the retail trade of tomatoes in Oyo state, Nigeria.

METHODOLOGY

The study was designed as a cross-sectional, descriptive and quantitative study and was conducted in three major retail tomato markets within Ibadan Metropolis, namely, Shasha market (Akinyele LGA), Bodija market (Ibadan North LGA), and Oje market (Ibadan South West LGA) in Oyo State, Nigeria. Oyo State, located in Southwestern Nigeria, and covers approximately 28,454 square kilometres (Sq. Km) and has a population of about 6,617,720. The selected markets are major hubs for fruits and vegetables, particularly tomatoes, attracting farmers, middlemen, retailers, and consumers due to their large quantities of merchandise and competitive prices. This makes them suitable for economic analysis at the market level.

The study used a two-stage sampling method. First, three markets (Shasha, Bodija, and Oje) were purposively selected from different Local Government Areas in Ibadan, chosen for their significance in fruit and vegetable trade. The sample size was determined using Yamane's formula, resulting in 150 retailers. forth by Yamane (1967):

$$n = \frac{N}{1 + Ne^2}$$

Where N=250 (based on headcount of retailers undertaken by the researcher)
n= sample size
e= precision level=5%.
N was found to be 153 and is approximated to 150 retailers.
The second stage involved the random selection of 50 retailers in each of the market to give a total sample size of 150 retailers for the study.

The study employed descriptive analysis and investment analysis. Frequencies and percentages were employed in describing the socioeconomic and enterprise characteristics of retailers, while investment analysis was used to estimate the investment loss incurred in retail trade because of postharvest losses.

Estimating Postharvest Losses: Following the work of Hodges *et al*., (2011), postharvest loss (PHL) was calculated as the sum of physical and economic losses:

- Physical losses: Proportion of tomatoes unfit for human consumption
- Economic losses: Proportion of partially spoiled tomatoes sold at discounted prices.

The formula used in estimating Postharvest loss was
PHL = Physical Losses + Economic Losses,
where $0 \leq PHL \leq 1$

Investment Loss Analysis: This analysis examined the effect of postharvest losses on returns to investment. It was as adapted from Murthy *et al.*, (2007) and calculated as:

Investment Loss (IL) = Potential Returns (PR) - Actual Returns (AR)

where: PR = (Total quantity sold × selling price) - ((total quantity purchased × buying price) + other market costs)
AR = (Total quantity sold × selling price) - ((total quantity purchased × buying price) + total value of physical and economic losses + other market costs)
Total investment loss in the study area will be given as:
$\sum_{i-n}$ (PRi- ARi)

RESULTS AND DISCUSSION

Socioeconomic and enterprise characteristics

The findings from the descriptive analysis are presented in Table 1. Findings showed that females dominated the retail trade of tomatoes (and other fruits and vegetables generally) with 66.4% of retailers being women. This is consistent with the body of research which posits that women generally dominate the retail trade of food and fruits and vegetables in particular while men dominate wholesale trade (Wongaa *et al*., 2014). Being majorly involved in retail trade directly links women with market, economic, sociological and environmental factors, which have implications on retail losses which in turn have effects on welfare for not just the retailers but on their households by extension. Therefore, the a need to pay attention to how retail market losses affect their business outcomes.

Of the 149 retailers sampled, majority (96%) were married. The average age of the retailers sampled was found to be 43.30 years. This indicated that most of the tomato retailers were still within the active age group. Participation of youth (ages 15-35) and older persons (> 60 years) were found to be low, accounting for 9.4% and 11% of the retailers in the study area.

The average household size of respondents was found to be 6. The average years of experience in retail trade of fruits and vegetables among the respondents was found to be 20.63 years. This finding agrees with Adejobi *et al*., (2011). This result implies that retailers have requisite experience to understand the effect of retail level postharvest losses on their businesses and should over these years of experience developed means to reduce losses.

Majority of the respondents (94.6%) reported membership in a cooperative or some form of trade association. Personal equity was the most reported (90.6%) source of financing for the retail trade of fruit and vegetables in the study area. Where personal equity became insufficient, 75.8% and 20.1% resorted to loans from cooperatives and money lenders respectively. No retailer of fruits and vegetables got any financing from government sources. Other sources of financing reported were friends and relatives and other forms of contributions. From these findings, it is evident that government support for retail trade of fruits and vegetables is very low leaving retailers on their own to sort their finances often from predatory sources. When this situation combines with postharvest losses, they could have negative effects on retail trade and returns on investment.

About half (50%) of the respondents did not have access to any form of credit facilities. Against the backdrop of retail postharvest losses, this constitutes a challenge to retail trade of fruits and vegetables. In addition to paucity of funds to invest in retail trade, the lack of credit facilities implies that in the case that retailers incur losses, there is no means to refinance the business. Lack of credit facilities also makes it difficult for retailers to invest in loss reduction techniques and strategies. Almost half of the respondents (47%) attained and completed secondary school education. Another 22.1% completed primary education. 10.1% completed some form of education from higher institutions while only 2 retailers did not receive any formal education. On the average, respondents attained at least ten years of education.

Table 1: Socioeconomic and retail characteristics of tomato retailers in the study area

Characteristics	Frequency	Percentages
Sex		
Male	50	33.6
Female	99	66.4
Age (Years)		
25-34	14	9.4
35-44	77	51.7
45-54	47	31.5
55-64	11	7.4
	Mean = 43.30	
Educational Status		
No Formal education	2	2
Primary school	37	24.8

Characteristics	Frequency	Percentages
Secondary School	95	63.8
Tertiary education	15	10.1
Household Size	Mean=6	
Experience in retail trade (Years)	Mean= 20.63	
Membership of cooperative or Trade association		
Yes	141	94.6
Source of Finance for retail trade		
Personal equity		
Cooperatives	135	90.6
Money lenders	113	75.8
Friends and relatives	30	20.1
Government sources	32	21.5
Access to credit		
Yes	68	45.63
Quantity of tomatoes purchased in the last transaction (Kg)		
<500	43	28.9
500-1000	53	35.6
1001-1500	15	10.1
1501-2000	14	9.4
2001-2500	11	7.4
>2501	13	8.7

Source: Field Survey, 2021.

Estimates of retail market level postharvest losses

Retailers provided information on the most recent wholesale purchases of tomatoes, prices and quantitative and qualitative losses of tomatoes. These were used to estimate the total market level postharvest loss. Postharvest loss was computed as the sum of physical loss and economic loss. Physical losses were estimated as the proportion of tomatoes that was deteriorated to the point that it was unfit for human consumption. Economic losses referred to the proportion of tomatoes that were partially spoiled or damaged and whose market price was discounted as a result. The study measured both the indicative average prices of good quality tomatoes and the discounted prices for tomatoes that had incurred quality deterioration at the different market chain nodes.

Physical Loss: Physical loss refers to the quantity of tomatoes that were completely damaged and unsellable. Total physical losses in the study area amounted to 7,830 kilograms. Among the respondents, 43% reported physical losses of less than 50 kilograms, while 39% lost between 50 and 100 kilograms, and 13% experienced losses ranging from 101 to 150 kilograms. Notably, larger volume retailers, although fewer in number, faced the highest losses; 4% reported losses between 15 and 200 kilograms, and 1% lost over 201 kilograms. This trend may be linked to the larger quantities of stock these retailers purchased. On average, each retailer lost 55.22 kilograms of tomatoes from their last transaction, resulting in a total loss with no potential for sale. Based on daily average prices for high-quality tomatoes, which were estimated at NGN 749.16 per kilogram, the average loss per retailer amounted to NGN 41,368.61.

Table 2: Distribution of respondents by physical loss incurred

Quantity (Kg)	Frequency	Percentage
Below 50	64	43.0
50-100	58	38.9
101-150	19	12.8
151-200	6	4.0
201 and above	2	1.3
	149	100
	Mean: 55.22Kg	

Source: Field Survey, 2021.

Economic loss

This is the value of tomatoes sold at discounted prices due to quality loss. The analysis revealed that the average economic loss incurred was NGN 3,864.60 per transaction. This was the economic value that was lost in the process of selling off tomatoes that had lost quality but was sold at discounted price.

Total market level postharvest loss is therefore calculated as the sum of physical loss and

economic loss. The average postharvest loss per retailer in the study area was found to be NGN 45,233.21 per transaction.

Investment Loss: is defined as the difference between potential and actual revenue for tomato retailers. On average, each retailer had a potential revenue of NGN 3,267,040.37 without postharvest losses, but this was reduced to an actual revenue of NGN 2,969,032.97 due to such losses. Consequently, the total investment loss in the retail trade of tomatoes in the study area was estimated at NGN 44,403,102, with an average loss of NGN 298,008.37 per retailer, representing 10% of their actual revenue.

Table 3: Potential Revenue, Actual Revenue and Investment Loss in retail tomato trade

	Potential Revenue	Actual Revenue
Mean value (NGN)	3,267,040.37	2,969,032.97
Average Investment loss (NGN)	298,008.37	

Source: Field Survey, 2021

Investment losses were further categorized by market and results are presented in Table 4. The findings revealed significant variations in investment losses:

- In Bodija market, 50% of retailers incurred losses between NGN 200,001 and NGN 300,000.
- In Oja Oba market, 62% faced losses between NGN 100,001 and NGN 200,000.
- In Shasha market, 38% of retailers experienced losses exceeding NGN 500,000, the highest among the three markets.

Overall, 29.5% of retailers incurred losses between NGN 100,001 and NGN 200,000, while 30.9% lost between NGN 200,001 and NGN 300,000.

Total and average investment losses were found to be highest in Shasha market (NGN 21,843, 120 and NGN 445,778 respectively). Similarly, investment losses were found to be high in Bodija and Oja oba markets. These substantial investment losses are detrimental to the retail trade of tomatoes and, if unaddressed, could lead to business failures and negatively impact on retail trade of tomatoes. Urgent action is particularly needed in Shasha market, where the losses are most pronounced.

Table 4: Total and average investment losses by retail markets

Market	Total Market loss (NGN)	Average Investment loss (NGN)
Bodija	13,561,250	271, 225
Oja-oba	8,998,732	179,974
Shasha	21,843,120	445,778

Source: Field Survey, 2021

Constraints to the retail trade of tomatoes in the study area

Respondents indicated how several factors constrained the retail trade of fruits and vegetables in their respective markets. Across all the categories of constraints, weighted scores of responses were estimated and indicated that these constraints exerted serious or fairly serious challenges to the retail trade of tomatoes in the study area. Low demand for tomatoes was found to be the most serious constraint. The majority (98.3%) indicated that low demand for fresh produce constituted a severe constraint. As it relates to market level postharvest losses, 91.3% of the respondents revealed that bad roads seriously constrained the retail trade of tomatoes. 77% of the respondents felt that the long distances covered between the source and destination markets only fairly constrained retail trade.

More than half (68%) of the respondents fingered lack of storage facilities as a serious constraint to retail trade. Of the respondents, 51.4% indicated that the lack of credit facilities was a serious nosiness constraint. This seems to be a situation that would endure for a long time. Given the level of losses incurred, it would be difficult for any creditor to make loans or finances available for a trade where losses are so high. It would require a turnaround in the retailers' fortunes to convince creditors to make finances available for retailers.

Table 5: Retailers' perception of constraints to retail trade of tomatoes

Constraint	Weighted Scores	Effect of the constraint	Frequency (percentages)
Low demand for tomatoes	4.00	Seriously affects business	149 (100)
Bad condition of roads	3.92	Fairly affects business	12 (8.1)
		Seriously affects business	137 (91.9)
High cost of transportation	3.74	Little effect on the business	2 (1.3)
		Fairly affects the business	35 (23.5)
		Seriously affects the business	112 (75.2)
After-effects of the COVID-19 Pandemic	3.70	Little effect on the business	4 (2.7)
		Fairly affects the business	37 (24.8)
		Seriously affects the business	108 (72.5)
Lack of storage facilities	3.64	Little effect on the business	7 (4.7)
		Fairly affects the business	40 (26.8)
		Seriously affects the business	102 (68.5)
Poor mode of transportation	3.53	Little effect on the business	5 (3.4)
		Fairly affects the business	60 (40.3)
		Seriously affects the business	84 (56.4)
Inadequate access to credit	3.28	Little effect on the business	15 (10.1)
		Fairly affects the business	77 (51.7)
		Seriously affects the business	57 (38.3)
Distance to the markets	3.05	Little effect on the business	14 (9.4)
		Fairly affects the business	114 (76.5)
		Seriously affects the business	21 (14.1)

Source: Field Survey, 2021.

Almost four-fifths of the respondents were forthwith in declaring the ongoing COVID-19 pandemic as seriously constraining the retail trade of tomatoes. Reduced social activity and declining disposable incomes, they say, affected trade in serious ways and raised concern amongst retailers. Market level postharvest losses add further uncertainty to already uncertain retail trade of fruits and vegetables.

CONCLUSION

This study examined the effect of market-level losses of fruits and vegetables on the returns to investment for retailers in Oyo State, focusing on postharvest losses of tomatoes. each retailer lost an average of 55.22 kilograms of tomatoes per transaction, translating to a loss of NGN 41,368.61 based on potential selling prices. Additionally, retailers incurred an average loss of NGN 3,864.60 from selling lower-quality tomatoes at discounted prices, leading to an overall retail market-level loss of NGN 45,233.21 for the last wholesale purchase transaction. Total and average investment losses were found to be highest in Shasha market (NGN 21,843, 120 and NGN 445,778, respectively). These substantial investment losses are detrimental to the retail trade of tomatoes and, if unaddressed, could lead to business failures and negatively impact on retail trade of tomatoes Potential revenue for each retailer was NGN 3,267,040.37 without losses, but actual revenue dropped to NGN 2,969,032.97 due to postharvest losses, resulting in an average investment loss of NGN 298,008.37—representing 10% of actual revenue. low demand for tomatoes, poor road conditions, limited access to credit, and the COVID-19 pandemic as significant constraints on the retail trade.

Retail-level postharvest losses of fruits and vegetables are a significant challenge in the study area, impacting income generation and poverty reduction. The study indicates high and unacceptable levels of postharvest losses, exacerbated by a lack of awareness among retailers regarding innovative practices to mitigate these losses. Given the substantial investment losses incurred, the absence of adequate credit facilities poses a risk of driving retailers out of business, adversely affecting household welfare and food security. Urgent policy interventions are therefore necessary. Such recommended policy actions include the provision of improved infrastructure and complementary services (e.g., electricity, roads, water, credit facilities). The government should focus on providing infrastructure, while private entities can offer additional services.

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Impact of agricultural sub-sectors performance contribution to Nigerian economic growth: Empirical evidence using Autoregressive Distributed Lag (ARDL) model

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Abstract: The agricultural sector in Nigeria has been the mainstay of the economy; however, there is tranquil negativity in the productivity of the sector and its contributions to economic growth. This study empirically examines the impact of agricultural sub-sectors' performance contribution to Nigerian economic growth, using time series data of 1981 to 2023. Augmented Dickey Fuller (ADF) and Philipps Perron (PP) test were used in examining the stationarity of the data series. Bound test was used to determine co-integration of agricultural sub-sectors and real GDP. Subsequently an autoregressive distributed lag (ARDL) model was used to determine the relationship of the variables under study. The study findings revealed that there was no long run relationship among the studied relationship variables. However, the combination effect of the aggregate agricultural sector has a significant contribution to economic growth. Conversely, only livestock and fishery subsectors significantly contribute to economic growth in the short-run relationship. The study, therefore, implies the viability of the subsectors as source of economic growth in Nigeria. It can be recommended that government agricultural programs and policies shall be sector specific and toward holistically improving specific value chains especially in the livestock and fishery sub-sectors.
Keywords: Subsectors, Agriculture, Philip Perron, Performance, Growth and Economy

INTRODUCTION

Agriculture is the heart of economic growth, development and poverty eradication in developing countries by serving as an engine and solution to economic prosperity (Sertoğlu, Ugural & Bekun, 2017) Agricultural sector remains the largest contributor providing inputs, food, employment opportunities, raw materials for other industries, provision of foreign earnings from exportation of the surpluses, and more importantly the enormous advantage of the value added in the various production process (Ehighebolo, 2023). The agricultural sector in Nigeria was the mainstay of the economy as it contributed about 80% of receipts on exports, 65% of GDP and about 50% of the government revenue during 1960s. This contribution over the years has taken a descending turn, leading to a low contribution of agriculture to GDP of about 26.84% in 2021 (CBN, 2022). This state of the sector decline was blamed on the 1970s oil glut and its consequences on several occasions, which had decreased Agricultural contribution to GDP during the period (Falola & Haton, 2008). The sector also continues to rely on primitive methods to sustain a growing population without efforts to add value. Even though Nigeria is blessed with fertile and cultivable arable land running into millions of hectares across different regions suitable for crop cultivations and livestock breeding, miles of flowing rivers and resourceful Atlantic Ocean with varieties of fishes and vast rich forest belt. There is still a negative reflection on the sector's productivity, its contributions to economic growth, and its ability to perform its traditional role of food production.

It is the realization of this fact that the nation's government initiated several agricultural reforms and policies aimed at improving the sector's performance. These include but are not limited to National Accelerated Food Production Programme (NAFPP), Agricultural Development Projects (ADPs), Operation Feed the Nation (OFN), Fadama I,II and III, National Economic Empowerment Development Strategy (NEEDS), Agricultural Trade Policy and agricultural subsidies, Agricultural Promotion Policy (APP) and more Agricultural transformation Agendas such as GEEPs and anchor borrower programs (FMARD, 2022). These established policies have recorded an improvement in the sector over the years. However, the potential of the sector in the country is still in doubt toward achieving the goal of sustainable food production, poverty reduction, ameliorating unemployment and general economic growth.

Previous studies have revealed a positive impact of the Agricultural sector's contribution to economic growth; however, the studies have employed varied approaches of evaluation; most of the scholars have evaluated the relationship by considering the agricultural sector as an aggregate, for instance, Ahungwa et.al. (2012); Abula (2016); Ekpo, (2017),

and Jonathan et al (2020) have evaluated and revealed the positive impact of agricultural sector aggregate on economic growth using time series data. More recent studies have assessed the implication of disaggregated agricultural sub-sectors' impact on economic growth and development (e.g Agboola et al, 2020; Akpan, 2021; Ehighebolo, 2023) using varied econometric approaches and they revealed specific agricultural sub-sectors implication on economic growth over a varied period. For instance, Edotola & Etumnu (2013) and Sertoğlu, Ugural & Bekun (2017) have revealed only positive impact of crop production sub-sector on Nigeria's economic growth using data series of 1981 to 2011. Consequently, in a quest for more robust policies that will accelerate agricultural sector productivity and enhance economic growth. This study evaluated the impact of Agricultural sub-sectors contribution to economic growth over the period of 43 years (1981-2023).

The study specifically addressed the following specific objectives.

i. Determine long run relationship between agricultural subsectors and economic growth
ii. Ascertain the influence of agricultural subsectors performance contribution to Nigeria's economic growth.

METHODOLOGY

To investigate the impact of crop, livestock, fishery and forestry subsectors on the economic growth of Nigeria, time series data from 1981 to 2023 for all the variables were obtained from the Central Bank of Nigeria's website (CBN) and Nigerian Bureau of Statistics (NBS). This study utilized Real GDP as a proxy for economic growth.

Modifying the regression model obtained from Akpan, (2021), the baseline equation for this study is expressed as

RGDPt = f(Crop, Livst, Forestry, FISHt, ε_t .....(1)

Where

RGDP = Real Gross Domestic Product
Crop = Crop production Value
Livst = Livestock Value
Forestry = Forestry Value
Fish= Fishery Value

Equation (1) is transformed to natural logarithms as follows:

$\text{LnGDPt} = \alpha_0 + \beta_1\text{LnCrop}_t + \beta_2\text{LnLivst}_t + \beta_3\text{LnForestry}_t + \beta 4\text{LnFish}_t + \varepsilon_t$..... (2)

The study made use of Augmented Dickey-fuller (ADF) and Phillip-Perron (PP) test to ascertain the level of stationarity of the variables, a Bound test was carried to test for a coin-integrating relationship between the variables. Furthermore, the diagnostics test of Autocorrelation, Heteroscedasticity and normality test was carried out to determine the consistency and reliability of the estimated relationship.

ARDL Econometric Model: The method of data analysis adopted for this study is ARDL. The technique is adopted due to its advantages over other time-series data analysis techniques. Some of these advantages are: it's a more robust econometrics technique for estimating the level relationship between dependent variables and a set of independent variables that may not necessarily be integrated of the same order, the model is used in determining the long-run relationship between series with a different order of integration (Pesaran & Shin 1999).

The general model to be estimated is represented by:

$\text{Ln}GDP\text{t} = \rho_0 + \rho_1\text{LnCrop}_t + \rho_2\text{LnLivst}_t + \rho_3\text{LnFish}_t + \rho_4\text{LnForestry}_t + \rho 5GDP_{t-1} + \varepsilon_t$… (3)

where GDP is the real per capita GDP (a proxy for economic growth), LnCrop is crop production, Lnlivst is the Livestock sub-sector contribution to GDP; Lnfish is the Fish sub-sector contribution to GDP, and LnForestry is the Forestry sub-sector contribution to GDP and ε is the error term.

The autoregressive distributed lag stationarity (ARDL) representation of the cointegration test equation to be tested for each model is given by:

$\Delta\text{LnGDPt} = \propto_0 + \sum_{i=0}^{1} \propto_1 i \Delta\text{LnCrop}_{t\text{-i}} + \sum_{i=0}^{2} \propto_{2i} \Delta\text{LnLivest}_{t\text{-i}} + \sum_{i=0}^{3} \propto_{3i} \Delta\text{LnFish}_{t\text{-i}} + \sum_{i=0}^{4} \propto_{4i} \text{LnΔForestry}_{t\text{-i}} + \sum_{i=0}^{5} \propto_{5i} \Delta\text{LnGDP}_{t\text{-i}} + \sigma_1\text{LnCrop}_{t\text{-1}} + \sigma_2\text{LnLivest}_{t\text{-1}} + \sigma_3\text{LnFish}_{t\text{-1}} + {}_4\text{LnForestry}_{t\text{-1}} + \sigma_5\text{LnGDP}_{t\text{-1}} + \text{U}_t$ …….. (4)

where all other variables are as defined, except Δ, which is the difference operator, $\propto 0$, $\propto i,1 - \propto i,5$ and $\sigma i,1 - \sigma i,5$, which are the respective coefficients, and $\mu 1t$, which is the error term.

The null hypothesis of the non-existence of a cointegration relationship is:

$H0{:}\sigma i,\ 1 = \sigma i,2 = \sigma i,3 = \sigma i,4 = \sigma i,5 \neq 0$ ……. (5)

This was tested against the alternative hypothesis of the existence of a cointegration relationship, that is:

$H1{:}$

$\sigma i,1 \neq \sigma i,2 \neq \sigma i,3 \neq \sigma i,4 \neq \sigma i,5 \neq 0$……(6)

The evaluation of the cointegration relationship was done with the aid of the lower and upper bound F-statistic critical values of Pesaran et al. (2001:300). A cointegration relationship is only valid when the calculated F-statistic is greater than the upper bound, otherwise it is inconclusive, or the null hypothesis of no level effect cannot be rejected.

The variables included in the ARDL representations were found to be none cointegrated, therefore only the short-run equation was estimated as given below

$\Delta\text{LnGDPt} = \propto_0 + \sum_{i=0}^{1} \propto_1 i\ \Delta\text{LnCrop}_{t\text{-1}} + \sum_{i=0}^{2} \propto_{2i} \Delta\text{LnLivest}_{t\text{-2}} + \sum_{i=0}^{3} \propto_{3i} \Delta\text{LnFish}_{t\text{-3}} + \sum_{i=0}^{4} \propto_{4i} \Delta\text{LnForestry}_{t\text{-4}} + \sum_{i=0}^{5} \propto_{5i} \Delta\text{LnGDP}_{t\text{-5}} + \text{U}_t$ ……(7)

RESULT AND DISCUSSION

Unit Root Test result for Stationarity

This section shows the various results of the tests carried out. Foremost, the Augmented Dickey–fuller and Phillip Peron are presented. Table 1 presents a summary of the stationarity result. All series have stochastic behaviour in ordinary form. However, series at their first difference and second difference form is stationary. The outcome of the ADF is like the PP. Based on the conclusion of the stationarity result, the article proceeds to estimate the long-run relationship using bound test co-integration test given the fact of mixed order of stationarity among the series variable

Table 1: Unit Root Test result

Series	Philipps Perron	Integration order	Augmented Dickey Fuller	Integration order
LnGDP	-5.2002***	I(1)	-5.215107***	I(1)
LnCrop	-6.0995***	I(1)	-6.099528***	I(1)
LnLivst	-9.8434***	I(2)	-9.428021***	I(2)
LnFish	-4.6103***	I(1)	-5.526581***	I(2)
LnForestry	-6.8409***	I(1)	-6.758236***	I(1)

Source: Authors' computation using E-views 9.

Co-integration: ARDL Bound Test

The result for the integration was shown in table 2. The result indicates that the computed F-statistic is lower than the upper critical bound at the 5% and 10% level of significance. This implies that there is no cointegration between the series, and it therefore implies that all the independent variables in the estimated equation are not cointegrated with the dependent variable over the study period. This indicated that the agricultural subsectors have only short run impact on the national economic growth

Table 2: ARDL Bound Test

Null Hypothesis: No long-run relationships exist		
Test Statistic	Value	K
F-statistic	2.265462	4
Critical Value Bounds		
Significance	I0 Bound (lower)	I1 Bound (upper)
10%	2.2	3.09
5%	2.56	3.49
2.50%	2.88	3.87
1%	3.29	4.37

Source: Authors' computation using E-views 9.

ARDL Short-Run Result

The short run result for the relationship between the variables is presented in table 3. The results F- value that is significant at 1% level of confidence and 0.93 value of R^2 indicate the overall fitness of the models in determining the influence of agricultural subsectors on economic growth. The results further show that only Livestock and fishery sub-sectors significantly influence economic growth at a 10% significance level. The coefficient of Livestock, which is positive and significant, implies that the magnitude of change in economic growth will increase by 2.45 units with a unit change in livestock productivity output, meaning that more investment in the livestock sub-sector will hasten economic growth. On the other hand, the negative and significant fishery sub-sector coefficient implies that value added from fishery sub-sector leads to a decline in the country's economic growth. This is true because most fish products are imported to the country, and importation decreases national GDP. Furthermore, the results have indicated the need for more investment in livestock subsector and effort by government to encourage and support domestic fish value chain to discourage importation, which has an inverse relationship with economic growth.

Table 3: ARDL Short-Run Result

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LOGGDP(-1)	0.781613	0.164468	4.75238	0.0000
LOGGDP(-2)	-0.01491	0.21225	-0.070267	0.9444
LOGGDP(-3)	-0.24747	0.17861	-1.385544	0.1755
LOGCROP	-0.0243	0.435436	-0.055798	0.9558
LOGLIVST	2.455204	1.294439	1.896732	0.0669
LOGFSH	-0.47893	0.278278	-1.721057	0.0949
LOGFRSTRY	-0.81429	0.666973	-1.220877	0.2311
C	-6.41512	3.575223	-1.794328	0.0822
R-squared	0.936941	Mean dependent var		11.22965
Adjusted R-squared	0.923147	S.D. dependent var		0.384005
S.E. of regression	0.106455	Akaike info criterion		-1.46533
Sum squared resid	0.362648	Schwarz criterion		-1.12755
Log likelihood	37.30649	Hannan-Quinn criter.		-1.3432
F-statistic	67.92291	Durbin-Watson stat		2.105034
Prob(F-statistic)	0.0000			

Source: Authors' computation using E-views 9.

Diagnostic check

The result for post-estimation diagnostic check was presented in Table 4. The result shows no serial correlation among the residuals; give that Breusch-Godfrey Serial Correlation LM Test that has shown no significance. The residual has constant variance over time and is normally distributed, given the insignificance value of ARCH Heteroskedasticity Test; implying that the series of the variable's relationship is homoscedastic. In addition, Figures 1 also present the stability graph of the models. It can be deduced from the figure that the models are stable for forecast; given the fact that CUSUM line falls in between the lower boundary and the upper boundary. The result implies the consistency and reliability of the estimated relationship making the recommendation of the study paramount for policy implication.

Table 4: Diagnostic check

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	1.094169	Prob. F (2,30)	0.3478
Obs*R-squared	2.719417	Prob. Chi-Square (2)	0.2567
Heteroskedasticity Test: ARCH			
F-statistic	0.84441	Prob. F (1,37)	0.3641
Obs*R-squared	0.870195	Prob. Chi-Square (1)	0.3509

Source: Authors' computation using E-views 9.

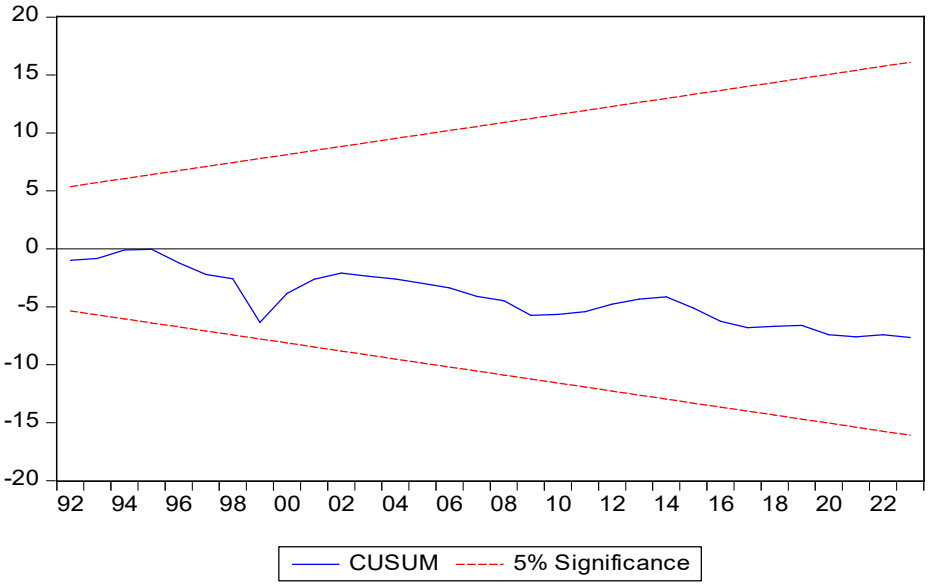

Figure 1: CUSUM graph for Stability diagnosis

CONCLUSION AND RECOMMENDATIONS

This study established the relationship between economic growth and agricultural subsectors. However, in the short run, the aggregate of agricultural subsectors significantly contributed to economic growth. Meanwhile, only livestock and fishery sub-sectors had a significant influence on the economic growth. This study proffers the following recommendations to ensure sustainability and enhance economic growth.

i. The Agricultural programs and policies shall be sector-specific and toward holistically improving specific value chains,
ii. The government should improve and support fish production technologies, given that they are paramount to national economic growth.
iii. Given its positive relationship with economic growth, the government and private enterprises should strengthen livestock sub-sector value chains with innovative technology to increase productivity.

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Analysis of cotton production with flexible risk specification, using trans-log stochastic production function

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Abstract: This paper analysed the production of cotton with flexible risk specification, using a trans-log stochastic production function. Data were obtained from a sample of 360 respondents using a structured questionnaire and analysed, using Trans-log production trans-log stochastic production function. The result reveals that, apart from risk-increasing labour, seed, fertilizer, and agrochemicals are risk-decreasing. Therefore, their effective use and proper management can help reduce output variance. Labour is a risk-increasing variable, meaning that farmers should employ less labour due to its ability to cause high fluctuation in output. The result also shows that six out of eight variables used in the inefficiency effect of the trans-log stochastic production model have a priori expected signs, four of which are significant. The negative coefficient indicates that the variables reduce inefficiency in cotton production. The result shows that technical inefficiency is significantly downsized with education, farming experience, marital status, extension visits, and access to credit. The negative sign of the age variable indicates that an increase in a farmer's age decreases the farmer's inefficiency level, meaning that older farmers are more efficient than younger farmers. Based on the study findings, it is recommended that the government should make adequate and timely provision of variable inputs such as seed, fertilizer, and agrochemicals as they increase mean output positively in the production process and are used in reducing the effect of risk in the production process.
Keywords: Cotton production, Risk specification, Stochastic production function, technical inefficiency.

INTRODUCTION

The cotton and textile sectors are significant because they play a vital role in the economic development of any nation. Cotton contributes to the Gross Domestic Product (GDP) and creates jobs and income for farmers in the country. As a cash crop, it is cultivated in most states of the Federation and helped in turning the country's fortune around before the discovery of oil in Nigeria. Unfortunately, many factors had militated against the survival of the cotton value chain in Nigeria. One of these is the capacity of this sector to contribute less than 15 percent to Nigeria's Gross Domestic Product (GDP). In the 1980s and 1990s, Nigeria was the third largest African textile industry, with over 180 textile mills functioning optimally, employing nearly 450,000 workers and contributing more than 25 percent of the workforce to the manufacturing sector. Recently, Nigeria has been ranked as Africa's 4th largest cotton producer, with an estimated production of around 300,000 metric tons annually. The country has a long history of cotton cultivation, with the northern regions being the main cotton-producing areas. The government has been increasing cotton production through various initiatives and support programs for farmers. However, challenges such as poor infrastructure, lack of modern farming techniques, and pest infestations continue to hinder the growth of the cotton industry in Nigeria (AGOA, 2021).

In addition, there has been a severe decrease in cotton farming, as statistics revealed that the cotton contribution to the country's GDP fell woefully from 25 percent in 1980 to 5 percent as shown by the recent economic indicators. In terms of the nominal non-oil contribution to domestic growth, the agricultural sector contributed 5.06 percent, which was higher than the 4.76 percent recorded in the preceding quarter. On the other hand, if crop production contributed 4.23 percent in the country, then cotton must be given prior attention by the government because of the setback experienced in its production in the country (Kriger, 2005).

As of the latest available data, the contribution of cotton to Nigeria's GDP is relatively small, accounting for less than 1% of the total GDP. The cotton industry in Nigeria faces various challenges such as low productivity, inadequate infrastructure, and competition from imported textiles. Efforts are being made to revitalize the cotton sector through initiatives such as the Cotton, Textile, and Garment (CTG) policy, which aims to increase local cotton production and boost the textile industry's contribution to the economy, (NBS,2020).

Due to a lack of vision on the part of those managing the economy at some point in time, a vibrant textile industry has turned to a shadow of its former self as most of the factories have all shut down, in some cases, taken over by churches and other sundry uneconomic ventures. Presently, the record has shown that less than 25 percent of those industries can be said to be functioning (AGOA, 2021).

Therefore, the study aims to analyze cotton Production with Flexible Risk Specification, Using a Trans-Log Stochastic Production Function. The study becomes incumbent, as it would identify factors that reduce risk in cotton production in the study areas. Identifying those factors would be a valuable exercise because they are significant for policy formulation.

The study employed a parametric model to examine the effect of risk on cotton production in the area. The parametric analysis is the stochastic frontier analysis (SFA) with flexible risk specification and technical inefficiency analysis.

Incorporation of production risk in the stochastic frontier model

The adopted model used in estimating stochastic production technology has accounted for production risk and technical inefficiency. Scholars have employed one of the three outlined variations in this aspect. The various models differed in accordance with how the inefficiency effect has been incorporated into the model. Battase & Broca, (1997) unfold that there is a possibility for the integration of production risk and the technical inefficiency in a model to add the inefficiency effect of the variance function together with the random noise component that represents the effects of uncertainty as shown in the below equation:

$y_i = h(x_i;\alpha) + g_i(x_i;\beta)(v_i - u_i)$…….(1)

The second possibility for production risk and technical inefficiency to be incorporated in a model is that of the multiplicative form where the inefficiency effect should be added to the mean output function as shown in the below equation:

$y_i = h(x_i;\alpha)(1-u_i) + g(x_i - \beta)v_i$……..(2)

Here, the additional assumption; $\exp\{-u_i\} = 1 - u_i$ has been incorporated into the model. The third possibility for the production risk and technical inefficiency to be incorporated into a model is the flexibility form of that model suggested by Kumbhakar (2002). For explaining technical inefficiency, therefore, the additional function q(x) was introduced in the model. This can be shown by the formular below:

$y_i = h(x_i;\alpha)(1-u_i) + g(x_i-\beta)v_i - q(x_i;z)u_i$…(3)

Where $h(x_i;\alpha)(1-u_i)$ represent the mean production function, $g(x_i-\beta)v_i$ represent the risk production function, α represent the vector of mean production parameters and β represent the vector of output risk parameters. While v_i represent the stochastic term, u_i represent the non-negative inefficiency variable. $q(x_i;z)u_i$ explains technical inefficiency with xi's as the input variables.

Conceptual Framework

Conceptual framework in figure 1 attempts to show the relationship between the dependent and independent variables of the research. The independent variables were Land Seed Fertilizer Labour and Agrochemical. The dependent variable is the cotton output. The intervening variables are Demographics: they include age, education level, Marital status, household size, and farming experience; the technological include land cultivation, planting, harvesting, and seed variety, and Institutional: workshop/seminar, credit access, and extension contact. Cotton (output) consists of three components: production model (Mean output function), factors affecting technical efficiency (inefficiency component), and production risk (output risk function). Mean production function, production risk, and technical inefficiency will be estimated simultaneously in the stochastic frontier production function. The independent variables that include land, seed, fertilizer, labour, and Agrochemical are considered to influence both the mean output and output risk. Likewise, the factors that influence technical efficiency are categorized into three parts, namely: demographic, technological, and institutional factors, (Figure 1). This is in line with the production function of Kumbhakar (2002). which enables mean production function, production risk, and technical inefficiency to be estimated simultaneously in the stochastic frontier framework.

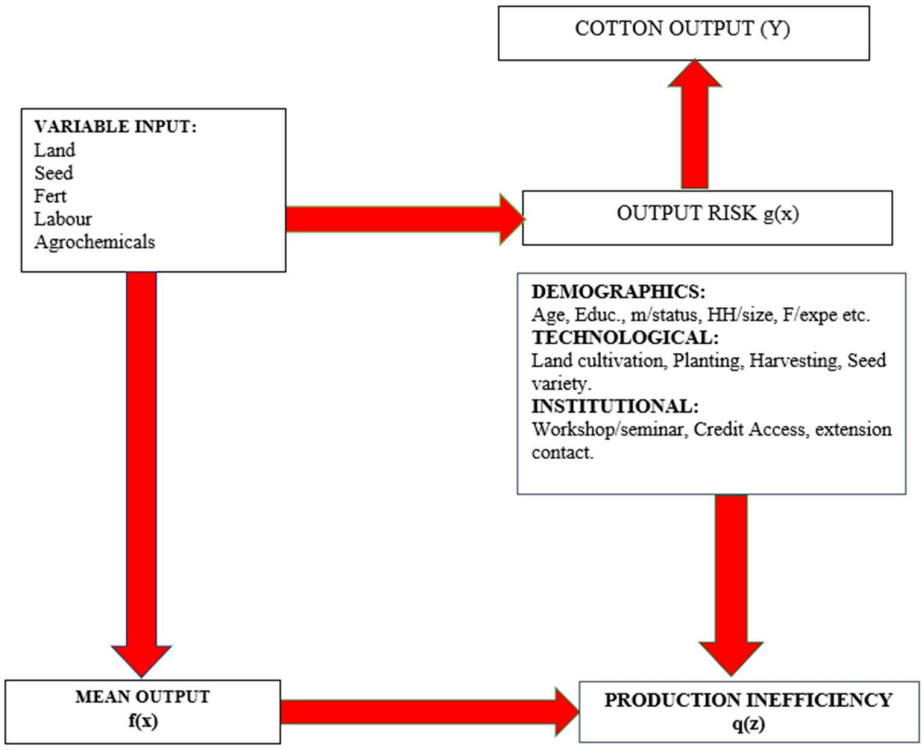

Figure 1: Conceptual Framework.

Source: Muhamma, B. (2018).

METHODOLOGY

The study was conducted in the Northeast zone of Nigeria. The Northeast zone is one of the six geopolitical zones of Nigeria that comprise six States-Adamawa, Bauchi, Borno, Gombe, Taraba, and Yobe. It covers one-third (280,419 km2) of Nigeria's total land area (909,890 km2). The zone has an estimated population of about 26 million people, around 12% of the total population of the country, Muhammad, B. (2018).

The target population for the study are the cotton farmers in the three states of the Northeast zone: Adamawa, Gombe and Taraba State. Adamawa state has twenty-two (22) local governments and five (5) were selected. Gombe State has eleven (11) local governments and three (3) were selected. On the other hand, Taraba State has sixteen (16) local governments and four (4) were selected (Table1).

Table1: Selected Local Government from the study area

State	Local Government	Local Government Selected
Adamawa	22	5
Gombe	11	3
Taraba	16	4
Total	**49**	**12**

Source: Field Survey data, 2016

The list of cotton farmers was obtained from the Afcott out-growers scheme. In arriving at the representative sample for the study from the list, a two-stage and simple random sampling (SRS) procedure for the choice of local government and cotton farmers was employed. A total of twelve (12) local governments were selected as the first stage for the study through a randomized sampling design of forty-nine (49) local governments in the study area.

At the final (second) stage a total of 165 cotton farmers were selected out of 501 farmers in Adamawa state. In Gombe State, 102 cotton farmers were selected out of 520, while 93 cotton farmers were selected from Taraba State out of 338 cotton farmers in the area. This gives 360 sampled respondents out of 1359 cotton producers in the study area (Table 2).

Table2: Sample Design Outlay for the Study

State	Selected Local Govt	Cotton Growers	Farmers
Adamawa	5	501	165
Gombe	3	520	102
Taraba	4	338	93
Total	**12**	**1359**	**360**

Source: Field Survey data, 2016

Sampling techniques and sample size

Yamane (1967) provides a simplified formula for computing sample sizes. Following the formula in calculating sample size as proposed by (Yamane, 1967), the study arrived at its sample size based on the population of cotton farmers available in the study area during the period of the study area during the period of the study. Yamane formula is specified as follows:

$n = \frac{N}{1+N(e^2)}$ ..... (4)

Where n = sample size, N = population size and e = level of precision.

The total sample size of cotton farmers is determined as:

N = 4000, e = 0.05 (0.95 confidence interval). Therefore:

n = 4000/1+4000(0.05)^2

= 360 respondents in all.

The sample size of the respondent in each state in the study area was determined using N= 1359, e = 0.05 (95% confidence interval). Hence, the sample size from each state can be obtained as:

Adamawa sample size

$n = \frac{501}{1359} x\ 360 = 165\ farmers$ ..... (5)

Gombe state sample size

$n = \frac{520}{1359} x\ 360 = 102\ farmers$ ..... (6)

Taraba state sample size

$n = \frac{338}{1359}\ x\ 360 = 93\ farmers$ ..... (7)

Method of data collection

Primary data was used for this study, and the data was gathered from the sampled respondents in the study areas using a structured questionnaire as a research instrument to collect information from 360 randomly selected cotton farmers in the study. Information on socioeconomic variables such as age, education, farming experience, extension contact, credit access, and off-farm activities was included in the questionnaire. The secondary information was gathered from journals, bulletins, and other literature materials from the international network (internet) like Google Scholar to enhance the farmer's response.

Method of data analysis

Two functional forms of the stochastic frontier model, that is, Cobb-Douglas and Trans-log functions are used as various studies have employed them in their analysis. Trans-log stochastic production function model was employed with flexible risk specification because it is known to be less restrictive and permits the combination of squared and cross-product terms of the exogenous variable inputs with the view of having the goodness of fit of the model, using a single-stage maximum likelihood function estimation procedure of Frontier version (4.1).

Trans-Log stochastic production model specification

As stated earlier the two common functional forms of stochastic frontier model that are generally used are Cobb-Douglas and Trans-log functions as various studies have employed them in their analysis. Trans-log stochastic production function model was employed with flexible risk specification for it is known to be less restrictive and permits the combination of squared and cross-product terms of the exogenous variable inputs with the view of having goodness of fit of the model, Donkoh *et al.* (2013). The trans-log stochastic production function model with flexible risk specification can be presented as follows:

$$lnP_j = \alpha_0 + \sum_{i=1}^{4} \alpha_i lnx_i + 0.5 \sum_{j=1}^{4} \alpha_{ii} lnx_i^2 + \sum_{i=1}^{4} \sum_{k=1}^{4} \alpha_{ik} lnx_i lnx_k + \varepsilon_j \quad (8)$$

ε_j is the stochastic disturbance term and is presented as:

$$\varepsilon_j = g(x;\varphi)v_i - h(x;z)u_i \quad (9)$$

In addition, the linear production risk function is specified as:

$$lnv_i^2 = \omega_0 + \sum_{w=1}^{4} \omega_w lnx_{wi} \quad (10)$$

Where:

X_i's represents input variables, v_i^2's is pure noise effects, ω_0's and ω_w's are the estimated risk model parameters, x_1 is the number of seed used measured in kg/ha, x_2 denotes quantity of fertilizer measured in kg/ha, x_3 means Agrochemical used measured in lt/ha and x_4 is labour used measured in man-days/ha. The input variables, seed, fertilizer, agrochemical, and labour, can either decrease or increase input output. Thus, ω_w's are the marginal production risks of individual inputs and when it is positive, it implies that the respective input is a risk increasing input (increasing output variance). However, when ω_w becomes negative, it indicates that the respective input is risk decreasing (reduces output variance).

RESULTS AND DISCUSSIONS

Mean estimates of marginal output risk

Just and Pope (1978) approach separates the difference between the input effect on output and

its impact on output variability using mean estimates of Marginal output of risk estimation. Moreover, the output variability in the production process has been determined by the input's factors. Some of these inputs are risk-reducing while others are risk-increasing, meaning that they can be used to sustain cotton production in the study area. The information of Marginal Output Risk estimate of inputs is presented in Table 3.

Table 3: Marginal Production Risk estimates for Variance Function

Variable	Parameter	Coefficient	Std Error	P-Value
Constant	β_0	17.2258**	2.9774	0.000
lnSeed	β_1	-4.2386**	1.2059	0.000
lnFertilizer	β_2	-2.3372*	1.1645	0.045
lnChemicals	β_3	-0.1234	0.4844	0.799
lnLabour	β_4	0.1299	0.6446	0.840

Source: Field Survey data 2016. **Note** * and ** denote significance at 5% and 1% level respectively.

The results in Table 3 reveal that seed and fertilizer risk-decreasing variables are significant at 1% and 5%. These estimated results hint that effective use and proper management of seed and fertilizer can help reduce output variance. The results for agrochemicals and labour are not significant. While the former is negatively related to the dependent variable, the latter is positively related. Being the risk-increasing variable, it is in line with the result obtained by Picazo-Tadeo and Wall (2011), Villano and Fleming (2006) and Kaka (2016), respectively. This, hypothetically, indicated that an average risk-averse farmer in the study area is anticipated to employ less labour due to its ability to cause high fluctuation in output. Instead, Seed, fertilizer and agrochemicals would be used relative to a risk–neutral farmer who is insensitive to risk, regardless of whether it is high or low risk, to reduce output volatility.

Inefficiency effect of trans-log stochastic production model

The inefficiency parameters were itemized by virtue of those revealing farmers' specific socio-economic characteristics, be it institutional or otherwise. Six out of eight variables used in the model have priori expected signs and four of them are significant. A negative coefficient indicates that the variables increase the efficiency (in other words, reduces inefficiency) in cotton production and vice versa. The outcome of technical inefficiency effects, as presented in Table 4 display that technical inefficiency is significantly downsized with age, education, farming experience, and access to credit. The negative sign of age variable indicates that a farmer's age decreases the farmer's inefficiency level, signifying that the older farmers are more efficient than the younger farmers. In other words, older farmers are more familiar with farming techniques in agricultural production than younger ones.

Table 4: Inefficiency Effect of Trans-Log Stochastic Model

Variable	Parameter	Coefficient	Std Error	P-Value
Constant	γ_0	-4.0711**	-4.0711	0.000
Age	γ_1	-0.0011*	-0.0011	0.032
Education	γ_2	-0.0125*	-0.0125	0.057
Marital Status	γ_3	-0.0034	-0.3841	0.193
Household size	γ_4	0.0090	0.0364	0.803
F/Experience	γ_5	-0.0034*	-0.0034	0.049
Extension Visit	γ_6	-0.1528	0.1107	0.167
Credit Access	γ_7	-0.3790*	0.1717	0.027
Off Farm Activities	γ_8	-0.3790	-0.2146	0.614

Source: Field Survey Data 2016. **Note** * and ** denote significance at 5% and 1% level respectively.

The result corroborates with the findings of Udoh and Akpan (2007); Amor and Muller (2010) that says older farmers are technically more efficient than the younger ones. But Villano and Fleming (2006) believe that age's influence on technical efficiency is relative to the empirical data being analysed. To them, age can only negatively influence technical efficiency if the farmers are

unwilling to risk adopting the best farm practices. If experience is the best teacher, the longer a person endures in a job, the more likely he becomes skilful.

Due to the risks and uncertainties involved in farming, there is a need to handle all the changes that may happen along the production process so that the farmer can remain in the business or stay on the farm for quite a long time. A distinct farmer who has been prosperous for many years in cotton farming is likely to be more knowledgeable about the pattern of rainfall, pest and disease indices, and the area's natural condition, contrary to a farmer who delves into the business without know-how or education on the business. The result of the study shows that experience has affected technical inefficiency negatively, insinuating that the more experienced the farmer, the less inefficient he will be. This decision is unvarying with the findings of Ogundari & Akinbogun (2010), and Alam *et al.* (2013).

The coefficient of education is negative as expected and statistically significant at a 10-percent significant level. This signifies that a higher level of education increases the chances of the farmer in the study area using improved and citified technology and techniques that require training, reading manuals, and attending conferences to help increase yield and optimum utilization of resources. This is in line with that of Maurice *et al.* (2015), and Oladimeji & Abdul Salam (2013) in their findings that farmers with more years of schooling tend to be more efficient in their production, presumably due to their enhanced ability to acquire technical knowledge, which make them closer to the frontier.

The coefficient of farming experience is estimated to be negative and statistically significant at a 5-percent level. The implication is that farmers with more years of farming experience tend to be more efficient in cotton production. This conforms with the finding of Coelli and Battese (1996) who reported a negative production elasticity concerning farming experience for farmers in India, thus suggesting that the older farmers are relatively more efficient, and vice versa. It is possible that such farmers gained more years of farming experience through ‘’Learning by doing”, And thereby becoming more efficient.

The estimated coefficient of farmers’ access to credit was also negative and significant and it indicates that the use of credit could decrease the inefficiency effect of production. On the other hand, farmers with fewer liquidity constraints may restrain the farms using the optimal input through optimal output. The result is therefore acknowledged and conceded with the findings of Bravo-Ureta and Pinheiro (1993) and Mailena *et al.* (2014).

Al-Hassan (2008) concludes that extension visits to farmers enable them to use approved cultural practices in their production process, which will encourage them to increase their efficiency in the long run. Extension agents are supposed to maintain advisory services and train farmers to enhance their efficiency. The coefficient of the Extension agents as shown in Table 4, has negative effects on inefficiency, which by implication, means that the more farmer acquired knowledge from extension services the more he becomes less inefficient, which is in consistent with the findings of Ghee-Thean *et al.* (2012).

CONCLUSION AND RECOMMENDATIONS

The study concluded that production risk contributes considerably to the vitality of cotton in the study areas because output variability is primarily explained by technical inefficiency and production risk. Production risk, as analyzed, is explained by seed and fertilizer as they are the only variable inputs that are significant and risk-reducing variable inputs. These variables can, therefore, be used to alleviate the effect of risk in the production process. Inefficiency factors like age, educational level, farming experience, and extension contact tend to improve farmers’ technical efficiency in the study areas as they have negative coefficients and significance.

Based on the findings of this research, variable inputs, such as seed and fertilizer, are essential in boosting cotton production. Therefore, it is recommended that the government make adequate and timely provisions for them as they increase mean output positively in the production process and reduce the effect of risk in the production process. In addition, cotton farmers in the study area should be encouraged to take up off-farm activities as they help boost their income and raise their living standards. It is recommended that the government should ease the accessibility to credit facilities and enlighten the farmers on the advantages of off-farm activities for their livelihood. Regarding technical inefficiency factors, especially education, there is a need for policy to promote formal education to enhance efficiency in production over a long period. This would enable farmers to make better technical decisions and help them allocate their production inputs effectively. In the short run, informal extension education could be effective, especially when targeted at farmers with limited formal educational opportunities.

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